In parallel with but completely independent from Harvey Cushing, Norway had its own giant in the establishment of the special field of neurological surgery. Vilhelm Magnus (1871-1929), born in the United States in Fillmore County, Minnesota, was Norway’s pioneering neurosurgeon. Following graduation in Oslo, he started his clinical training in neurology and became an early member of the small group of neurologists of the time who were dissatisfied with the therapeutic nihilism generally accepted in relation to diseases of the nervous system. After working with Victor Horsley, whom he held in high esteem, Magnus devoted himself to surgically treatable lesions in the nervous system. During a quarter of a century he single-handedly established the special field of neurological surgery in Norway. Magnus was a far-seeing and brilliant surgeon with a broad intellectual mind, a startling diligence, and wide research activities. He published his first scientific paper in 1899 and his total contribution to the literature amounted to 70 papers. In 1901 he was able to demonstrate the importance of the corpus luteum in the first 3 weeks of pregnancy. As early as 1903 Magnus manifested his interest in the surgical treatment of brain tumors. In 1926 his surgical material comprised 216 patients, with an 8% operative mortality rate among 161 cases of supratentorial tumor versus 17% for 55 cases of infratentorial tumors, including 14 cases of acoustic tumor. Vilhelm Magnus, who visited Harvey Cushing in 1928, has hitherto not been given the attention he merits.

**Key Words** · Vilhelm Magnus · Harvey Cushing · Victor Horsley · neurosurgical history

The end of the 19th and beginning of the 20th century was an era of significant scientific progress and important discoveries. It is probably no coincidence that some of the outstanding pioneers of these achievements were acquainted with each other. Vilhelm Magnus (1871-1929) studied medicine at the Royal Frederik University in Kristiania (now the University of Oslo) with the Norwegian explorer Roald Amundsen (1872-1928), who abandoned medicine for arctic ventures. The Swedish explorer of Central Asia, Sven Hedin (1865-1952), also established a close friendship with Harvey Cushing (1869-1939).¹²

**Youth and Schooling**

Vilhelm Magnus was born in the United States on February 13, 1871, in the town of Arendal, North Prairie, Fillmore County, Minnesota. There his father, Morten Henrik Magnus, was priest in the synod of the Norwegian Evangelical-Lutheran church. The Norwegian parson loved his Dickens and, when he put his glasses over his nose, he was simply the good-hearted Mr. Pickwick himself. He was always willing to help his countrymen as well as anyone else, and was held in very high esteem by all in his congregation.

In the autumn of 1875 Morten Magnus was forced to leave the United States due to the ill-health of his wife. The family then spent a couple of years in Southern Europe, where for some time Morten Magnus was priest to the Scandinavian and Finnish citizens of Ajaccio in Corsica.

In 1881 and 1882 the Magnus family visited France, Germany, and Denmark, then moved back to Norway where they settled in Bergen. Morten Magnus was an exceptionally warm-hearted and faithful person. He collected clocks, which were found all over the vicarage, some indicating date, month, and year, others playing hymns, and yet others producing a chime of bells every quarter-hour.

Vilhelm Magnus thus spent his infancy and early youth traveling. When, at the age of 12 years, he started school in Bergen, he had received education in Italian and French schools only, and could not speak the Norwegian language at all. His friends respectfully re-
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Early Training
Immediately after graduation, Dr. Magnus started his clinical training in neurology at the Department of Neurological Diseases, Rikshospitalet (the National Hospital), in Kristiania. His tutor there was Professor Christopher Leegaard (1851–1921), Norway’s first professor of neurology. 61

In view of his cosmopolitan background and inquisitive mind, it is quite natural that young Vilhelm went abroad the following year (1898) for further studies. He first went to Paris where he applied himself to the study of histology and neurology for a year. There he experienced the great French school of neurology at the Faculté de Médecine, at the Université de Paris. During that year he contributed correspondence to a newspaper in Kristiania about the ambulance services in Paris. 59

In 1900 he again went abroad, first to Germany, where he spent 3 months in Frankfurt am Main studying neuroanatomy and neuropathology under Carl Weigert and Ludwig Edinger (Fig. 3). When, in 1918, the latter died following surgery for prostatic hypertrophy, Magnus drew attention to Edinger’s divine gift as a teacher and inspiration in the field of comparative brain anatomy: “We were but a few young pilgrims who chose to go to the Old Senckenberg Institute like to another Mecca to learn the basis of comparative brain anatomy under the guidance of Professor Edinger. His enthusiasm when he thought he had discovered a hitherto not described nucleus or nerve tract was overwhelming, not that he considered the demonstration, per se, as important as the possible physiological importance of the new discovery.” 47

After finishing his studies in Frankfurt, Magnus went to Breslau where he was initiated into studies in experimental embryology at the Abteilung für Entwicklungs-geschichte of Professor Gustav Born (1851–1900).

Studies in Neurology and Experimental Research
Magnus took an early interest in clinical neurology. In 1899 he published his first scientific paper dealing with hereditary and familial diseases of the nervous system. 19 This study was based on careful observations of two brothers who had been patients at the Department of Neurology at the Rikshospital. In the following years Magnus published a series of papers related to neurological disorders which all bear witness to his wide research activities and broad intellectual mind. 37–41, 49, 52, 53, 63, 73, 74, 76, 81

Stimulated by his studies under Professor Born, he also found time to perform extensive experimental research on the function of the corpus luteum. 9 Based on a series of experimental investigations on rabbits, he furnished scientific proof of Born’s hypothesis of an active secretion from the corpus luteum of a substance necessary for the maintenance of pregnancy. Magnus in 1901 was the first to demonstrate the presence of what he called “a diversification factor,” 57 which substance many years later was to be given the designation “progesterone” (first isolated in 1934 by Butenandt). The word “hormone” was not yet in existence; it was used for the first time in 1905 by Starling, at Hardy’s suggestion.

