The Royal Danish Academy of Sciences and Letters

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Preface

For some time it has been felt that there might be a need for an illustrated booklet telling our sister academies, foreign members, correspondents, visitors and other interested people abroad about our Academy. The realization of this idea has been made possible through the generosity of the Alfred Benzon Foundation, to which the Academy tenders her most cordial thanks. We also thank Mr. Lennart Larsen, photographer to the Danish National Museum, for his excellent assistance, and the Carlsberg Foundation, as well as the Museum of National History at Frederiksborg for having placed a few other photographs at our disposal. Not least we thank Mrs. Jennifer Paris, and two members of the Academy, Dr. John Bergsagel and Professor Alan R. Mackintosh, for carefully translating and revising the manuscripts of the contributors.

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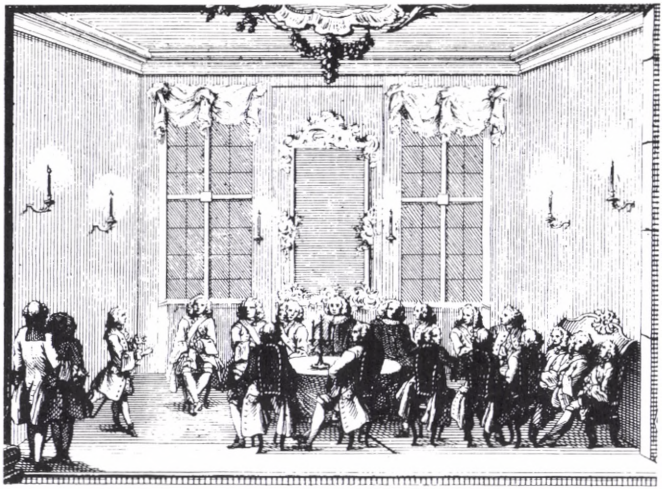
King Christian VI,
founder of the Academy and its first patron.
Painting by J. S. Wahl.

Outline of the History of the Academy

The Royal Danish Academy of Sciences and Letters owes its existence to the initiative of three personalities: King CHRISTIAN VI, his very culturally involved Prime Minister, Count JOHAN LUDVIG HOLSTEIN of Ledreborg, and the Royal Historiographer HANS GRAM. On 13th November 1742, with the approval of the King, a learned society was initiated which, following Gram's suggestion, was to be a *Collegium Antiquitatum* to promote the study of the nation's history. At the very first meeting, however, the scope of the society was enlarged to include all scholarly pursuits in general.

The new Academy was to consist of three classes of members: *rådgivere, arbejdere* and *adjunkter*, i.e. advisory, active and associate members, under the leadership of a president, for which office J. L. Holstein was an obvious choice. Members were to gather for regular meetings at which lectures would be held and business transacted, the latter being primarily concerned with the publication of learned treatises.

In its first years the Academy functioned without a set of statutes, but during the course of the 18th century its name became established and a seal was issued. The first statutes were drawn up in 1776 and a little later a membership diploma was issued.



Meeting of the Academy in Holstein's mansion,
10 Stormgade, Copenhagen, on January 18th, 1751.
Etching by O. H. DE LODE.

The admission of new members to the Academy to ensure the continuation of its many-facetted activities has always been a matter which has attracted much interest, and the rules governing this procedure have often been the subject of discussion and change. Until the first statutes were drawn up, new Danish members were frequently admitted at the invitation of the president, a procedure which was obviously rather arbitrary and often dependent on rank and social standing.

From 1776 members were admitted by election, the number being unlimited. However, throughout almost the entire 19th century there were only between 40 and 50 Danish members.

In the years 1792 and 1795 members were divided into four classes, one for history, one for

physics, one for mathematics and one for philosophy, which corresponded to the subject groups specified in the statutes. In 1866 the four classes were amalgamated into two, one for history and philosophy and one for mathematics and the natural sciences, each with its own chairman.

The interpretation of which subjects fall within the sphere of the Academy has at times given rise to debate. The traditional view is that members should be recruited from among the basic sciences, i.e., philosophy, history (including archaeology, art history and musicology), linguistics and philology, mathematics, physics (including chemistry, astronomy, geology and the like), and the biological sciences. Outside the scope of the Academy lie the applied sciences, i.e., theology, law, clinical medicine, the technical sciences, commercial science, agronomics etc. – but with exceptions such as ecclesiastical history, history of law, political economy and, within medicine, such subjects as bacteriology, pharmacology, physiology, genetics, pathology, serology and suchlike disciplines.

After the year 1900 the number of Danish members began to increase rapidly and it proved necessary to introduce rules to limit the membership, based on statistical calculations of accession and mortality.

In addition to its Danish members, the Academy has elected a large number of foreign members during the course of time. Interest in these elections has fluctuated – partly under the influence of political factors. In recent years the need to establish connections with research workers from abroad has very much increased.

Finally, in earlier times the Academy had a third category of members, namely honorary members, who were often nobles and others of high social standing who had some interest in science and scholarship. Since 1815 the Academy has elected only one honorary member under special circumstances. This was Crown Prince FREDERIK (VIII), who very frequently participated in Academy meetings. The provisions for the admission of this particular class of member are now no longer operative.

Since the establishment of the Academy in 1742 the Sovereigns of Denmark have been its patrons. Christian VI must be especially mentioned in this connection as he was directly involved in the Academy's establishment and personally interested in several of its earliest undertakings. CHRISTIAN VIII was president of the Academy both as Crown Prince and as King, while Crown Prince he chaired nearly all of its meetings.

In the first hundred years of the Academy's existence, leading aristocrats or courtiers with scholarly and scientific interests were elected president. This first phase in the existence of the Academy culminated with the presidency of King Christian VIII, since which time the office of president has been entrusted to a member wholly on the basis of his personal and scholarly qualifications, whereas until the death of Christian VIII a considerable part of the Academy's work consisted of assignments imposed on it by the King or the state. The activities of the Academy have since been concentrated entirely on research projects proposed by the Academy and its members, and

The presidential chair of King CHRISTIAN VIII.

on international collaboration on these tasks. The new series of presidents began with ANDERS SANDØE ØRSTED and was continued by J. N. MADVIG, JULIUS THOMSEN and VILHELM THOMSEN. After some years with a succession of presidents who held office for shorter periods, NIELS BOHR

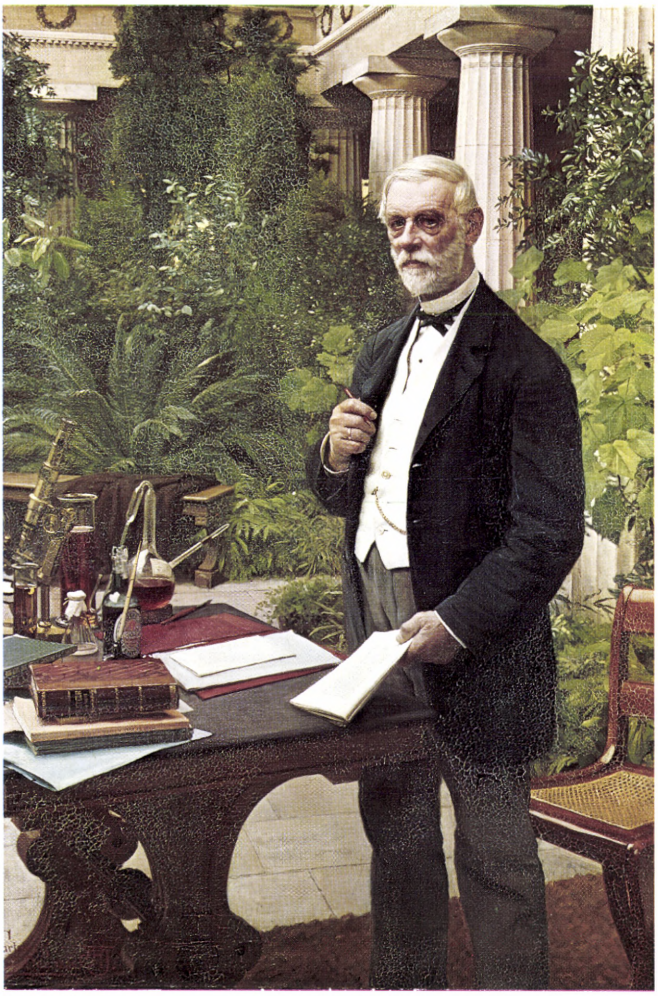
was elected president in 1939 and retained the office until his death in 1962. Later presidents have again held office for relatively short periods of time.

The management of the ordinary business of the Academy has from the beginning been entrusted to a secretary elected from among the members. The first secretary, HENRIK HIELMSTIERNE, dealt with all matters, but later on the duties of the secretary were relieved of the functions of editor and of treasurer. H. C. Ørsted was a particularly active secretary in the years 1815–1851. During the term of office of JAPETUS STEENSTRUP in 1866–1878 a secretariat was set up to assist the secretary.

The finances of the Academy are under the supervision of a permanent Financial Commission, established in 1780. The Academy as such is legally independent and not subject to any state authority. It has always demanded the greatest possible independence of the State, and is distinguished in this respect from the academies of many other countries.

At the time when many of the Academy's undertakings were prescribed by the King, the expenses involved were defrayed by him. At a later date funds, particularly for the issue of publications, had to be sought from the state. The Academy also receives financial support from other sources, such as the Carlsberg Foundation.

One function of the Academy which is exceptional is that it elects the members of the board of the Carlsberg Foundation. The Carlsberg Foundation was set up in 1876 by the brewer J. C. JACOB-



J. C. Jacobsen, founder of the Carlsberg Foundation. Painting by A. Jerndorff.

sen, who immediately requested that the Academy take it in its charge. J. C. Jacobsen explained his motivation for this assignment by saying that the

The members of the Academy in 1896, gathered in the former meeting-place, the palace which now is part of the National Museum. Painting by P. S. Krøyer.

Academy was "that society in which Danish scholarship has hitherto found and certainly always will find its most outstanding representatives, and which in our country is the only institution fortunate enough to be independent of all outside, non-

scholarly interests and influences". The objectives of the Foundation are to continue and extend the work of the Carlsberg Laboratory and to promote the natural sciences, as well as mathematics, philosophy, history and philology. In addition, a few years later the Foundation established the Museum of National History at Frederiksborg. The board of the Carlsberg Foundation consists of five members, elected by the Academy from among its own members. On the death of J. C.

The Carlsberg Foundation's building on H. C. Andersens Boulevard in Copenhagen, where the Academy has its premises on the first and second floors, plus the top storey.

Jacobsen in 1887 the Foundation became the owner of the Old Carlsberg brewery and in 1902 of the New Carlsberg brewery which had belonged to CARL JACOBSEN, son of J. C. Jacobsen. In 1902 the New Carlsberg Foundation was set up as a new department to promote artistic endeavours in Denmark, and in particular to administer the New Carlsberg Glyptotek – built in 1897 – by the State and the municipality of Copenhagen which came to house the large art collections of Carl Jacobsen. This unique combination of a large industrial concern and a learned institution gives the latter considerable resources for the support of Danish scholarship and art.