In September, 1901, Magnus gave a talk before the Norwegian Medical Society on the importance of ovarian function, with special reference to the function of the corpus luteum during the different phases of pregnancy. Like almost all of his pioneering studies, this presentation was published only in the Norwegian journal Norsk Magazin for Laegevidenskaben. 57 Fraenkel and Cohn published a paper on the same subject also in 1901 in Anatomischer Anzeiger, and in 1903 Lud-
wig Fraenkel became internationally recognized for his description of the function of the corpus luteum in a paper published in the Archiv für Gynakologie. The lack of international recognition of Magnus' work is most certainly due to the fact that, despite his good knowledge of English, German, and French, he chose to publish almost all of his studies in Norwegian journals.

Prior to his experimental work, Magnus identified three questions which he wanted to elucidate, and he was able to find the answer to all three. These were: 1) Does ovarian function influence pregnancy? 2) If ovarian removal in a pregnant animal arrests the pregnancy, is this due to removal of the ovarian stroma or corpora lutea? and 3) If destruction of corpora lutea arrests pregnancy, does this occur during the whole period of pregnancy or is it only valid for a limited duration during pregnancy?

Magnus first started his experiments using rats but had to give this up since he was unsuccessful in observing reproduction of his rats: "I spent so many long hours in vain sitting in wait for copulation of sexually uninterested rat pairs!" He then bought 65 rabbits of which many succumbed due to tuberculosis or other disease; however, the experiments were successful in 16 animals, in which the duration of pregnancy could be ascertained. Magnus performed the laparotomies under ether anesthesia and aseptic conditions. In six animals bilateral ovariectomy was done and in eight the corpora lutea was cauterized at different stages of pregnancy. With these experiments, he was able to demonstrate the importance of the corpus luteum during the first 3 weeks of pregnancy. After performing a one-sided ovariectomy he established that a living fetus could be present in the uterus on both sides. With these findings previous theories of a nervous system influence could be abandoned. Magnus proposed many further anatomical, biological, pathological, physiological, and chemical matters for further study, but had to conclude that "these would require many more experimental animals than I could ever hope of having at my disposal. After all I have been able to demonstrate the importance of the corpus luteum for pregnancy and a hitherto un-
known function of the ovary. Hopefully I will later be able to solve some of the remaining problems."

Between 1903 and 1910 Magnus discussed the oral treatment of morbus Basedow with blood or milk from goats on which he had performed a thyroidectomy at the University Physiological Institute. He also showed an interest in the genetic predisposition for certain diseases and undertook a series of experiments with transplantation of ovaries in rabbits of different strains in an attempt to elucidate the hereditary mechanisms behind strain characteristics.

The Special Field of Neurological Surgery

In 1903 Vilhelm Magnus first manifested his interest in the surgical treatment of brain tumors in a paper entitled "Brain tumors," and the next year he published papers on "Brain surgery," "Tumor cerebri," and "Tumors of the brain."

He was an early member of the small group of neurologists who at that time were dissatisfied with the therapeutic nihilism generally accepted in relation to diseases of the nervous system. Despite a lack of formal surgical training he considered himself competent enough to perform intracranial as well as spinal operations, like Otfried Foerster in Germany and Clavio Vincent in France later. To this group of far-seeing neurologists also belonged Vladimir Bechterev in Russia who, as early as in 1897, stated that "even if the only recourse of today's neurologists in the field of brain surgery is to untrained operators, then at least the next generation will not have to suffer such privation: for by then specialists with neurological training behind them will have taken up the scalpel to perform what rightly forms a part of their domain."

Magnus' accumulated practice and experience from animal experiments most certainly played a major role in his decision to establish himself in the difficult special field of neurological surgery.

At the same time, William Osler (1849–1919) in the United States, recognizing the place of surgery in the treatment of some neurological disorders, played a very significant role in influencing and aiding young Harvey Cushing in his endeavors. As early as 1896 Cushing stated of his contemporary general surgeon colleagues: "Not operating much, considerable sepsis in the house. No wonder! These men operate about the way a commercial traveller grabs a breakfast at a lunch counter."

Cushing's opinion was shared by Magnus, who concluded: "The general surgeon applies the same technique to operations on the central nervous system as he employs in surgery of the abdomen, and it is an all too heavy-handed treatment of the sensitive brain tissue, causing a shock reaction, which is the most frequent cause of death resulting from brain operations."

With Victor Horsley in 1903 and 1904

In 1903 Magnus' insights in neurology and his increasing interest in brain-tumor surgery brought him to

Victor Horsley (1857–1916) in London, with whom he stayed for 2½ months, participating in operations as well as in experimental animal work focused on the function of the tectal plate. Horsley was to become his close friend and he learned a lot from him. Throughout his life Magnus expressed his keen admiration for the British master scientist and neurosurgeon. About the famous National Hospital for the Paralysed and Epileptic, Magnus wrote:

"The hospital staff counts 20 of the most famous neurologists in Great Britain, each of whom has a defined number of beds. Horsley for example had 6 beds at his disposal. It appears that the number of available beds for each specialist is related to his service seniority. The hospital was very clean and sober and to each department of 18 beds there was an assembly hall fitted with carpet, piano, and leather armchairs. The operating theatre, however, was far from acceptable; it was very old-fashioned and to combat the aseptic shortcomings Sublimate solution was flooded all over the place."