Meeting of the Academy in the assembly hall on April 17th, 1964, in the presence of H. M. King FREDERIK *IX, H. M. Queen* INGRID *and Princess* MARGRETHE*, now H. M. Queen* MARGRETHE *II and present patron of the Academy.*

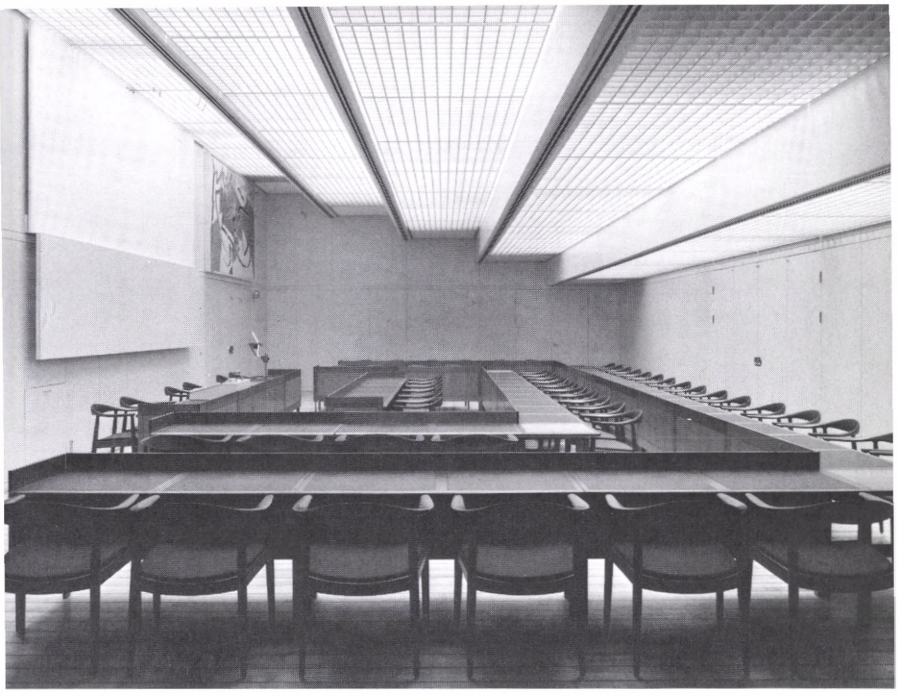
The board's composition of active scholars and scientists ensures a very intimate connection between the Academy and the Foundation whose primary task is support of basic research. Until the establishment of National Research Councils by the Government in the 1950's the Carlsberg Foundation, by its yearly contributions, performed a function which was vital in many ways for the development of the Sciences and the Humanities in times when support, besides the rather restricted regular university allowances, was very difficult to obtain elsewhere.

The main forum for the activities of the Academy has always been its regular meetings, at

The assembly hall, redecorated in 1976.

which papers are read and administrative business discussed. The venue has often been changed, and it was fortunate for the Academy that in 1893 the Carlsberg Foundation offered it permanent premises, free of charge, in a new building that the Foundation was to build on Vestre Boulevard (now H. C. Andersen's Boulevard) in Copenhagen. The Academy moved into these premises in 1898–1899 and thus acquired ample space for meetings, offices and storage. On the occasion of its centenary the Carlsberg Foundation rebuilt and modernised the premises, a munificent gift which made possible an expansion of the Academy's activities.

A task of essential importance to the Academy is



The new lecture hall with furniture arranged for a symposium.

the publication of learned papers, and these are tangible evidence of its activities in disseminating knowledge of scientific and scholarly matters and making known the initiatives and results of Danish research for the benefit of Danish science and of the nation and to the honour of the Academy. In 1745 publication started of the *Skrifter* (Memoirs), in which series were printed the papers read by the first members at their meetings. Many important works have appeared here in the course of time. In 1822 the *Skrifter* were divided up into two series according to subject matter, and in recent years these have again been further subdivided to satisfy the wishes of specialized libraries. In addition to the *Skrifter,* the Academy started to publish

annual *Bekendtgørelser* (Transactions) in 1793, containing information on the prizes offered by the Academy for works on set subjects and on the prize papers received. This extremely modest publication rapidly developed into an *Oversigt* (Annual Report) that in addition came to include reports of meetings and such like matters and, before long, also numerous scientific papers on a variety of subjects. In 1917 the papers were dropped from this publication, to be issued in several series of *Meddelelser* (Communications), the annual *Oversigt* becoming once again a report of meetings and of the administrative side of the Academy's activities, supplemented by a report to the Academy

The reading room.

Skrifter,

ſom udi

det Kiøbenhavnſke

Selſkab

af

Lærdoms og Videnſkabers Elſkere

ere

fremlagte og oplæſte

i Aarene 1743 og 1744.

Første Deel.

KIØBENHAVN,

Udi det Kongelig Wäyſenhuſes Bogtrykkerie

og paa dets Forlag.

Trykt af Gottmann Friderich Kiſel. Aar 1745.

Title page of the first volume of the Academy's Memoirs 1745.

from the Carlsberg Foundation, obituaries of deceased members, etc.

Danish was the only language used for regular Academy publications for more than a century, but from 1867 a summary in French was permit-

ted in the *Oversigt*, and a few years later also shorter papers in French. Only in 1902 was the use of the principal languages permitted in all publications of the Academy – a necessary step if Danish scholarship was to become known outside Denmark.

Another important activity of the Academy in earlier times was to offer prizes for papers on certain set subjects and to pass judgement on the papers received in response. The papers were sometimes rewarded with sums from endowments of the Academy, sometimes with a gold medal, perhaps supplemented by a sum of money. The problems set and the responses given in these set papers in themselves help considerably to illustrate the history of learning in this country, and often the papers reflect the topical problems and trends which occupied Danish society at the times in question.

At its inception the Academy was envisaged as a purely national institution, but in the natural course of events an international scholarly collaboration has gradually developed, first through the election of foreign members and the posting of prize papers, later through an exchange of scholarly publications. Personal contacts have often been established through the Academy representatives who attend congresses, jubilees and the like abroad. Since 1900 the Academy has represented Denmark in an international association of academies for the promotion of scholarly enterprises and the facilitation of intercourse among research workers. Two world wars have disrupted this international collaboration, but after each ter-

mination of hostilities it has rapidly been re-established.

Finally, brief mention should be made of some of the larger undertakings of the Academy, particularly those of the first hundred years of its existence when, to a certain extent, it acted as a consultative and executive organ of royal and state powers which dictated its activities.

The most extensive task of a practical scientific nature which has been imposed on the Academy has without doubt been the complete geographical and trigonometrical surveying of Denmark and the two duchies of Schleswig and Holstein, and the subsequent production of maps according to the survey. Work started in 1761 and lasted until 1843 when it was transferred to the topographical department of the General Staff for continuation. By that time the Academy had completed the first actual survey of the country and the tangible results were the 24 maps of Denmark and Schleswig that were then published. The Academy can thus be considered the forerunner of the present-day Geodetic Institute of Denmark.

The lengthiest undertaking of the Academy has been the publication of a Danish dictionary. In 1776 a commission composed of Academy members was set up which in 2115 meetings, held under difficult conditions, worked through vast vocabularies. The first volume of *Den danske Ordbog* appeared in 1793, and the work was completed with the eighth volume in 1905 – exactly 125 years after the appearance of installment A in 1780. Of course, the dictionary had become totally obsolete on completion, but it is still of great importance

inasmuch as it includes the greater part of the old vocabularies. Even before the Academy's dictionary was complete, work was well under way on a new one comprising words from the 18th to the 20th centuries, the result of which was the *Ordbog over det danske Sprog* (Dictionary of the Danish language), volumes I-XXVIII, 1918–1956, published by the Danish Society of Language and Literature and financed by the Carlsberg Foundation and the Danish State.

A further important work was the *Regesta Diplomatica Historiæ Danicæ*, which contains lists of old Danish diplomas and letters up until 1660 with specifications of their contents – an important source of historical research. The Academy appointed a commission for this task in 1828, but publication of the work did not begin before 1843. The actual collection was completed with the two volumes issued in 1870, but was continued with two volumes of supplements. It was not until 1907 that the work of the commission was completed. Plans to publish a *Regestum Diplomaticum*, a collection of diplomas and letters, had to be abandoned, and only in our own times has a *Diplomatarium Danicum* been completed, by the Danish Society of Language and Literature financed by the Carlsberg Foundation and the State.

Lastly, mention should be made of a publication of the Academy that is unique for its time. This is the description of a journey to Egypt and Nubia made in 1737–1738 by the young Danish Captain F. L. Norden, which appeared, after his death, in French in two large folio volumes in 1750 and 1755 and includes 159 plates with engravings of Nor-

den's drawings. In the following years several editions of this book appeared abroad in English, French and German.

In 1772 the Academy published yet another pioneering work containing the results of the investigations and collections made by two Icelandic students, EGGERT OLAFSEN and BIARNE POVELSEN, on journeys through Iceland in 1752–1757.

Moreover, the Academy has concerned itself with such widely differing matters as historical almanacs, chronometers, meteorological, astronomical and geomagnetic observations, artesian well-boring, etc.

ASGER LOMHOLT

The Academy and International Research in the Humanities

It is obvious that a national academy will, to a large extent, be concerned with matters of national interest. Studies of Denmark's past and present, of the Danish language, art and culture have therefore always figured prominently in the Academy's activities. However, only by force can science and scholarship be compelled to deal exclusively with national and practical problems, and it is chiefly the results of basic research, carried out in fields outside the range of Nordic subjects, to which Danish research in the humanities owes its world-wide reputation. The majority of the scholars who have made such contributions have been connected with the Academy, and in a great many cases highly important treatises dealing with the humanities have been published by the Academy.

Two areas in which the subjects were primarily of national interest, but the results of which attracted attention far beyond the Danish frontiers, are those concerned with SAXO and the prehistory of Denmark. Saxo's historical work *Gesta Danorum* is one of the more extensive writings of the European Middle Ages, and it is an unusually consistent and daring attempt to employ ancient Latin literary prose with Germanic basic material.

Any progress in research on Saxo has therefore been assured attention everywhere among classical philologists, Germanists and medievalists, and since the founding of the Academy in 1742 Saxo has often been the subject of communications in its publications. In more recent times not only Saxo, but also the study of medieval Latin in general have been so assiduously cultivated by Danish philologists, in particular M. Cl. Gertz (1844–1929), Hans Ræder (1869–1959) and Franz Blatt (1904–79) that it was quite natural to entrust the editorial supervision of the new international lexicon of this language, *Novum Glossarium Mediae Latinitatis*, to Danes. A commission under the Academy, headed by Franz Blatt as chairman and editor-in-chief was, until his death, in charge of this publication.

In the very first volume of the Academy's Memoirs, which also became known outside the Danish realm through a Latin translation, Erik Pontoppidan (1698–1764), dealt with a find from Denmark's prehistory. From this find he deduced that, prior to a period which practised cremation and buried bronze grave goods, there had been a period in which uncremated bodies and flint objects were entombed. It was such observations as this, combined with the ideas of a gradual technological development maintained by ancient Roman authors, that led, half a century later, in the Museum of Danish Antiquity, to the practical representation of the so-called three-period system (the Stone, Bronze and Iron Ages). Nevertheless, it was J. J. A. Worsaae (1821–1885), the founder of the strictly scientific study of prehistory, and

Sophus Müller (1846–1934), the great systematist and acute scholar, who long ensured Denmark a leading position in prehistoric archaeology through their European-oriented works. In our own times Johannes Brøndsted (1890–1965) achieved wide recognition as one of the most knowledgeable scholars of Viking culture; but the research carried out by Gudmund Hatt (1884–1960) on prehistoric houses and fields in Denmark was of greater significance.

However, as earlier indicated, the Academy and its members have gained a particularly enviable reputation for original contributions in other fields of research. Contributions of especial distinction have been made in classical philology proper, Oriental studies, linguistics, and classical and Near Eastern archaeology, subjects which have been eagerly cultivated from the outset, but art history, ethnology, and musicology have also gradually entered the picture. It is hardly remarkable that classical and Oriental subjects were the first to attract attention when we consider that European culture is the product of a centuries-long process built on an ancient foundation, that the sacred texts of the prevailing religion were written in Greek and Hebrew, and for more than a millenium European scholarly literature was chiefly written in Latin.

The names of some of the Danish scholars of classical philology still stand out today, and of them J. N. Madvig (1804–1886) and J. L. Heiberg (1854–1928) are the most outstanding. Madvig participated in the establishment of the modern source-critical and text-interpretive

J. N. Madvig, president of the Academy 1867–1886 and first chairman of the board of the Carlsberg Foundation. Painting by Carl Bloch.

method; his writings on the theory of languages, as well as his Latin grammar and Greek syntax, were pioneering achievements. Heiberg is particularly

renowned for publishing the works of the Greek mathematicians, natural scientists and physicians. On Heiberg's initiative, shortly after 1900 and in collaboration with the Berlin Academy, the Academy started an edition of the Greek medical texts, *Corpus Medicorum Graecorum*, and later the Academy took over the publication of the works of the Greek lexicographers, *Corpus Lexicographorum Graecorum*, with A. B. Drachmann (1860–1935) as editor.

Oriental studies were given their first real impetus with the material brought back to Denmark by the ambitious Danish expedition to the Orient of 1761–1767. Among other things, this material included copies of the inscriptions at Persepolis. Decisive steps towards the interpretation of these were made by Friedrich Münter (1761–1830), and his results were published in the Academy's Memoirs. Further breakthroughs in the same field were later achieved by Rasmus Rask (1787–1832) and, in particular, by N. L. Westergaard (1815–78). These two scholars, who copied inscriptions and collected manuscripts during long journeys to the Orient, laid the foundations for modern Iranian and Indian philology, fields in which another two Danish scholars have gained themselves international renown: Arthur Christensen (1875–1945), especially for his work on the Sassanians and his edition of Avesta, the sacred book of the ancient Persians and Dines Andersen (1861–1940), first and foremost as editor of the Academy's publication *A Critical Pāli Dictionary*, the great lexicon of the Indian language in which so much Buddhist literature is written. In

spite of this trend, the old central field of interest in Oriental studies, that of Semitics, has not been neglected in Denmark, and here two scholars should be singled out: FRANTS BUHL (1850–1932) and JOHANNES PEDERSEN (1883–1977). Buhl achieved European recognition for his geography of Palestine, his work on the formation and transmission of the Old Testament and his enlarged, modern edition of the German Gesenius' great Hebrew-Aramaic dictionary – indispensable for any Semitist – and for his portrayal of the founder of the Islamic religion, Muhammad. Pedersen's monumental work on *Israel*, which had enormous influence among both Orientalists and historians of religions all over the world, shed an entirely new light on the original culture and religion of the Israelite people. This he achieved by a thorough analysis of the entire source material, not only the Old Testament, but also the writings of neighbouring peoples as well as archaeological finds. Furthermore, the philologist and historian of religions VILHELM GRØNBECH (1873–1948) wielded no small influence in parts of Europe. When still relatively young, he contributed much to the study of the Turkish language, and later he dealt with the pre-Christian Nordic culture on basic principles corresponding to those used by Pedersen in his studies of *Israel*.

As a Turcologist, Grønbech was a pupil of the linguist VILHELM THOMSEN (1842–1927), who, in being more than an Orientalist, continued the line from Rask. Rask's main efforts concerned the Old Icelandic language and its position in the Indo-European family of languages; but he also dealt

with languages derived from other roots, for example Finnish, and he is perhaps best remembered for establishing the law concerning the Germanic sound shift, whereby, for example, the Romance *p* at the beginning of a word corresponds to our *f,* in a word such as *father.* Thomsen led the way in exploring the Turkish language family by his epoch-making deciphering of the Old Turkish inscriptions at Orkhon in Mongolia. Moreover, he greatly furthered the study of the Finno-Ugri languages, of Lycian, one of the ancient languages of Asia Minor, as well as of Etruscan. The discovery of certain sound laws made by Thomsen and KARL VERNER (1846–96) revolutionized the concept of the original sound system of the Indo-European languages. HOLGER PEDERSEN (1857–1953) pioneered the study of the Celtic languages through his comparative Celtic grammar; he described Tocharian, the old Indo-European Central-Asiatic tongue, and defined a new class of Indo-European languages, the Anatolian. OTTO JESPERSEN (1860–1943) achieved world-wide fame by elucidating the development of the English language and by organizing a new discipline, phonetics. KRISTIAN SANDFELD (1873–1942) was the father of modern Balkan philology, and KURT WULFF (1881–1939) proved the relationship between the Chinese-Tibetan and the Malay-Polynesian languages. Rask and others of his time had already shown an interest in Eskimo languages, but it was WILLIAM THALBITZER (1873–1958) who brought Eskimology into line with the demands of present-day linguistics. KRISTOFFER NYROP (1858–1931) performed outstanding work in

Romance studies, Louis Hammerich (1892–1975) in German studies and folklore; Hammerich also contributed to the exploration of the Eskimo languages. Together with the distinguished Slavist and leading expert on Russian literature, Adolf Stender-Petersen (1893–1963), he set about the publication, under the auspices of the Academy, of an Old Russian – Low German phrase-book for merchants dating from 1607 that is a goldmine from the point of view of philology and cultural history: *Tönnies Fenne's* Low German Manual of Spoken Russian. The greatest name in our circle of linguists in recent decades has, however, been that of Louis Hjelmslev (1899–1965), son of the mathematician Johannes Hjelmslev, mentioned in the next chapter. In a revolutionary manner Hjelmslev gave a new orientation to the study of the structure of languages, and in the hitherto most consistent manner he formulated a theory of language. In his view, language was a prerequisite for thinking, and philology was thus the real basic science of the humanities. Although there have been several important philosophers among the members of our Academy, of whom Harald Høffding (1843–1931) in particular won wide respect for his treatment of the history of more recent philosophy, Hjelmslev's theory of language has probably met with greater response abroad than any other philosophical work of a modern Danish humanist. The fact that language research has reached so high a level of development in Denmark, to some extent allowing comparison with the situation in physics where the solution of the problems confronting him led Niels Bohr

(1885–1962) into philosophy, has often been ascribed to the circumstance that a small nation, more than a large one, has of necessity to learn the principal foreign languages. This explanation is probably not fully adequate: it has certainly also been of importance that the old Danish monarchy encompassed a large linguistic spectrum ranging from Greenlandic, Icelandic and Faeroese, via Norwegian and Danish, to Friesian and German. Moreover, at an early stage the old Danish scholars on their travels to the south and to the Orient fully understood the value of bringing all kinds of manuscripts back home with them.

Classical and Near Eastern archaeology developed side by side with classical philology and Oriental studies. The Academy made its name in archaeological circles outside Denmark through its publication in French in the 1750's of F. L. Norden's records of his journeys in Egypt and Nubia (mentioned above by A. Lomholt), but more particularly by numbering among its members such archaeological pioneers as Georg Zoëga (1755–1809), the great methodologist of Mediterranean archaeology, Friedrich Münter (1761–1830), one of the founders of Early Christian archaeology, and Peter Oluf Brøndsted (1780–1842), who is reckoned among the first field archaeologists in Greece. Three Danish excavations of the same magnitude as those undertaken by large nations – on Rhodes, carried out by K. F. Kinch (1853–1921) and Christian Blinkenberg (1863–1948), at Kalydon by Frederik Poulsen (1876–1950) and Ejnar Dyggve (1887–1961), and at Hama – all became known initially through

the publications of the Academy. The same applies to a large number of the portrait studies of Frederik Poulsen, of Dyggve's writings on Early Christian archaeology, of KNUD FRIIS JOHANSEN's (1887–1971) interpretations of Greek works of art, and to the well known volumes of JULIUS LANGE (1838–1896) on the representation of the human body in the figurative arts, in which he demonstrated that so-called frontality is a constant phenomenon in all primitive art. Since 1970 the Academy has also published the results of the Danish excavations in Phoenicia. Represented by Christian Blinkenberg, the Academy was, moreover, co-founder of the international publication dealing with ancient painted pottery, the *Corpus Vasorum Antiquorum*, to which Denmark has to date supplied eight volumes.

F. L. Norden had already made ethnological observations on his Nile journey, and when in the 1840's the Academy became involved in the organisation of the scientific circumnavigation of the globe by the corvette *Galathea* studies were also made of exotic peoples and their cultures. In more recent times KAJ BIRKET-SMITH (1893–1977) issued his studies of the cultures of the Pacific area in several of the Academy's publications; some of these studies resulted from Birket-Smith's own participation in a new *Galathea* expedition. In this context it should be mentioned that the Academy has now taken the initiative in publishing the Pre-Columbian antiquities that are kept in Denmark in the series *Corpus Antiquitatum Americanensium*. Many of these artifacts were brought to Denmark by the first *Galathea* expedition.

Among the internationally-orientated enterprises of the Academy, finally, is the publication of the music manuscripts of the Orthodox Christian Church in the impressive series *Monumenta Musicae Byzantinae*; the musically-talented classical philologist CARSTEN HØEG (1896–1961) played a role in deciphering the Byzantine musical notation and initiated the whole of this work. Also, in more recent musicology, Academy members have achieved world-wide recognition, i.a. KNUD JEPPESEN (1892–1974) for studies in 16th century Italian music, in particular Palestrina.

P. J. RIIS

The Academy and the Exact and Earth Sciences

One of the greatest services the Academy has rendered to the exact sciences – a term perhaps employed too narrowly in our times for astronomy, physics, chemistry and mathematics – has been to provide economic support. At first this was only slight in financial terms but often of decisive importance; for example, the support arranged by the tireless Academy Secretary H. C. ØRSTED (1777–1851), for the Danish discoverer of the law of conservation of energy, L. A. COLDING (1815–1888). The expression "Danish discoverer" is used because this was in fact an item of basic knowledge which was brought to light roughly simultaneously in several places in Europe.

Later on it was the *Carlsberg Foundation*, established by the brewer J. C. JACOBSEN (1811–1887), that was of invaluable importance for the development of the exact sciences in Denmark. Many of our most influential scientists have been members of the board of this Foundation, which is elected by the Academy, and have therefore been involved in the development of research in this country far beyond their own fields.

For chemistry and the associated biological sciences in particular, the *Carlsberg Laboratory*, also founded by J. C. Jacobsen in 1876, has been of great significance through the strongly interna-

tionally-orientated research that has been, and still is, carried on there. This also applies to the Foundation's *Institute of Biology* (1932).

Moreover, the Academy has been of importance in maintaining a *tradition* within the exact sciences in this country. This is exemplified by its publication of OLE RØMER's notebook, *Adversaria*, in 1910, edited by THYRA EIBE and KIRSTINE MEYER, the former being the Danish translator of Euclid. Another example is Kirstine Meyer's edition of the *Scientific Papers of H. C. Ørsted*, accompanied by two weighty treatises dealing, respectively, with Ørsted's sientific activities and his other contributions to Danish society – including his strenuous efforts as the Academy's Secretary.

Furthermore, the Academy has produced special publications to commemorate various scientifie events and taken other steps to maintain interest in earlier research and in great names in science, e.g., the Academy celebrated the 300th anniversary of the birth of OLE RØMER in 1944.

In addition, earlier publications have sometimes been re-issued with commentaries, after the realization that the work in question had been of greater significance than was apparent on its first appearance. This was the case with a treatise by the surveyor CASPAR WESSEL (1745–1818). He was the brother of the poet Johan Herman Wessel, who wrote of Caspar Wessel: "He reads the law and draws maps. Being as busy as I am lax". This treatise gave a definite geometric basis for calculations with complex numbers and contains ideas that point towards algebraic concepts conceived at a much later date. This was Caspar Wessel's only

known contribution to pure mathematics and it was without importance for later developments – particularly because it was written in Danish – but it is a captivating testimony of the rich intellect of an isolated mathematician.