In the following year (1904) Magnus again visited Great Britain. He paid a short visit to Liverpool, but Sherrington had left to present a series of lectures in the United States. Magnus then again went to work with Horsley in London. He reported:

"In London there is a unique opportunity — as probably nowhere else — to observe a series of brain and spinal cord operations during a relatively short period. Horsley has practically a monopoly, and with good reason because hardly anyone has been so well qualified to be a pioneer. His basis in physiology acquired through many years' experiments on animal brains is combined with an unusual ability of observation and swift meticulous action. His results are brilliant, and he may for instance perform an exploratory laminectomy on indications which for the less knowledgeable may seem doubtful. His technical skill in operations on the central nervous system may be illustrated by the successful removal of a pituitary tumor in a patient with acromegaly with a favorable outcome. His technique is the simplest possible, as it must be under the conditions prevailing for London surgeons. It is not becoming for a doctor to run a private clinic in England, and thus they must operate in nursing homes. Some of the ones I visited had no operating theatre, and Horsley operated in the bedroom where the thick carpet was not removed. In others a small operating room was arranged in a former garden cottage. He also performed operations in the patients' homes. Under such circumstances the British surgeon must learn to use the least complicated equipment and to work under what we would call primitive conditions. For the same reasons antisepsis prevailed. Sublimate in strong alcoholic solutions was virtually considered a magic water, a few seconds' rinsing of the hands in this fluid being regarded as sufficient. But on the basis of bad experience the British surgeon has seen the danger of superficial antisepsis and has learned to take advantage of surgical instruments. The most surprising thing in London was to observe how little the surgeons touched the wound with their fingers. Horsley for instance performed extractions of the gasserian ganglion without touching the field with his fingers. The use of rubber gloves was common. Another surprising observation was the untrained assistants. Residents are not found in the London hospitals, only house surgeons, young newly graduated physicians in a few places, but most often students, and they change every 3 to 4 months."

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Establishing Neurosurgery in Oslo

In 1903, Magnus performed his first two-stage operation to remove a deep-seated tumor in the left cerebral hemisphere of a 47-year-old man with focal epileptic seizures and a rapidly developing right-sided hemiplegia and aphasia. The description of this procedure is a classic in neurosurgery.4,6

Four years later he published a paper2 concerning surgical treatment of brain tumors. In this he discussed very precisely focal and general symptoms of brain tumors, stating that the possibilities of the correct localization of brain tumors based on precise knowledge of neuroanatomy had increased markedly in the last decade. Magnus meant that, based on the duration and type of symptoms, the presence of extracerebral tumors such as endotheliomas or, with today’s nomenclature, meningiomas versus intracerebral tumors such as gliomas could be diagnosed with some accuracy. He also pointed to the different neurological symptoms caused by tumors located in the pituitary fossa, at the skull base, and in the frontal, parietal, occipital, and temporal regions compared with those caused by tumors located in the thalamus, internal capsule, and cerebellum. He did not think much of doctors who delayed the diagnosis of brain tumor, treating their patients with iodine-potassium:4,22

“As soon as the diagnosis of a brain tumor is established one has to consider if the tumor is operable. If the patient has a more protracted history with slowly progressive symptoms then an endothelioma is probable and one should then attempt to perform an operative removal. Should the tumor turn out to be a glioma then a palliative craniectomy is sufficient since even if one removes such a tumor with the resection in apparently healthy brain tissue the tumor will soon relapse. I completely leave out of account medical treatment of brain tumors which I consider of no use. No doctor would suggest iodine-potassium treatment for a sarcoma of the tibia. The same principle should be clear for patients with brain tumors in whom such “treatment” only leads to unnecessary delay and may cause blindness from optic atrophy due to advanced papilledema.”

In his paper, Magnus also discussed the phenomenon of pseudotumor cerebri, solitary cerebral metastasis, and meningeal carcinomatosis.4,6 Of the 10 patients on whom he had operated for a brain tumor, only one died despite the fact that “all 10 patients were admitted in a most advanced stage of disease after a far too long delay in considering surgical treatment.”

Sole Neurosurgeon in Norway For a Quarter-Century

It is certainly most remarkable that, under the prevailing utterly primitive conditions and without affiliation either to any major hospital or to the University, Magnus was Norway’s first and only neurosurgeon during the first quarter of this century. For many years he worked without an assistant and with only inexperienced personnel to provide anesthesia, a field in which he also published interesting reports.22,51,58

In 1921, Magnus summarized his results of brain-tumor surgery in a 138-page volume entitled Bidrag til hjernechirurgiens klinik og resultater (“Contributions to investigate diagnostic techniques and results of brain surgery”). This was published as a supplement to the Norwegian medical periodical Norsk Magasin for Lægevidenskaben.18 In the introduction, Magnus emphasized that the literature of the time was more or less devoid of documentation of results of any large series of patients operated on for brain tumors by one surgeon. He also noticed that few surgeons had honestly reported on their complications and failures “with the exception of von Eiselsberg who, in his “Über die chirurgische Behandlung der Hirn- und Rückenmarkstumoren” (published in 1913 in the Verhandlungen der Deutschen Gesellschaft für Chirurgie), clearly had described the case history of each of the 168 patients with brain tumor on whom he had operated in a 12-year period.