The activities of the Academy and its members obviously reflect the most important aspects of the history of the exact sciences in Denmark. However, it should be noted in this connection that the Academy was first founded in 1742, by which time Danish scientists had already made their mark in several fields. In astronomy, physics and chemistry this applies to Tycho Brahe (1546–1601), Rasmus Bartholin (1625–1698), Ole Rømer (1644–1710) and Ole Borch (1626–1690), while the great Niels Stensen (Nicolaus Steno) (1638–1696) was also familiar with the exact sciences. Moreover, this list includes only the most famous names; almost two hundred years were to pass before Danish science was to achieve results even approaching the same importance.

The following is an attempt, in very brief glimpses, to describe some features of the development of the exact sciences in Denmark in terms of the efforts of the scientists involved, but shortage of space clearly only permits a very rough outline and thus precludes mention of much valuable research and many accomplished scientists. Furthermore, it is hardly possible for anyone to give an entirely impartial survey – for the unity of research has vanished with increasing specialisation and it is almost impossible, even within a circumscribed field to comprehend the whole subject.

The oldest of the exact sciences in Denmark is *astronomy*. After the unique work of Tycho Brahe and Ole Rømer in observational astronomy, a *tradition of astronomical research* was established that has remained intact in this country until the present day. Since these early years there has been a steady development of this subject but without results of comparable significance. No names will be mentioned in connection with this long tradition – its main feature is its continuity, which probably exceeds that of any other exact science in this country.

Two distinguished Danish astronomers in our century should be mentioned. EJNAR HERTZSPRUNG (1873–1967) carried out his work in Germany and Holland; it comprised a number of significant stellar-astronomical investigations. The so-called Hertzsprung-Russell diagram, which gives the relationship between the colours of the stars and their actual luminosity, proved to be of decisive importance in the development of astrophysics.

At the same time, the chair in Copenhagen was held by ELIS STRÖMGREN (1870–1949) whose sphere of research was celestial mechanics and who contributed much to practical international collaboration in astronomy.

With regard to *physics*, the first breakthrough after OLE RØMER was made by H. C. ØRSTED (1777–1851). His fame is based on his discovery of *electromagnetism* in 1820, among his other achievements in chemistry and physics, but it should not be forgotten that he was the first scientist to produce *aluminium*, which he termed the clay-soil

metal, or *Argillium*. To these successes should be added his very substantial contributions to society in general: the establishment of the *Polyteknisk Læreanstalt* (now the Technical University of Denmark), and of the *Selskab for Naturlærens Udbredelse* (Society for the Dissemination of Natural Science) and everything that followed in the wake of these initiatives. From 1815 to 1851 he was a very active and influential Secretary of the Academy.

Another great physicist was L. V. LORENZ (1829–1891). He distinguished himself both in experimental physics and in mathematical physics and made valuable contributions to, for example, the theory of light and the understanding of the relationship between the refractive index of a material and its specific gravity. He also studied the electrical- and thermal-conductivity of metals and their temperature dependence. The significance of his original and far-reaching research was only properly recognized after his death.

C. CHRISTIANSEN (1843–1917) acknowledged the debt he owed to Lorenz. As Professor at the of Copenhagen University and at the Technical University, he was the first physicist in Denmark to found an actual school of research. His work in widely differing fields had the character of rather isolated investigations (apart from the series of studies on *frictional electricity* in his later years) and was characterized by originality and a wealth of ideas. He is especially well-known as one of the first scientists to recognize the so-called *anomalous dispersion* of light.

One of Christiansen's pupils was KIRSTINE

MEYER (1861–1941), the most important historian of physics in this country, and an excellent and influential teacher. She never became a member of the Academy, but she performed valuable work under its auspices. MARTIN KNUDSEN (1871–1949) carried out a series of internationally renowned investigations on *gases under such low pressure*, that their properties – in theory, very easy to calculate – were experimentally very difficult to measure. He was a leading figure in Danish and international *physical oceanography* and Secretary of the Academy for thirty-two years (1917–1949), where he did much useful work in furthering international collaboration, which became of ever-increasing significance in his time. Other pupils of Christiansen should be mentioned: JULIUS HARTMANN (1881–1951), who became one of the forerunners of modern plasma physics through his *magneto-hydrodynamic investigations*; the spectroscopist and biophysicist H. M. HANSEN (1886–1956), who wielded considerable influence because of his broad physical insight and his collaboration with Niels Bohr; and P. O. PEDERSEN (1874–1941), Rector of the Technical University for many years, who made important contributions in different fields of electro technology (e.g., the propagation of radio waves). In a fruitful collaboration with VALDEMAR POULSEN (1869–1942), he further developed Poulsen's discovery of so-called continuous radio waves for radiotelegraphy and radiotelephony systems.

NIELS BOHR (1885–1962) was also a pupil of Christiansen, and his work provided the next, and uniquely important breakthrough in Danish phy-

Niels Bohr, president of the Academy 1939–1962. Painting by Henrik Sørensen.

sics. As early as 1906 Bohr and P. O. Pedersen were awarded the Academy's gold medal for their treatises on surface tension and waves. His significance for the development of *modern atomic* and *nuclear physics* is well known, as is his new and penetrating *insight into the epistemology of the physical world.*

He was President of the Academy from 1939 until his death, a term of office broken only by the years when he was forced to flee the country because of Nazi barbarism; it is no exaggeration to say that he cast a very special light over the work of the Academy. Through the work of Niels Bohr, Copenhagen became the centre of international research in atomic and nuclear physics – housed in the famed Blegdamsvej 17, now the *Niels Bohr*

Institute. All in all, he was the scientific world's most dedicated advocate of the value and importance of international collaboration in-research.

Among Niels Bohr's Danish colleagues were J. C. JACOBSEN (1895–1965), who worked especially on radioactivity; the above-mentioned H. M. Hansen; the spectroscopist EBBE RASMUSSEN (1901–59), who was secretary of the Academy for all too short a period in 1959; and CHRISTIAN MØLLER (1904–80), who took over this post and held it until his recent death. Møller's very broad-based work as a theoretical physicist was concentrated in his later years on the theory of relativity, where he held a leading international position.

Turning now to *chemistry*, the first notable contribution was made by the organic chemist WILLIAM ZEISE (1789–1847), who introduced accurate *quantitative chemistry* to Denmark. Thereafter, C. T. BARFOED (1815–1889) is known for his development of *methods of analytical chemistry*, particularly in organic chemistry. As a consultant to J. C. Jacobsen, the brewer, he had considerable influence on the founding of the Carlsberg Laboratory, where he became a board member. In this context mention should be made of J. KJELDAHL (1849–1909), who was the first head of the Department of Chemistry of the Carlsberg Laboratory, and who is now particularly remembered for his method of detecting nitrogen in organic materials: *"to kjeldahle"* is an international expression among chemists.

The two leading figures in chemistry in the last century and at the beginning of our own were, however, JULIUS THOMSEN (1826–1909) and S. M.

JØRGENSEN (1837–1914). The former is particularly famous for his unique, and extensive research in *thermochemistry* and for his prediction, through a new arrangement of the so-called *periodic system* (later used by Niels Bohr) of the existence of the *noble gases*. Jørgensen is remembered for his pioneering investigations of *complex metal compounds* and for his contributions to the *history of chemistry*. From 1888 until his death Julius Thomsen was an authoritative, and at times somewhat uncompromising, President of the Academy.

Because of S. M. Jørgensen's general attitude to chemistry and his interest in his pupils, it was he who started a research school. Of his pupils S. P. L. SØRENSEN (1868–1939) should be given first mention. He became head of the Department of Chemistry at the Carlsberg Laboratory, and was known for his studies of *enzymes and proteins*, as well as for his investigations of the importance of the *hydrogen ion concentration* in many fields. In 1938 he was elected President of the Academy, but died the following year.

NIELS BJERRUM (1879–1958) and J. N. BRØNSTED (1879–1947), both from the school of Julius Thomsen and S. M. Jørgensen, founded the modern tradition of *physical chemistry* in Denmark. They contributed much to the theory of *strong electrolytes*, in which they both were international leaders, but were also very active in other fields of physical chemistry. For example, Bjerrum pioneered the development of *molecular spectroscopy*, while Brønsted made a valuable contribution to the development of the third law of thermodynamics through his so-called *affinity studies*.

E. Biilmann (1873–1946) was a versatile organic chemist who for many years headed the research in organic chemistry at the University of Copenhagen. He played a large part in the work of the International Union of Chemistry.

Three of the following generation deserve mention: J. A. Christiansen (1888–1969), successor to J. N. Brønsted at the of Copenhagen University and internationally renowned for his research on the *kinetics of chemical reactions*; A. Langseth (1895–1967), who achieved unique results in *molecular spectroscopy* (the so-called Raman effect); and finally K. Linderstrøm-Lang (1896–1959), one of the most inspiring Danish scientists of our own times. Linderstrøm-Lang was head of the Department of Chemistry of the Carlsberg Laboratory, where he supervised an extensive and international research programme in a stimulating and versatile manner. At the same time he carried on his own very considerable research work, comprising *structure studies of proteins* and *enzymes*, as well as developing the *micromethods* that he had originated, which led to very important breakthroughs in biochemistry and other areas of biology.

H. G. Zeuthen (1839–1920) was the leading personality in Danish *mathematics*, although the far earlier C. F. Degen (1766–1825) and Zeuthen's contemporaries, the astronomer T. N. Thiele (1838–1910), Julius Petersen (1839–1910), J. P. Gram (1850–1916), C. Juel (1855–1935), J. L. W. V. Jensen (1859–1925) and Niels Nielsen (1865–1931) also contributed much to the development of the subject in this country. Earlier, we noted the single, unheeded contribution of Caspar Wessel.

Zeuthen's work particularly concerned *geometry* and the *history of mathematics*, and it is especially as a historian that his reputation has survived for posterity: he had a very highly developed ability in discovering the basic ideas and relationships in Greek mathematics. In this work he collaborated with the classical philologist J. L. Heiberg (1854–1928), whose editions of the Greek mathematicians have been very important for the history of mathematics. Zeuthen was, for as long as 39 years, Secretary of the Academy, a position he filled with great efficiency and sound judgement.

Four of the pupils of Zeuthen and of his contemporary university colleague Julius Petersen deserve mention:

Firstly, Johannes Hjelmslev (1873–1950), who dealt particularly with the *foundations of geometry* and the possibility of developing what he termed a "*realistic geometry*" able to reproduce the geometrical situations experienced in reality more satisfactorily than classical Euclidean geometry.

T. Bonnesen (1873–1933) was a schoolmaster for several years before becoming professor of geometry at the Technical University, at which time he energetically resumed the geometrical studies that had led in his youth to a doctorate in non-Euclidean geometry. He became particularly interested in so-called *isoperimetrical extremal problems*. His mathematical textbooks introduced a significant reform into the teaching of mathematics in Danish senior schools.

Finally, of Zeuthen's many pupils, mention must be made of Harald Bohr (1887–1951), brother of Niels Bohr and his strong supporter in

personal and administrative matters, as well as in the formulating of the epistemological questions in which both were keenly interested. Harald Bohr made significant and rapidly recognized contributions to the theory of numbers and to mathematical analysis, in particular relating to the theory he constructed for the so-called *almost periodic functions*. He was an excellent and inspiring teacher and, largely as a result of his work, exact methods in analysis finally became recognized in Denmark after introductory endeavours by NIELS NIELSEN.

Rather outside the general mathematical tradition lies the work of J. F. STEFFENSEN (1873–1961), who was a lawyer by training, but who had a great interest in mathematics from his early youth. He cultivated this interest in different ways, particularly in *actuarial mathematics* in which subject he was the first professor in Denmark (1923–1943), carrying on a tradition begun by T. N. THIELE and J. P. GRAM.

JAKOB NIELSEN (1890–1959) was educated in Germany and started a very promising academic career in that country, but being a pro-Danish Schleswiger he returned to Denmark in 1921. His fundamental and original mathematical works are concerned with *topology* and *group theory*. He acted as Secretary of the Academy from 1945 to 1959, and as one of the "founding fathers" of UNESCO he contributed much to international collaboration on research, e.g., in the establishment of the inter-European research organization for nuclear physics, CERN, in Geneva, a project in which he gave Niels Bohr strong support.

MOGENS PIHL

THE EARTH SCIENCES

Two classical figures in the history of the Earth sciences, NIELS STENSEN and RASMUS BARTHOLIN, are mentioned elsewhere in this booklet. F. L. NORDEN's unique expedition to Egypt and Nubia has also been discussed: his monumental work dealing with this journey is especially valued because of its significance for archaeology; but obviously it also contains contributions to geography and ethnology. Similarly, the Academy supported travels in Iceland: EGGERT OLAFSEN's and BIARNE POVELSEN's *Reise gennem Island* (Journey through Iceland) I–II, 1772 (mentioned above and re-issued in Iceland in the 1970's) has its place among the Academy's most important publications and touches upon all aspects of the nature and culture of this volcanic island. An early member of the Academy, ERIK PONTOPPIDAN (1698–1764), after having published works on a variety of Norwegian topics, planned and embarked upon the great topographical work of his century in Denmark, *Det Danske Atlas* (The Danish atlas), I–VII, 1763–1788. Against this background it was only natural that interest should be extended to include Iceland, which until 1944 belonged to the Danish monarchy.

By about the middle of the 19th century geology had become established as a separate subject and was dominated by J. G. FORCHHAMMER (1794–1865). Originally a chemist, he had been admitted to the Academy at an early age and was supported by H. C. Ørsted, whom he followed as head of the Technological University. The surface of Den-

mark is differentiated but, with the exception of the island of Bornholm, it is almost exclusively of quaternary age and at that time this interesting fact went unnoticed. However, Forchhammer applied himself to a number of questions and in 1835 he issued the first geology of Denmark. One of his excursions was made in the company of CHARLES LYELL, with whom he established a friendly association. For obvious reasons, Forchhammer was concerned with "chemical geology" and he produced important treatises on the disintegration of feldspar to kaolin and clay, on the importance of seaweed species for the production of alum slate and other minerals, as well as a large work on the constituents of seawater and their distribution in the oceans (1859). He was a scholarly, unassuming and practical scientist.

F. JOHNSTRUP (1818–1894), a pupil of Forchhammer, was of rather comparable, many-sided importance for his time. He wrote a number of treatises on subjects from different geological disciplines to the elucidation of glacial phenomena; with his recognition of the Ice Age he went beyond the stage reached by his teacher. The geology of the Faroe Islands, Iceland and Greenland was a natural subject for him and for other Danish scientists to tackle , and it was primarily Johnstrup who took the initiative in the establishment of the two institutions now known as the *Geological Survey of Greenland* (1876) and the *Geological Survey of Denmark* (1888). He was head of both these institutions, which have not only been and still are of vital importance for the training of Danish geologists, for their organization and for providing out-

lets for their publications in close collaboration with the *Geological Museum* of the University of Copenhagen, but also for international research.

The Greenlandic tradition in Danish research is of considerable interest, because Greenland possesses some of the oldest known rocks on Earth. Among older followers of this tradition are two generations of professors: the petrograph N. V. Ussing (1864–1911), who carried out studies, e.g., of the nephelin-syenites of Greenland; and the mineralogist O. B. Bøggild (1872–1956), whose chief work was *Mineralogia Groenlandica* (1905, an English version appeared in 1953). Furthermore, Ussing made studies of features of the geology of Jutland and Bøggild of the limits of the ice and of the volcanic moler sediment. During the same period J. P. Ravn (1866–1951) carried out epoch-making studies of the pre-quaternary fossils in Denmark. He was awarded both the silver and the gold medals of the Academy for works on Cretaceous and Tertiary mollusks. Ravn's efforts were all the more important because Danish fossils in the 19th century were so often subjected to sporadic or incomplete studies whereas the material very much deserved an overall survey.

Present-day research in this field has been carried out by Christian Poulsen (1896–1975), who in particular produced palaeontological descriptions of palaeozoic fossils in Greenland and Canada, as well as in Denmark, and by Alfred Rosenkrantz (1898–1974) who produced a series of works on Greenlandic Jurassic, Cretaceous and Tertiary and – earlier – on the Danien stage in Denmark – from which this era takes its name.

Surveying, cartography and geophysics are disciplines with long traditions in the Academy, not just in theory but also in the form of extensive practical undertakings. Surveying was the province of the Academy in the years 1761–1843, whereafter it was transferred to the General Staff, and subsequently to the Geodetic Institute. Well-deserved biographies of the pioneers Thomas Bugge (1740–1815) and H. C. Schumacher (1780–1850) have been written recently by their present-day successor Einar Andersen (1905), formerly professor at Copenhagen University and director of the Geodetic Institute.

Erik Dal

The Academy and the Biological Sciences

The Academy has played a major role in promoting research projects in the humanities and applied physics. Its influence on biological research has been less direct. By electing the Board of Directors of the *Carlsberg Foundation*, it has, however, influenced the biological sciences in a decisive way. Up to the Second World War the development of biochemistry in Denmark was more or less synonymous with the research carried out at the *Carlsberg Laboratory*. Also, genetics and cell biology in this country owe a great deal to that laboratory.

The Laboratory consists of two sections, a Department of Chemistry and a Department of Physiology, which happen to have had men of great talent as leaders. The Foundation chooses from among its own Board members three natural scientists who, together with two adjunct members, consitute the Board of Trustees of the Carlsberg Laboratory. Although connected with a large industrial enterprise, research in the Carlsberg Laboratories has largely been of a basic and fundamental nature; but applied research has also been carried out. All the heads of departments of the Carlsberg Laboratory throughout its existence have been members of the Academy.

There are two periods in which biological

research has flourished in Denmark, these being the second half of the 17th century and, some 300 years later, in the present century.

ANATOMISTS

The first period of biological research in Denmark, which occurred before the founding of the Academy but should nevertheless be mentioned, was dominated by the scholars THOMAS BARTHOLIN (1616–1680) and NIELS STENSEN (NICOLAUS STENO) (1638–1686). In 1652 Bartholin described the human thoracic duct, and in 1654 the lymph vessels, to which he gave the name *vasa lymphatica*. This original discovery was made simultaneously by OLOF RUDBECK in Uppsala. Bartholin wrote a textbook of anatomy that appeared in 30 editions in a number of European languages; and in 1663 he published a second edition of MALPIGHI's treatise from 1661, *De pulmonibus*, in which Malpighi reported the discovery of the capillaries. This demonstrates the close contact which existed between Danish biologists and distinguished scholars abroad. Stensen discovered the duct of the parotid gland (*ductus Stenonianus*) and described the histological structure of muscle tissue. He rapidly became known throughout Europe and was appointed court physician in Florence (to Fernando II and Cosimo III). He correctly interpreted fossils of marine animals as being evidence that an area of land had earlier been covered by sea, and he is considered to be one of the founders of geology and palaeontology. His work *De solido*

appeared in an English translation in 1671. In 1675 he converted to Catholicism and relinquished all his scientific pursuits.

Of the 19th century, ADOLPH HANNOVER (1814–1894) was the most distinguished anatomist in Denmark.About the year 1842, after studying with Johannes Müller in Berlin, he published his *Mikroskopiske undersøgelser af nervesystemet* (Microscopical investigations of the nervous system). He introduced the method of using a chromic acid solution as a fixative. Hannover found that this preserved both the outer and inner structure of a tissue as well as hardening it to the right degree for sectioning. Furthermore, he recognized that the nerve fibres of the brain originate from cells in the brain. Later he carried out research on cancer and introduced epithelioma as a concept. For various reasons, he never held a chair in anatomy and his membership of the Academy was therefore of importance to him. L. L. JACOBSON (1783–1843), who was both an anatomist and a practising physician, discovered the sense organ *organon vomeronasale* in the nasal cavity of plant-eating vertebrates. He also described the renal portal vein system of some vertebrates and demonstrated the presence of kidney-like structures in invertebrates.

Among later anatomists, LÁRUS EINARSON (1902–1969) is known for his investigations into nerve cells and for the invention of gallocyanine staining. He developed micro-spectrophotometric methods of studying the nuclei of nerve cells.

PHYSIOLOGISTS

Several distinguished physiologists have been members of the Academy. The first, P. L. PANUM (1820–1885), established the Danish school of experimental physiology around 1860, after having studied with Claude Bernard in Paris. He is probably best known for his epidemiological studies of measles. He studied an epidemic on the Faroe Islands, where measles had not previously occurred, to determine its incubation time. Panum's most important pupil was CHRISTIAN BOHR (1855–1911), who studied with Carl Ludwig in Leipzig and became one of the leading pulmonary physiologists of his time. He discovered, in 1904, the effect of CO_2 on the oxygen binding curve of haemoglobin (the Bohr effect) and developed methods of determining respiratory "dead space". In studies of oxygen transport from alveolar air to lung capillary blood, it was necessary to know the average oxygen pressure in the blood during passage through the lungs. For this purpose Bohr developed a method of integration (the Bohr integration) and formulated the first mathematical model of gas exchange between blood and alveoli. His innate understanding of physics made him a pioneer in the rational description of physiological phenomena. He came to the conclusion (which later proved to be erroneous) that oxygen was transported into the blood of the lung by an active process. His treatment of the problem was so precise that his papers on gas exchange in the lungs are still being discussed.

It was Bohr's pupil, AUGUST KROGH (1874–

1949), who in the last year of Bohr's life proved that gas transport in the lungs occurs by passive diffusion. Krogh became one of the leading figures in physiology and his fields of activity were extremely wide ranging; among his achievements were the determination of cardiac output by means of acetylene, and investigations of capillary function. He formulated the concept – since called the Krogh cylinder – explaining the functional unit in solute exchange between blood and tissue and in 1920 was awarded the Nobel prize for this work on capillary physiology. Later, Krogh studied osmoregulation in marine animals and comparative respiratory mechanisms. In his later years his interests shifted from passive diffusion processes to energy-dependent transport of ions and molecules, and he became a pioneer in this field. In 1946 Krogh delivered the Croonian Lecture to The Royal Society; in this succinct account he summarized the results of his transport studies. In his final years Krogh once more changed his field of research, this time to the study of the metabolism of insect flight. Krogh made important contributions in fields ranging from plankton biology to the physiology of the blue whale. In 1948 he resigned his membership of the Academy in protest against an election policy which he considered too conservative. T. Weis-Fogh (1922–1975), who was the last of Krogh's many pupils, studied the physiology of insect flight, in particular the metabolic state before and during flight in the locust. He contributed to our understanding of the formation of insect cuticle and the molecular basis of the elasticity of resilin and elastin. Weis-

Fogh held a chair in zoology at Cambridge University from 1966 until his untimely death in 1975.

Einar Lundsgaard (1899–1968) discovered that muscle contraction does not require the production of lactic acid, as had been assumed by Otto Meyerhof and A. V. Hill, but that the contraction takes place by means of energy stored in phosphate bonds. These investigations, which started with the discovery that iodo-acetic acid prevents the production of lactic acid, but not the contraction itself, revealed that creatine-phosphate was the energy donor (although this was later placed secondary to adenosine triphosphate (ATP), both of which are produced by energy-coupled processes). Lundsgaard also discovered that alcohol conversion is a function exclusive to the liver. Quite early in his career (1939) he demonstrated that the main effect of insulin on blood glucose concentration is secondary to an action on the membrane transport of glucose in muscle cells.

Emil Christian Hansen (1842–1909) worked in the Department of Physiology at the Carlsberg Laboratory, where he developed a method of cultivating yeast from a single cell, now an important technology in the production of beer of constant quality.