Magnus observed that von Eiselsberg’s mortality rate was 38% while Tooth, reporting at the 7th International Congress of Medicine in London on 265 cases operated on by Horsley and his colleagues at the National Hospital for the Paralysed and Epileptic, had found a 37% mortality rate. In the period from 1903 to 1920 Magnus’ own series comprised 112 patients undergoing 197 operations with a surgical mortality rate of 8.1%, a phenomenal result for the time. Magnus had also operated on 20 patients for epilepsy and noted that none of the 10 cases of genuine epilepsy had been improved whereas, of the other 10, two had been cured, two were improved, and six remained unchanged. He had lost one patient in status epilepticus. In one case Magnus found a walnut-sized cyst in the occipital lobe; he emptied this and covered a dural defect with fascia lata.

It is evident that Magnus very closely followed the international literature on all subjects relating to his special interests. In cases of epilepsy surgery, he used “The osteoplastic trepanation à la Wagner4,5,8 and the simple Gigli wire saw” between the four to five Burr holes taken up with a manual trephine, . . . I never used the electrically operated trephine for I had to operate in many various small hospitals and during summer time at the countryside where I had to be confident with the simplest of instruments.”18 Magnus had also performed craniectomies in one case of scaphocephaly and in “an achondroplastic dwarf whose headache was cured.”25

In 1913 Magnus carried out an exploratory cranieotomy over the left motor cortex in a 39-year-old woman with frequent jacksonian seizures in her right limbs and first-stage papilledema. He found a large arteriovenous “angioma” and performed a decompressive cranieotomy including removal of a 6 × 6-cm piece of dura but refrained from any attempts to remove the malformation. Instead, Magnus had the patient irradiated and, at follow-up review 7 years later, she had been free of seizures for 4 years. “In this case radiotherapy was more lenient than the knife,” Magnus laconically stated.18 As in so many other matters, his thoughts in this case demonstrate how far ahead of his time he was.

In grief he reported on a 37-year-old man with a 3-
year history of jacksonian seizures. The patient had been subjected to all kinds of medical treatments despite continuous deterioration to a left spastic hemiplegia and advanced papilledema. Magnus removed a falcial meningioma weighing 195 gm. The patient’s hemiplegia improved but “had he been diagnosed three years earlier the outcome would most certainly have been even better.”

Magnus stressed that the prodromal symptoms of a brain tumor are often associated with behavioral disturbances like depression or decreased mental and physical capacities, often misdiagnosed in the beginning as neurasthenia. He stressed the importance of repeat ophthalmoscopic examinations in such cases and emphasized that a nihilistic view of diagnosis and operative treatment of brain tumors was completely unjustified. He quoted Brissaud who once said: “Surgical treatment of brain tumors is a very sad issue,” and remarked “this he really came to experience more personally for he was to die from a glioma.” Magnus believed that by palliative craniectomy patients with gliomas could be saved from unbearable headaches and blindness before dying from their tumors. Dr. Magnus harshly condemned those of his colleagues who withheld such palliative treatment from their patients.

In conclusion he stated that the special field of neurological surgery puts severe demands on its practitioners, who must possess strong mental capacities, “for the disappointments are many and heavy to bear.” He continued, “There is no reason to give up and throw down the gauntlet like the American neurologist Knapp who has suggested that palliative surgery only should be performed in all cases of brain tumor. This is not right, for one must always attempt to localize the tumor and thereafter try to remove it with all precautions so as not to produce further damage to the brain tissue.”

When Magnus summarized his experience with brain-tumor surgery in more than 200 patients at a meeting in Rome in 1926, he related that during the first 10 years of his career he had operated under very primitive conditions in different small hospitals and also in the countryside and had hence been forced to rely on but a few simple instruments. He concluded: “La condition essentielle de la technique est de connaître la technique de ses propres instruments.”

Among Magnus’ many studies is an interesting case report of a meningioma which was visualized on plain skull radiography (Fig. 4). A 33-year-old woman had suffered from increasing headache and a paresis of the left hand which progressed to a left-sided hemiplegia. She also developed seizures and papilledema. Skull x-ray films revealed markedly enlarged vessel grooves and erosion of the skull bone in an area over the right motor cortex corresponding to the left upper limb just behind the coronal suture. Magnus pointed out that only rarely can brain tumors be so exactly localized with the help of x-ray films. He rightly suspected that the tumor must represent a densely vascularized endothelioma, and made a large decompressive craniectomy over the tumor; however, he had to abandon an attempt at removal in the first stage because of severe bleeding from bone and dura. The patient stood surgery well but developed a high fever and died after a couple of days. At autopsy Magnus found the meningioma which he could easily remove by blunt dissection from the brain bed.

In 1928 Magnus reported on the successful removal of a cystic cerebellar tumor in a 14-year-old girl first treated in 1921. The patient had severe headache, papilledema, gait disturbance, and left dysdiadochokinesia, and Magnus diagnosed the presence of a tumor in the left cerebellar hemisphere. He operated in two stages and found both cerebellopontine angles free from tumor. However, at puncture of the left cerebellar hemisphere he found a cyst which was drained of yellowish fluid. The patient recovered but 3 years later developed an abducens palsy and a partial facial and trigeminal palsy. This time (1924) Magnus found a solid tumor the size of a hen’s egg in a cystic cavity occupying the whole left cerebellar hemisphere. He removed the tumor and noted that, despite the loss of the left cerebellar hemisphere, the patient showed no gait or balance disturbances. She was given additional radiotherapy and at follow-up examination 3 years later (1927) she was in excellent condition.