Erik Zeuthen (1914–1980) became head of another Carlsberg research institute, *The Biological Institute of the Carlsberg Foundation*, where he succeeded Albert Fischer (1891–1956), known as one of the pioneers of tissue culture. Zeuthen developed a technique for synchronization of cell growth by means of heat shock. The protozoa *Te-*

trahymena pyriformis was the preferred test object in his studies of the biochemistry of cell division.

BIOCHEMISTS

The development of biochemistry in Denmark is closely connected with the research carried out at the Carlsberg Laboratory. After the establishment of the Laboratory in 1875, the Department of Chemistry was headed by JOHAN KJELDAHL (1849–1900), who developed a method for determination of nitrogen in organic material which is still utilized. Kjeldahl was followed by S. P. L. SØRENSEN (1868–1939), who studied the chemistry of proteins. He synthesized ornithine and proline, and elucidated the composition of arginine. He also developed the technique of formol titration as the first practical method for studying proteolytic cleavage. In 1909 he introduced the concept of pH, as an expression of hydrogen ion concentration; and he demonstrated the significance of pH in enzymatic processes. A number of his buffer solutions became standard requisites in many laboratories. Sørensen was a distinguished pioneer of protein chemistry and, toward the end of his life, he became president of the Academy. He was succeeded at the laboratory by K. LINDERSTRØM-LANG (1896–1959), likewise a protein chemist. Lang contributed both theoretically and experimentally to the understanding of the nature of proteins in solution, and he established the concepts of primary, secondary and tertiary structure of proteins. In cell physiology he developed micro-

methods, including the Cartesian diver method for the measurement of respiration in individual cells. Numerous distinguished guests were received at his laboratory, many of them from abroad, particularly from the USA during Lang's later years. By means of his ultramicromethods, enzymatic processes could be determined quantitatively in microscopically small amounts of tissue. In addition, Lang had an unusual flair for the mathematical analysis of biochemical conditions. Among biochemists from outside the Carlsberg Institute, Henrik Dam (1895–1974) was awarded the Nobel Prize for his discovery of vitamin K in 1940.

GENETICISTS

Wilhelm Johannsen (1857–1927) received his scientific training under Kjeldahl and Wilhelm Pfeffer (Leipzig). Although he was a professor of plant physiology, Johannsen's interest lay in genetics. In a series of fundamental experiments on the inheritance of seed size in beans, employing rigorous statistical methods, Johannsen clarified the difference between inherited and environmentally produced variation. He found that selection for size within "pure lines" obtained by strict self-fertilization was without effect on the offspring. Two lines differing only slightly in size would retain this slight difference generation after generation. After crossing the two lines they could be reestablished in the progeny by selection. His work *Elemente der exakten Erblichkeitslehre* established the concepts of the genotype and phenotype as well as the term

gene. This book formed the theoretical basis for the development of genetics in this century.

ØJVIND WINGE (1886–1964) formulated the theory of speciation in plants through polyploid evolution by means of species hybridization followed by doubling of the chromosome number of the hybrid. This work and his experimental cytogenetic investigations initiated extensive research into chromosome cytology and cytogenetics in Denmark. Winge can claim to be the founder of chromosome pathocytology through his discovery of chromosome abnormalities associated with plant and animal tumours, and is known as the father of yeast genetics through establishment of the sexual cycle for yeast and carrying out of the first genetical work with this organism. His international reputation is attested by his membership of both the Royal Society and the National Academy of Sciences of the USA.

MOGENS WESTERGAARD (1912–1975) was the intellectual successor of Johannsen and Winge. He discovered that the male sex in *Melandrium album* (white campion) is determined by the presence of a Y-chromosome – an important step in the development of cytogenetics. Westergaard worked on chemical mutagenesis and used the back mutation test to establish the allele-specific pattern of back mutation. He later used electron microscopy to study the importance of the synaptonemal complex in crossover mechanisms. He, too, was a member of the National Academy of Sciences of the USA; through his contacts with leading laboratories abroad he played a large part in the development of molecular biology in Denmark.

Carl Syrach-Larsen (1898–1979), a pupil of Ø. Winge, was the founder of the genetical school of forest tree breeding and established the first seed orchards for forest trees in Denmark. His concepts made a major impact on the development of such seed orchards in other countries.

PATHOLOGISTS AND MICROBIOLOGISTS

The best known of Danish pathologists, Johannes Fibiger (1867–1928), was awarded the Nobel prize in 1926 for his investigations of the *Spiroptera carcinoma*, an example of a cancer produced exogenously. The finding was based on an accidental observation on rats, being used for other purposes, which developed cancer of the stomach. The tumours contained a nematode (*Spiroptera neoplastica*) with which the rats had been infected by eating cockroaches, the host of this nematode. His work on exogenously produced cancer was a great stimulus for this branch of cancer study; and in 1949 an experimental cancer research institute was set up in Copenhagen bearing Fibiger's name. Bernhard Bang (1848–1932) was a professor at the Royal Veterinary and Agricultural University. His name is associated with the bacteria that gives rise to contagious abortion in cattle. He described this microorganism (*Brucella abortus* Bang) , which produces undulant fever in man. Bang is also known for his fight against tuberculosis in domestic animals, based on the principle of ridding the

stocks of tuberculosis by isolation of the infected cattle under continual tuberculin control. GUNNAR TEILUM (1902–1980) classified and systematized tumours of the testicles and ovaries.

Pasteur's work on infectious diseases led to the initiation of prophylaxis, which resulted in great advances in microbiology. The first director of the Danish State Serum Institute, THORVALD MADSEN (1870–1957), developed quantitative methods for evaluating the antibody-antigen relationship and carried out reaction-kinetic investigations concerning the attenuation of toxins. He was president of the Permanent Standards Committee of the League of Nations and was president of its Committee on Hygiene. FRITZ KAUFFMANN (1899–1978), who came to Denmark from the Kaiser Wilhelm Institute, Berlin, in 1933, classified the types of Salmonella bacteria. Two other scientists have been of importance in basic and applied microbiology: S. ORLA-JENSEN (1870-1949) systematized lactic acid bacteria, and C. O. JENSEN (1864–1934) investigated the relationship between human and bovine tuberculosis.

ZOOLOGISTS

Although the 18th century was not a particularly outstanding period for Danish biological research, three zoologists deserve mention. All of them greatly extended our knowledge of new species. They were: O. F. MÜLLER (1730–1784), J. F. FABRICIUS (1745–1808) and OTTO FABRICIUS (1744–1822). The latter, who was at the same time a

clergyman and afterwards a bishop, provided knowledge of arctic fauna through his treatise *Fauna Groenlandica*. O. F. Müller developed our knowledge of small, mainly aquatic animals and plants by describing a large number of species from fresh and salt water. J. F. Fabricius, in 1776, published the most important entomological work in Denmark, *Philosophia entomologica*, containing some 10,000 descriptions of new species.

In the years 1845–1847 the corvette *Galathea* circumnavigated the globe, and the marine animals collected during the voyage were later deposited in the Zoological Museum in Copenhagen. The Academy was involved in the planning of this expedition, but it was carried out at the expense of the state which invested an impressive sum of money in this enterprise.

At the suggestion of the Academy, Peter Wilhelm Lund (1801–1880) travelled to Brazil in the 1820's to carry out investigations on the vegetation. Having returned to Brazil in 1835, he studied the stalactite caves of Lagoa Santa, where he excavated and exposed 150 species of mammals, among them a giant armadillo and a giant sloth, that were 'conserved' in these natural conditions. The *Galathea* expedition took home to Denmark many of Lund's finds; and although the British Museum wished to purchase them for a large sum of money, the collections remained in Denmark. Lund himself never returned to his native country, but stayed in Brazil where he is considered one of the founders of Brazilian zoological research.

Japetus Steenstrup (1813–1897) and J. C.

Schiødte (1815–1884) were the leading zoologists in Denmark in the 19th century. Although Steenstrup, like many other scientists in those days, never completed a formal university training, he became university professor in zoology. He is particularly well-known for his studies in quaternary zoology, in which he identified bones from peat-bogs and archaeological sites, making possible the ordering of the finds in a chronological system. He pointed out how the various layers of plant remnants in the bogs provide information as to successive conditions prevailing in nature through the ages, furnishing evidence on flora and fauna immigration. He became a founder of bog-geology and vegetational history and demonstrated, for the Danish region, four periods of afforestation: the aspen-, the pine-, the oak-, and the alder- (later beech-) periods – a sequence which is still held valid. He coined the term *køkkenmødding* for the Stone Age refuse dumps, a Danish word which has been incorporated into the English language as 'kitchen middens'. Steenstrup contributed to zoological systematics, and his studies of cephalopods in many ways represented an important contribution (which has recently been published in English, 1962). Being a very active and popular person, he was an influential member of the Academy and was instrumental in the creation of the Carlsberg Foundation. The collaborative work between archaeologists and zoologists was supported by the Academy which in 1848 appointed the first 'Kitchen Midden' commission. In 1893 and 1937, two similar commissions were formed – in both cases with considerable support

from the Carlsberg Foundation and with several members of the Academy as participants.

His contemporary, J. C. Schiødte, continued the entomological research of earlier times and made extensive contributions to the characterization of beetles and their larvae. At the age of 25 he published his first extensive work, '*Genera and Species of Danish Beetles*', dealing with ground-beetles and water-beetles. His life-long occupation with beetle taxonomy resulted in a series of papers published between 1861 and 1884 under the collective title, *De Metamorphosi Eleutheratorum Observationes*, a work which has proved of fundamental importance by its elucidation of the variations within every single character and by showing which characters are of systematic significance. Freshwater biology was introduced by C. Wesenberg Lund (1867–1955), who published *Plankton Investigations of the Danish Lakes I–II* at the turn of the century.

Mathias Thomsen (1896–1976) initiated the study of insect endocrinology in Denmark.

MARINE BIOLOGISTS

The studies in marine biology of the zoologist Otto Frederik Müller have already been mentioned. Naturally enough, this subject has been of great importance in Denmark, which is surrounded on all sides by sea. C. G. Johannes Petersen (1860–1928) introduced quantitative techniques in the investigation of the benthic animals and plants. He invented the socalled "Petersen Grab". Johannes Schmidt (1877–1933) investigated the relation

between environment and genotype of Atlantic races of cod and gained special recognition for his theories on the migration of the eel between Europe and the Sargasso Sea. He worked at the Department of Physiology of the Carlsberg Laboratory and organized and led a circumnavigation of the globe with the expeditionary ship *Dana* (1928–1930). The voyage was funded by the Carlsberg Foundation. Descriptions of the material collected were issued over a series of years in the form of *Dana Reports*, comprising some 90 volumes and a total of 8,000 pages. The expedition discovered a submarine mountain ridge in the Indian Ocean, subsequently named the Carlsberg Ridge.

Among more recent Danish marine biologists, mention should be made of GUNNAR THORSON (1906–1971) who demonstrated the absence of planktonic larvae in arctic regions and the deep sea. His most important research concerned invertebrates of the marine bed. ANTON FREDERIK BRUUN (1901–1961) was particularly involved in deep sea research, in part on an international level, and is known for his definition of zones in the deep sea. He was the leader of the 2nd Danish *Galathea* expedition around the world (in 1950–1952). Bruun was not a member of the Danish Academy but was internationally recognized, as reflected in his membership of the Academy of Sciences of the United States.

EUGENIUS WARMING (1841–1924) originally studied with P. W. Lund in Brazil. He founded the study of ecological botany in Denmark, carried out research on plant geography, and described plant communities. C. RAUNKIÆR (1860–1938) introduced the circle method for quantitative description of the plant composition in different types of landscape. He is probably best known for his classification of plants according to 'life form', depending on how they have adapted themselves to survival during unfavourable periods, and for the fact that this classification of plants is confirmed by their geographical and climatic areas of distribution.