Magnus’ Results of Surgery for Trigeminal Neuralgia

In 1921 Magnus also published his results in 31 patients with trigeminal neuralgia who were treated surgically with resection of the pontine nerve root or gasserian ganglion with pain relief in 30 patients. Two years later he presented his surgically treated tri-
Vilhelm Magnus — pioneer neurosurgeon
geminal neuralgia cases at the 14th Annual Meeting of
the Scandinavian Surgical Society in Stockholm. In
1929 he was able to document his results of retroga-
serian rhizotomy in 100 patients with trigeminal neu-
ralgia, 31 of them over 70 years of age (this paper was
published posthumously). The complications were
postoperative facial palsy in seven cases (five of which
were transitory) and one transient fourth nerve weak-
ness. All but one patient experienced pain relief. When
considering the poor preoperative condition of many
patients who were und nourished and tormented by
chronic pain, the results were exceptionally good.

Pituitary Specialist

In patients with suspected pituitary tumors, in 1913
Magnus started substitution therapy with subcutaneous
pituitary hormone injections combined with palliative
craniectomy followed by radiotherapy. His diagnoses
were based upon radiographic investigations of the
sear region, ophthalmoscopy, and visual tests including
repeated examinations of the visual fields. He pub-
ished papers on this subject in 1916 and 1923 and in
1925 he argued with the ophthalmologist, Pro-
essor Sigurd Hagen, who had raised objections to his
demonstration of the possibility of treating with radio-
therapy a woman with a pituitary tumor.

"When faced with a female patient with bitemporal hemi-
anosia, somnolence, and amenorrhea — and pregnancy can
be ruled out — there is in my opinion sufficient data to suggest
the presence of a pituitary tumor. There is no doubt that
without treatment the patient may become blind within a
couple of weeks. To adopt a conservative attitude in the hope
that the disorder should represent a retrobulbar neuritis with
a benign course would be far too dangerous. It is a most severe
but unfortunately rather common mistake in brain and cord
disorders that the doctor takes an attitude of wait and see,
until the symptoms have become irreversible.

"To consider trephination as a difficult surgical interven-
tion is not in keeping with surgical concepts of today. It is for
example known that William of Orange was trephined 17
times without suffering from ill-health and Meche de la
Touche trephined one and the same patient 52 times. Philip
of Nassau was trephined 27 times and in proof of his well-
being he boozed to severe inebriation with a bunch of friends
of whom three died from acute alcohol intoxication."

Magnus was of the opinion that the effect of radiation
therapy on pituitary tumors could be enhanced by re-
mval of temporal bone which absorbed much of the
radiation. He suggested surgery via the transsphenoidal
route should palliative craniectomy and additional ra-
diotherapy not be successful in cases of intrasellar ade-
nomas. He advocated the transcranial subfrontal ap-
proach in cases where the tumor could be suspected to
expand into the suprasellar region as well.

On Subdural Hematomas

Under the title "A case of operated traumatic late-
apoplexy," Magnus in 1912 reported on the gratifying
result of removing a large chronic subdural hema-
toma. The patient was a 50-year-old man who 1
month before had suffered head trauma to the temple
with oozing scalp wounds which finally healed prior to
the development of symptoms of increasing headache,
nausea, and vomiting. On admission he was confused
and very drowsy, and showed bradycardia. Magnus
suspected that the patient had developed an intracranial
abscess and raised a frontotemporal bone flap accordin
to the method described by Wagner. He then discovered
a subdural clot 4 cm deep covering the whole cerebral
hemisphere. He evacuated the hematoma and rinsed
the subdural space with saline heated to body temper-
ate. The patient made a quick and complete recovery.

Magnus thoughtfully recalled a similar case from his
very early neurosurgical experience: a 40-year-old man
who had recovered well after a moderate head trauma
but then 3 weeks later had deteriorated and died while
Magnus felt hesitant to perform an exploratory crani-
ectomy. At autopsy he had found a similar subdural
clot compressing the cerebral hemisphere. He was sur-
prised that the operated patient had not shown any
limb paresis "since the hematoma was maximal over
the motor cortex but this must be due to the fact that
it had developed slowly over a long time and is in
accordance with similar cases of traumatic late apo-
plexia described by Bollinger in 1891."

In a later report entitled "A case of delayed meningeal
bleeding," Magnus described a middle-aged male pa-
tient with a fairly heavy consumption of alcohol whom
he was requested to visit in consultation on January 5,
1925. The patient was drowsy and bedridden with a
right hemiplegia, and showed some speech difficulties.
Magnus also found advanced papilledema with severe
ocular protrusion. The patient's wife reported that her
husband had a 9-week history of increasing headaches
with acute onset of hemiparesis on December 10, 1924.

A consulted physician had diagnosed the condition as
brain hemorrhage and recommended complete bed rest.
Magnus suspected "the presence of a brain tumor in
the supramarginal gyrus with an adjacent bleeding caus-
ing the acute exacerbation." Since the patient did not
show any hemianopsia he considered the suspected
growth to be located superficially. He therefore operated
on the patient with an osteoplastic flap, according to
Wagner, over the left parietal region. To his surprise he
found a subdural clot over the whole brain convexity.
Following removal of the hematoma and rinsing with
saline of the subdural cavity he replaced the bone flap,
and the hemiparesis and aphasia cleared completely in
a week. The papilledema remained, however, and visual
acuity in the left eye deteriorated. Magnus therefore
operated on his patient again 1 month later but found
no signs of remaining hematoma. The patient finally
recovered completely apart from left amaurosis due to
left optic nerve atrophy.