Three quaternary botanists have contributed in significant ways to their field, N. HARTZ (1867–1937), KNUD JESSEN (1884–1971), and JOHANNES IVERSEN (1904–1971). Hartz, who was not a member of the Academy, discovered the Allerød oscillation, a warmer period during late glacial periods – later demonstrated all over the earth. Jessen carried on the work of Hartz. In 1928 he published *Stratigraphical and Paleontological Studies of Interglacial Fresh-water Deposits in Jutland and North-East Germany*, in which pollen-analysis was employed for the first time in Denmark, parallel with the identification of seeds and fruits. Jessen carried out a series of pollen-analytical datings of prehistoric finds and on the whole did a great amount of pioneering work: investigations on cereals and weeds in the past, pollen-analytical and geological investigations of interglacial and post-

glacial peat-bogs in Ireland. Finally, Johannes Iversen became internationally respected as a leading figure in vegetational history. He included the herbaceous plants in pollen-analysis and by this means produced a far more varied picture of, for example, late glacial vegetation and climate. He demonstrated a late climatic oscillation before the Allerød period (the Bølling oscillation, which later has been identified everywhere). His eminent knowledge of vegetational ecology is the background for his paper on Stone Age farming and clearing of forests *Landnam in Denmark's Stone Age*. In the early 1950's he hacked out a slash and burn clearing in Draved Forest in order to support his interpretation of pollen-diagrams. A part of the forest was burned down after felling of the large trees with flint axes, followed by sowing in the ashes and (later) by cropping by cattle.

P. Boysen Jensen (1884–1959) investigated the production of organic matter in woods and was one of the pioneers in the study of growth hormones in plants. He also made quantitative investigations into the light-requirements of various trees.

Much of the work carried out by Danish zoologists and botanists in the 19th century, and also in this century, has only slowly gained international recognition, because it was mainly published in Danish – in contrast to the contributions within the experimental biological sciences, physiology, biochemistry, and genetics which, from the beginning, have been internationally oriented.

Christian Crone

The Academy Today

The old Danish name of the Academy is *Det Kongelige Danske Videnskabernes Selskab,* originally translated into Latin as *Societas Regia Hafniensis bonis artibus promovendis dedita,* but now on the Academy's seal, and on printed matter destined for abroad, another Latin designation is used: *Regia Academia Scientiarum Danica.* The first academy was founded in the 4th century B.C., when the Greek philosopher Plato gathered his disciples together for discussions in Akademeia, the grove of the Attic hero Akademos, outside Athens. Since then this name has been associated with inter-disciplinary gatherings of scientists and scholars. Such academies have often played an important part in the development of human society, and it is still their purpose to foster to this aim. By comprising, in principle, all basic sciences, academies normally dispose of a very great body of learning which they make available to international research and to the individual nation.

When new members are to be admitted to the Royal Danish Academy of Sciences and Letters, proposals are first made verbally, then submitted in writing, and later thoroughly discussed at several meetings. The members admitted after this procedure are such scholars whose abilities and activities hitherto allow the assumption that they will work for the objectives of the Academy. It is important to realise that this institution was

founded at a time when the situation of the university was about to change, and that it was to act as a kind of consultative organ, besides which, to a certain extent, the usefulness of research projects was to be taken into account – all of which is reminiscent of the situation today. The Academy has naturally sought, in the course of time, to adapt itself to changing circumstances, but in the main its objectives have remained the same, as expressed in the recently revised Article 1 of the statutes according to which the Academy "has as its purpose the strengthening of the position of scholarship in Denmark, particularly that of basic research, and of promoting inter-disciplinary understanding. These objectives are to be achieved especially by holding meetings and issuing publications, through international collaboration, and by consultative activities".

The Academy has two divisions or "classes" – one for the humanities (earlier termed "history and philosophy") and one for the natural sciences ("mathematics and natural sciences"). At the present time (May 1980) the following subjects are represented in the class for the humanities, which comprises 75 native and 99 foreign members (the numbers in brackets give first the Danish and then the foreign members): history (10, 20), archaeology (5, 13), art history (2,2), ethnology (1,5), comparative religion (1,1), musicology (4,3), philology and literary history (28.48), jurisprudence and political science (4,0), economics (4,4), philosophy and psychology (3,5). In the class of natural sciences the distribution is 110 native members and 180 from abroad, embracing the following sub-

jects: mathematics (12,22), physics (21,22), chemistry (16,30), astronomy (6,7), earth sciences (14,15), botany (6,13), zoology (8,7), biology (15,36), physiology, anatomy and medicine (16,28), history of science (1,1).

Heading the Academy is the president, elected for a four-year term and assisted by a council, which comprises, in addition to the president, the immediately preceding president, the chairmen of the two classes, who are the vice-presidents, the secretary, the editor, the treasurer, the chairman of the financial committee and the chairman of the committee for external activities in Denmark. The Academy meets fortnightly from October to May, usually on Thursdays. At these meetings one or two members present the results of their most recent research in the form of a lecture, and in advance of the publication of their results. After the lectures information is given on research collaboration and on the work of the different commissions and committees set up by the Academy to deal with particularly pressing scientific matters. Class meetings are held after the general meetings should there be any matters of particular interest to the class for discussion.

The regular publications of the Academy are issued in five series, two for the humanities (*Historisk-filosofiske Meddelelser, Historisk-filosofiske Skrifter*), distinguishable by their different formats, one for mathematics and physics (*Matematisk-fysiske Meddelelser*) and one for biology (*Biologiske Skrifter*), and a yearbook, the so-called *Oversigt over Selskabets virksomhed* (Report on the activities of the Academy), which contains a list of members, offi-

cials and commissions, obituaries of recently deceased Danish members and reports on work carried out during the year under review. One does not need to be member of the Academy to submit a paper and request its publication. If, after very careful scrutiny, the Academy finds it suitable for inclusion in one of its series, the work will be accepted and published and, in the same way as members' own papers, it will be sent to the some 837 institutions with which the Academy maintains exchange agreements; in this way such a paper becomes known over most of the world. In return the Academy annually receives, via exchange agreements, some 8000 publications which, after registration and display, are handed over to the libraries of Danish state institutions. The normal publishing activities of the Academy, including the exchange of publications, are thus of great importance: for a number of countries, particularly in the east, it is usually only possible to receive such scientific publications through the Academy, as exchange agreements are arranged at academy level.

Recently the Academy has initiated the publication of a special series of small booklets intended for the Danish public. Compared with applied research, the public usefulness, as it was called in the 18th century, or social relevance, as it is called today, of basic research is probably rather more difficult to evaluate. The Academy therefore felt that one of the first things that should be done after the improvement of its premises (provided by the Carlsberg Foundation on the occasion of its centenary in 1976) was to open its doors to the

public and to provide all interested parties with information on basic science in a series of lectures on a popular level. These lectures are presently printed in small booklets of which a total of 30 is planned.

International collaboration not only covers the exchange of publications but also the organisation of congresses and other scientific meetings at which research experience is exchanged and new methods and projects discussed. Furthermore it involves publishing the results of vast co-operative enterprises, particularly those monumental series whose demands with regard to manpower, specialist knowledge and finances quite exceed the capacity of any individual country. Such supranational scientific projects are organised in a number of unions and associations of which *L'Union Académique Internationale* for the humanities and the *International Council of Scientific Unions* for the sciences are the most important. Together with the various Danish state research councils, which give grants to the Academy for this purpose, and with the Danish institutions engaged in the work in question, the Academy sets up national committees or commissions that organise and follow local work in Denmark and provide the link with the unions and associations at whose meetings the Academy's delegates represent Denmark. The national committees and commissions for the humanities chiefly concern Denmark's participation in international publishing projects; at the present time there are 12 such works in progress, of which five have to date been directed from Denmark. These are: the universal lexicon of Medieval Latin

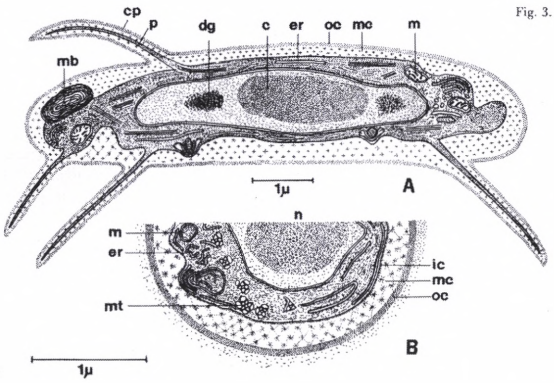


Fig. 3. Diagram of spermatozoa of *Daphnia longispina* O. F. Müller.
A. longitudinal section.
B. cross section.
Legends: c = carysome-like body, cp = extra-cellular coat on pseudo-podium, dg = clump of dark granules in nucleus, er = endoplasmic reti-culum, ic = inner layer of extra-cellular coat, m = mitochondria, mb = myelin body, mc = middle layer of extra-cellular coat, mt = microtubules, sur-rounded in a stellate fasion by unknown tubules, n = nucleus, oc = outer layer of extracellular coat, p = pseudopodium.

although not dominating, and in some cases a myelin-like lamellated body was seen. The mito-chondria have a dark matrix and distinct, some-what dilated, cristae. The ground plasm in the cell is fairly dark, somewhat granular and the plasma membrane is simple and uncomplicated.

Spermatogenesis is of the cystic type (Fig. 2A). Each cyst contains ten or more spermatids. There is no recognizable change of size during matura-tion, and the young spermatids differ from mature spermatozoa mainly in their darker plasm, which contains numerous ribosomes.

Comments on the spermatozoa of Holopedium. Sperma-tozoan structure and spermatogenesis in *Holoped-ium* are hardly distinguishable from those of euphyllopods. As, e.g., in Anostraca the sperma-tozoa are simple, amoeba-like cells and are formed in typical cysts in the testicular wall. There is no increase in size during maturation of spermatids as in the Sididae and the Onycho-poda, nor is there any reduction in size as in most Anomopoda.

Genus Daphnia

Material

Daphnia (Ctenodaphnia) magna Straus. Emdrup Sø, Copenhagen, 21. VIII. 72 and 20. IX. 72, ♂♂, 1 % Os. – Ottenby, Öl., Sweden, 4. X. 74, ♂♂, 3-A. – Sebhka Zima, Morocco, 12. IV. 77, ♂♂, 3-A, (coll. Å. Jespersen).

D. (Ctenodaphnia) atkinsoni Baird. Laboratory culture of sand from Gush Etzion, Israel, collected 11. VI. 73 (Coll. Ch. Dimentman), ♂♂, 2 % Os.

D. (Ctenodaphnia) lumholtzi G. O. Sars. Marrakech, Morocco, 29. XII. 76, ♂♂, 3-A (coll. Å Jespersen and J. Lützen).

D. (Daphnia) curvirostris Eylmann. Søborg, Copen-hagen, 26. IX. 74, ♂♂, 2 % Os, 3-A.

D. (Daphnia) longispina O. F. Müll. Søborg Mose, Co-penhagen, 18. X. 72. ♂♂, 1 % Os.

D. (Daphnia) galeata Sars. Lyngby Sø, Zealand, 19. X. 72 and 19. XI. 72, ♂♂, 1 % Os.

D. (Daphnia) cucullata Sars. Lyngby Sø, Zealand, 12. X. 73, ♂♂, 3-A.

The tubular testicles of the *Daphnia* species, lying on each side of the intestine, have thick walls consisting mainly of the very large, vegetative cells ("cellules géantes", Delavault & Gerard

(*Novum Glossarium Mediae Latinitatis*), the publication of Byzantine music manuscripts (*Monumenta Musicae Byzantinae*), a lexicon of the Indian language Pāli, so important for an understanding of Buddhism (*A Critical Pāli Dictionary*), a complete edition of the works of the Greek lexicographers (*Corpus Lexicographorum Graecorum*), and an Old Russian – Low German Manual (see above p. 35). A special commission directs research on the history of agricultural implements and field structure, while two commissions deal with matters wholly relating to Denmark: investigation and registration of the sources of Danish history in private Danish ownership, and work on research areas in Denmark. The class for sciences also participates in the last named project. The scientific national committees represent, in particular, the large international unions for astronomy, biophysics, biochemistry, biological sciences, physics, physiology, geodesy and geophysics, geography, geology, chemistry, mathematics, medicine, oceanography, space research, etc. In addition to native members, other specialists may be elected to sit on some of the commissions and national committees; in commissions under the class for the humanities these groups make up a total of 35 persons (9 non-members), and under the class for the sciences, a total of 193 persons (139 non-members).

A few words should be said about the finances of the Academy. In addition to the funds provided by the research councils for international collaboration, as mentioned above, the Academy receives a government grant, hitherto mainly intended for its

DET KONGELIGE DANSKE VIDENSKABERNES SELSKABS PJECESERIE

GRUNDVIDENSKABEN I DAG

4

C. MØLLER

OMVÆLTNINGER I FYSIKERNES TANKESÆT I VORT ÅRHUNDREDE

UDGIVET I SAMARBEJDE MED FOLKEUNIVERSITETETS BIBLIOTEK
AF FOLKEUNIVERSITETET I KØBENHAVN

1977

Cover of the fourth booklet in the series Grundvidenskaben i dag (Basic science to-day): C. Møller, Omvæltninger i fysikernes tankesæt i vort århundrede (Upheavals in physicists' ways of thinking during the present century), 1977.

publishing activities, and another larger grant from the Carlsberg Foundation for publications, operating expenses, etc. In addition, the Academy has at its disposal some capital and a number of endowments. The generosity of its members has recently manifested itself in the setting up of a Members' Contribution Fund, which can assist with the operating expenses of the Academy, particularly those associated with its meetings.

Some of the Academy's resources make it possible to reward scholars. The gold medal of the Academy is awarded for very special, often life-long efforts. The silver medal, which carries a monetary prize (see ref. p. 64), and a few other grants are awarded to younger research workers of promise. Moreover, on the nomination of the Carlsberg Foundation, the Academy elects the occupant of the honorary residence at Old Carlsberg in the suburb of Valby. In addition, the Academy disposes of two other free residences: Lundehave in Elsinore and Knud Sand's villa in Gentofte, north of Copenhagen.

The improved premises have greatly increased the potential of the Academy. The number of members has been increased, and it has been possible to admit more of the younger Danish research workers. The administrative staff enjoy satisfactory working conditions, a reference library has been enlarged, an archive reading-room has been out-fitted, and the Academy now has four rooms which may be assigned to members for special research projects. As formerly, the old assembly hall may be used for special meetings – e.g., the *Alfred Benzon Foundation* holds its international

betvā, Vin I 276,16; ~iṁ parimasissāmī ti piṭṭhi-kaṇṭakaṁ yeva parigaṇhāmi . . . , ~i piṭṭhi-kaṇṭakaṁ allīnā hoti, M I 80,25 = 81,21 = 246,8 (Ps II 50,19 *foll.*; *cf.* Sv 993,33).

udara-jivhā-maṁsa, *n.*, *"the flesh of the stomach's tongue"*; *description of the spleen*: pihakan ti ~aṁ, Vism 257,22 (jivhā-saṇṭhānaṁ udarassa mat-thaka-passe ṭhitaṁ, Vism 500,5; (*spleen*) hadayassa vāma-passe ~assa matthaka-passaṁ nissāya ṭhitaṁ, 257,25 = Pj I 55,26; semhaṁ . . . ~e ṭhitaṁ, Vism 261,4 = 359,33 = Pj I 61,23 = Vibh-a 65,18 = 244,10 ≠ Pj II 248,27; (udariyaṁ) ~ena ceva udariya-bhāgena ca paricchinnaṁ, Vism 259,27 = Vibh-a 242,32; kammaja-tejo uṭṭhahitvā ~aṁ gaṇhāti, "chāto 'smi, āhāraṁ me dethā" ti vacāpeti, bhutta-kāle ~aṁ muñcitvā vatthuṁ gaṇhāti, As 330,26; — ~ = *uterus*? tassā (*woman on funeral pyre*) aggi-vega-santattaṁ ~aṁ dvedhā ahosi, dāruko . . . uppaṭitvā . . . , Mp I 274,10 = Th-a I 43,12.

udara-pariyosāna, *mfn.*, *ending with the belly*; (sariraṁ) ~aṁ atirekaṁ uddhumātakaṁ hoti, Vism 185,26 (~aṁ: uparima-sariraṁ, mhṭ *S*^{e} I 301,9); hattha-pāda-nābhi-~āni (*the limbs: hands, feet, navel, lastly the belly*), Ja I 148,13.

udara-pāda, *m.*, *whose feet are the belly, i. e. a snake*; pād'ūdare (Sn 604) ti ~e, udaraṁ yeva yesaṁ pādā, Ps III 434,15 (M *No.* 98).

udara-pūra, **1.** *mfn.*, *filled with the* udara: (kāyo) anta-pūro ~o yakapelassa . . . *"filled with bowels, stomach, liver . . ."* (udara *here replacing, m.c.?,* udariya (*gorge*) *of the list of 32 impure constituents of the body, cf.* [1]udariya; Pj II 247,25: udarassa pūro ~o, udaran ti udariyass' etaṁ adhivacanaṁ, taṁ hi ṭhāna-nāmena udaran ti vuttaṁ); — **2.** *mfn. and subst. m.*, *filling the stomach*; a) *adj.*: eka-divasaṁ pi ~aṁ āhāraṁ na labhi, . . . gabbha-malaṁ ~aṁ labhi, . . . sunakho . . . bhatta-vamanaṁ ~aṁ labhi, . . . tena ~o āhāro nāma na laddha-pubbo, Ja I 238,23-26; *adv.*: udarāvadehakan ti ~aṁ, Sv 1031,15; udarāva-dehakaṁ bhutvā ti . . . ~aṁ bhuñjitvā, Th-a III 78, 25; — b) *subst.* yāvad-atthaṁ ~aṁ katvā paribhuñji, Ja I 236,16; yaṁ kiñcid eva kevalaṁ °-mattaṁ vaṭ-ṭati, Vism 108,19; °-hetu, Ja VI 210,18^{e}.

udara-maṁsa, *n.*, *the flesh of the belly*; ~aṁ (*of dead body*) . . . khādiyamānaṁ (*by crows etc.*), Sv 772,8 = Ps I 273,21 = Mp III 359,11.

udara-vaṭṭi, *f.* [*sa.* -vartiḥ], *the circumference of the abdomen, a round* (*or swelling?*) *belly*; chi, bhante, . . . ~iyā ghaṭṭehi, Vin III 39,22; bhikkhuno jantā-ghare ~iṁ tāpentassa (asuci mucci), 117,27; °-maṁsaṁ, Vism 262,24 = Vibh-a 245,34.

udara-vāta, *n.*, *the wind* (*one of the three* dosas *or humours*) *in the belly whose "irritation" causes discomfort*; theriyā ~o kuppi, Ja II 392,24 = 433,5; ~o kupito, 393,11; ~o vūpasami, 393,21; ~o paṭipas-sambhi, 433,9; — tathāgatassa ~o uppajji . . . satthā gilāno . . . ko ābādho ? ~o, Mp I 304, 20-22; tassa . . . ~o samuṭṭhahi, . . . kiṁ te rujati ? ~o me samu-ṭṭhito, Dhp-a IV 129,16; — °-**ābādha**, *m.*, satthu ~e uppanne, Th-a II 87,24 (*v. l.* vātābādhe); atekiccho ~o ahosi, Ras II 8,27.

udarāvadehakaṁ, *ind.* (*see* avadehakaṁ), *so as to overfill the stomach*; yāvad-atthaṁ ~aṁ bhuñjitvā, D III 238,23; M I 102,3; A III 222,25; 249,26; IV 343, 13,21; V 18,23; Vibh 378,1; Th-a I 190,19 ≠ Spk II 107,9 ≠ Vism 33,25 (*cf.s:* ~an ti udara-pūraṁ, taṁ hi udaraṁ avadehanato ~an ti vuccati, Sv 1031,18 = Ps II 69,7 = Mp III 325,27 = Vibh-a 504,22; udara-vadibitvā upacinitvā pūretvā, Mp III 307,18); ~aṁ bhutvā, Th 935.

udariṇī, *f.* [*ts.*], *pregnant*; Pds-ṭ 89,3.

[1]udariya, *n.* [*sa.* udarya], *"what is in the* udara*"*, *contents of the stomach*; Rūp 363; Mogg IV 26 (*mfn.*); udare bhavaṁ ~aṁ, Sadd 790,2; ~aṁ udare ṭhitaṁ asita-pīta-khāyita-sāyitaṁ, Bu (Vism 258,23 = 358,27 = Vibh-a 62,28 = 241,32); — *in stock list of 32 impure constituents of the body*: atthi imasmiṁ kāye kesā lomā . . . antaṁ anta-guṇaṁ ~aṁ karīsaṁ . . . muttaṁ . . . , Khp III; D II 293,16; III 104,26; 105,10; M I 57,18,30; 185,19; 421,31; III 90,17,29; 240,23; S IV 111,20; A III 323,25; V 109,24; Paṭis I 7,1; Vibh 82,12; 193,23; 194,7,29; Mil 26,10; Nett 74,8; 77,29; Vism 240 *foll.*; *cf.s:* Pj I 57,31 = Vism 258,23 = Vibh-a 241,32; Vism 358,27 = Vibh-a 62,28; Paṭis-a 81,32; — Vism 366,3; 588,19; Vism-mhṭ *S*^{e} 105,18; — °-**bhāga**, *m.*, *the room, space, region, place of the gorge*; (udariyaṁ) paricchedato udara-paṭalena ceva ~ena ca paricchinnaṁ, Vism 259,27 = Vibh-a 243,1 ≠ Pj I 59,14.

²°-udariya *in* **sa-°**, **saha-°**, **so°** [*sa.* sodarya *"co-uterine brother"*] *qq. v.*

uda-vattha, *n.*, *a water-garment*, *i. q.* udaka-sāṭikā *q. v.* ? ~aṁ (*v. l.* ura-v°) tathā vassika-sāṭa-kaṁ, Ap 303,24.

[uda-vaho Ja VI 543,7^{e} *w. r. for C*^{e}*B*^{e} udaka-vāho].

uda-sadda, *m.*, *the word* uda (*water*); ~en'eva udak'attho vutto . . . pāḷiyaṁ kevalo ~o na diṭṭha-pubbo, Sadd 237,18-20.

uda-su, *dv.*, *the particles* [1]uda *and* su; ~û ti

biological symposia there. Moreover, the development of the top storey has provided yet another auditorium with all modern facilities where public lectures as well as large professional meetings and symposia can be held.

The old premises contain a number of works of art and historic furnishings from earlier times, of particular interest are portraits of the founders of the Academy, of its officials and other Danish scholars, as well as traditional Danish furniture. The old assembly hall is graced by P. S. KRØYER's famous picture of a meeting of the Academy, painted in the years 1895–1898, and with a ceiling painting, by KRÆSTEN IVERSEN, depicting the myth of Prometheus, painted in 1925–1926. Hanging in the new lecture hall is RICHARD MORTENSEN's picture "Glæde over sejren i Østen" (Joy at the victory in the East), painted in 1975, which is on loan from the Carlsberg Foundation. Furthermore, the New Carlsberg Foundation and the Museum of National History at Frederiksborg have provided the Academy with several works of art on loan.

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Reverse of the prize medal of the Academy instituted by King Christian *VII in 1768, originally made by J. H.* Wolff*, probably after a design by P.* Cramer*, but modified when in 1801 a new stamp was made by P.* Gianelli*. According to the Latin inscription the medal is dedicated "to the elicited luminary truth".*