Magnus discussed the possible reasons for the long-
standing optic nerve process despite the normaliza-
tion by surgery of the increased intracranial pressure and
the difficulties in arriving at a correct diagnosis. He
related that only after his discharge did the patient admit that he had sustained a head injury 11 weeks prior to his deterioration: he had been hit on the head by a drunken man who had become angry because he had not lent him his car. Magnus thoughtfully noted that this important information would have simplified matters if known earlier. He also commented that cerebrovascular fragility due to alcoholism should probably be taken into account when considering the etiology of the subdural hematoma in this case. He ended his paper with a philosophical comment on the probable misuse of diagnoses such as traumatic neurosis and simulatio cerebri in patients who in fact might suffer from late effects of head injury in the form of subdural clots “which must be properly diagnosed and surgically treated for the best of the patient.”

On the Etiology of Multiple Sclerosis

In 1921 Magnus addressed the Norwegian Society of Medicine on the etiology of multiple sclerosis (MS). This was at a time when it was commonly believed that this disease might be associated with a luetic infection. Magnus had injected guinea pigs intraperitoneally with blood from MS patients and subsequently investigated blood and tissue samples from the experimental animals. His conclusion on the experiments was: “All my experiments have turned out to be completely negative despite my access to 23 MS patients with experiments in 42 guinea-pigs and seven rabbits. None of the animals have developed neurological signs. . . . Following these experiments I must express my scepticism to the proposal that guinea-pigs may become paralytic after injection of blood from patients suffering from disseminated sclerosis.”

On Miscellaneous Subjects

During his stay in Frankfurt am Main in 1900, Magnus wrote a paper on the etiology of beriberi stressing the importance of polished rice as a possible causative agent. In 1906 he described a case of acute myelitis and in the following year a case of syringomyelia. He also dealt with many diverse subjects such as improving manuals for disinfection of the hands prior to surgery, hospital bookkeeping and medical records, and analgesia for sciatic pain.

In 1916 he described two cases of Huntington’s chorea and the neurological deficits in herpes zoster. In the same year he published the first case reports in Norway of the typical syndrome caused by occlusion of the posterior inferior cerebellar artery, previously described by Wernicke, Wallenberg, Spiller, Hun, and others. His discussion in this study bears witness to his exact knowledge of the vascular supply to the brain stem and the complex neuroanatomy of this fundamental part of the brain.

In 1921 Magnus lectured to the Norwegian Society on genetic research. While working with ovarian transplantation he had become interested in albinism.

Studying the available international literature on the subject, he had found that heredity of albinism in humans had not gained much attention. He therefore send a letter of inquiry to every practicing physician in Norway (approximately 500) for identification of albinotic individuals, and had thus been able to identify 122 albinos in a total population of more than one million humans. He had then proceeded to successfully delineate the relationships in 50 families with 108 albinos. He suggested that albinism is a non-dominant attribute which may suddenly appear after a latent period of several generations. Magnus concluded that “All the collected data are published in Pearson’s work ‘Albinism in man’ and future genetic scientists in Norway may here find material which they can use as a basis for continuing research.”

Magnus also lectured on cerebrospinal fluid findings in patients with extramedullary spinal tumors. He considered such cases especially rewarding from a surgical viewpoint. He had successfully removed a ventrally located endothelioma and emphasized the complete absence of sensory symptoms prior to diagnosis in this case in contrast to a case of neurinoma which he had removed a decade earlier with a most favorable outcome. Magnus also presented his general outlines for when and how lumbar puncture should be performed, and described the risk of coning in patients in whom increased intracranial pressure could be anticipated; he especially warned against lumbar puncture in cases of posterior fossa tumors. In 1922 Magnus published a review of neurosyphilis and in the following year he discussed the clinical importance of Wassermann’s test. He also expressed opinions concerning birth control and abortions.

Apart from weekends at his recreation house outside Oslo (Fig. 5) where he also performed animal experiments, Magnus took 1 week off every year to go salmon fishing in Korgen in northern Norway (Fig. 6).

Comments Following Horsley’s Premature Death

In an obituary published after Sir Victor Horsley’s premature death in Mesopotamia in 1916, Magnus concluded:

“Undoubtedly Sir Victor Alexander Horsley — the creator of neurosurgery — became considered as one of the great leaders of British medicine, although his literary production in terms of the number of pages was not that impressive. But in England people judge by other criteria than the mere number of published pages.

“Already as a very young doctor he became a pioneer in everything he undertook. At age 27 he was the first to show that the thyroid gland has an internal secretion and he proposed that myxedema patients should be treated with thyroid gland transplants. Two years later he gained a world reputation after a successful removal of a cerebral tumor and in the following year he removed a spinal tumor.

“Rarely before had a surgeon been so well qualified to perform revolutionary surgery as Horsley. For 6–8 years he had almost exclusively devoted his time to experimental work in the physiology of the nervous system as a superintendent.
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FIG. 5. Magnus with his youngest daughter Synnøve outside his recreation house in 1922.

of the Brown Institute. One senses his enormous working capacity by learning that during the years 1884 to 1890 he simultaneously was superintendent of the Brown Institute, manager of the laboratory of pathology at University College, surgeon at University College, and surgeon at the National Hospital for the Paralysed and Epileptic, in all these places performing original work under the simplest imaginable conditions.

“...At the National Hospital he had to perform brain-tumor surgery in a small corner of a ward only demarcated by moveable screens, and later in an auditorium not equipped for surgical use. It was only during his final years that he was given a modest operating theatre. His technical skill as a neurosurgeon was phenomenal and may be exemplified by the fact that so far no one else had succeeded in the extirpation of pituitary tumors via the temporal approach. Horsley had performed this operation in 10 patients without mortality several years before any other surgeon even thought of surgery for such lesions. In his small miserable cave of a laboratory at University College — dirty, cramped, and very poorly equipped — Horsley was in his right element. There he regularly performed experiments on certain afternoons regardless of the amount of clinical practice.

“His immense diligence resulted in a universal knowledge of experimental physiology, neurology, anatomy, pathology, surgery, archeology, history, and politics. He stood head and shoulders above all the other consultants and for that reason was called the consultant of consultants. Horsley was one of those giants who materialize at long intervals. Courageous, chivalrous, and without concern about his own person, glowing with the holy fire of indignation when detecting something he considered wrong, he hit as hard as was to be expected from a man as strong as him. This was sometimes interpreted as belligerence and intolerance, although it was really a manifestation only of a most straightforward and self-sacrificing character.

FIG. 6. Vilhelm Magnus with his salmon catch in northern Norway.
“His sense of justice and admiration for the good and right made him a born reformer and he consequently immediately volunteered for war service in the ill-fated Mesopotamian campaign when he learnt of the miserable conditions there. “It may be claimed that it was a great pity that Horsley did not publish his neurosurgical results in a monograph. He often mentioned it himself — with a humorous glint in his penetrating gray eyes. However, his interests were so manifold and his working time so extremely occupied that it would have been a waste of his time.”

Overall Results of Brain-Tumor Surgery

In June, 1925, Magnus presented his overall results of brain-tumor surgery at the annual meeting of the Scandinavian Surgical Association in Copenhagen.28 He had by then operated on 189 patients with brain tumors, the surgical mortality rate being 7.7% for supratentorial tumors and 17.8% for posterior fossa tumors. Of the 60 patients on whom he had operated for trigeminal neuralgia, only one had died. During the discussion after the lecture in Copenhagen, Magnus was congratulated on his brilliant achievements by his Swedish colleague Herbert Olivercrona, 20 years his junior. At that time, the latter’s own experience included about 50 supratentorial tumors, but the operative results had not yet been followed up. Olivercrona stated that he had up to that time operated on 18 posterior fossa tumors, with five deaths resulting. In the program of the Copenhagen congress, Vilhelm Magnus summarizes his “Experiences from 20 years of brain surgery.”28

“Brain surgery, in particular the operative treatment of tumors cerebri, is one of the problem children of surgery, these operations being counted among the most hopeless undertakings of a surgeon and the mortality being horrific. Fedor Krause, for example, has a mortality of 50%, Küttner 45%, and von Eiselsberg 40%. For operations such as extirpation of acoustic nerve tumors the mortality is over 80%. These poor results underlie the pessimistic persuasion that the extirpation of a brain tumor should not be attempted — that palliative trephination is the utmost that can be performed. Horsley’s own experience in- made him a born reformer and he consequently immediately been a waste of his time.”

Pioneer Aneurysm Surgeon

On the initiative of the neurologist Fuller Albright1 in Baltimore, Walter Dandy in 1928 ligated the carotid artery in a patient suffering from an aneurysm exerting pressure on the oculomotor nerve.2 The value of Dandy’s pioneering effort is in no way diminished by the fact that his patient died after surgery or that Vilhelm Magnus had already in the previous year succeeded in ligating the internal carotid artery in a 69-year-old man suffering from intractable trigeminal neuralgia. Magnus suspected that his patient was suffering from a slowly growing brain tumor exerting pressure on the gasserian ganglion. As the patient’s condition was unbearable, Magnus performed an operation to decompress the trigeminal nerve root. As the dura mater was detached from the base of the cranium, Magnus “came on a tumor about the size of a chestnut with a smooth surface and glistening like mother of pearl, strictly limited and situated on the surface of the Gasserian ganglion.”14 During his further attempts at detaching the dura from the surface of the tumor, a hole was torn and the contents of the “tumor” poured out. About half of the content was emptied when there was “a great gush of blood, that could not be stopped by tamponade.” Now Magnus ligated the internal carotid artery, and the bleeding stopped. Afterward the trigeminal nerve root was removed. He reported this case in May, 1927,14 noting that “the patient stood the operation very well and declared that he could not have been given a better birthday gift, as he had completed his sixty-ninth year on the day of surgery.” The very fact that the operative procedure could be achieved at all under the circumstances, and with the instrumentarium of the time speaks for the superb surgical virtuosity of Vilhelm Magnus.

Vilhelm Magnus and Harvey Cushing

A year before his death, Vilhelm Magnus accompanied a young woman with a large pituitary tumor to Boston (Fig. 7) for consultation with Dr. Cushing, who operated on the patient. Afterward Magnus commented that he used the same surgical techniques as Cushing did. Unfortunately, the tumor recurred but the patient lived for another 25 years. Magnus took the opportunity to stay and paid a 5-week visit to Cushing’s by then world-famous clinic at the Peter Bent Brigham Hospital. In a typewritten report, Magnus gave his “Impressions of American neurosurgery”21-44.

“American surgeons like Cushing, Dandy, Frazier, and Adson have during the last 10-15 years specialized in this branch of surgery and brought surgery of the nervous system to the level where it stands today. My visit is limited to 5 weeks at the Peter Bent Brigham Hospital in Boston. I consider it more worth while to stay just at one place for a little longer than to fritter away 1 or 2 days at each of several hospitals: one cannot study in depth on such a tour, cannot grow familiar with all those small technical refinements which are the distinguishing marks of any particular school. At present, Cushing is the undisputed leader in surgery of the nervous system,
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because he more than any other has developed a school, gathering about him pupils whom he sets to work. From him and his pupils there come a quantity of publications every year. He himself is eager to hear the latest findings, continually testing new methods of both examination and operation. Thus in his department, over the past 2 years or so, use has been made of a technique with diathermy scalpels, this being a great advance for the extirpation of endotheliomas, the bloodiest of all these operations. Diathermy has been employed twice or more for the successful extirpation of endotheliomas which, with an ordinary technique, would have been hazardous due to the profuse bleeding from the diploe and dura mater. This device was said to be the only one that had been made outside the laboratory, but one that would soon be on the market — doubtless at a price to make us Europeans faint.

“The Peter Bent Brigham Hospital is disorderly and in part unhygienic, because there is not the same washing and scrubbing as we are used to in our hospitals, brooms being used first on all the floors before they are swabbed, probably because they are afraid that the thick linoleum — battleship linoleum — which has been used will rot if it is washed too much. There are employed nurses without number, with their helpers and helpers’ helpers in the form of lady typists and stenographers, secretaries, and undersecretaries, keepers of the lists, and more. One must not suppose this to be some manifestation of the so-called speed and efficiency of America. On the contrary, these storied faculties, said to be part and parcel of America, were something of which I saw little or nothing at the Peter Bent Brigham Hospital. Never have I seen a hospital where there was such a dalliance with time and so much flirtation between nurses and doctors. Operations posted and scheduled to begin at nine were not under way before 10:30. The pace was leisurely in the extreme — not merely in the brain operations, which always must proceed with circumspection and deliberation, but also in general surgery such as appendectomies. . . . The operations rendered an impression of great cleanliness. If a bloody swab fell on the floor, it was plucked up on the instant — clearly, the staff were highly anxious to preserve the immaculate condition of their white tiled floor!

“The extirpation of brain tumors proceeded with the greatest caution, and with the use of a number of small technical tricks. Cushing was full of expedients for arresting bleeding: it was a pleasure to see how free from blood his operations were, and the care he took to stem even the slightest hemorrhage. He said that he considered operations for tumors of the acoustic nerve to be the most exacting ones he knew, and he had harsh judgment to pronounce on those surgeons who without the requisite experience undertook these operations, which in the hands of an inexperienced surgeon were desperate remedies indeed. He was also sharp in his condemnation of those surgeons who set about brain operations after only having witnessed one or two of them before. I have never known a surgeon who took such pains with every single patient as Cushing did. The mainspring of his work was his boundless anxiety about his statistics — that the mortality should not exceed 10%.”

In 1969 the Moseley Professor of Surgery at the Harvard Medical School spoke of his predecessor in that chair, Harvey Cushing:84

“Like a central mountain peak that appears to rise higher and higher above the surrounding foothills as the whole mountain range recedes in the distance, so Cushing’s unique stature not only stands the test of time but rises higher with each passing decade. Many have said that he opened up a new field of therapy almost singlehandedly. In addition, he was valid and literate in several other fields of biologic study, had a remarkable impact on people, became the friend of Presidents, artists, and scientists in the international set of the day, became a public figure and noted author, America’s most renowned surgeon, and profoundly influenced the public’s image and understanding of surgery in America.”

Like Harvey Cushing, Vilhelm Magnus was a tremendous worker whose greatness came from an accumulation of advances based on meticulous operative techniques, an inquiring mind, and a terrifying diligence. Magnus, however, was a lone wolf and, in contrast to Cushing, he did not create an international image of the great surgeon he was and, in conformity with William Macewen, he did not develop a succeeding school. Working with endless exactitude and finesse, Cushing was a notoriously slow operator, who claimed that fast surgery was poor surgery. In the hospitals at the front during the Great War this even became a major area of contention between Colonel Cushing and his surgical colleagues. Magnus was both a meticulous and a fast surgeon, who was not very impressed by Cushing’s tempo.84 In contrast to the great American, Magnus performed all his operations under extraordinary primitive conditions at small private hospitals and without the aid of a single trained assistant until the last years, when he received help from a colleague by the name of Knudzon (Fig. 8). The reason that his unprecedented results have not gained international recognition is most probably due to the fact that, with the exception of two articles,14,71 Magnus’ total contribution was published in Norwegian.13,15,70,72–82 The most remarkable fact is that Magnus held no post at the University. After his service as Fellow in Neurology at the University from 1907 to 1909 he only applied for a University position on one occasion. This was in 1921 when the professorial chair in neurology was named after his first teacher Professor Leegaard. However, Magnus withdrew his application...
before a nomination had been discussed by the medical faculty, and later did not apply for any other academic position.

After his visit to Boston, Magnus declared "It may be concluded that the Americans do not have much of an academic tradition. This of course has both disadvantages and advantages. To the latter may be assigned the fact that the Americans establish a professorship if they consider that they have the suitable man for it, whilst in our University the maintenance of a professorial chair is considered most important irrespective of whether there exists a suitable man for it."

Vilhelm Magnus' Legacy

Magnus had prepared two abstracts, one on frontal lobe tumors and one on his results of operation for trigeminal neuralgia, for presentation at the annual meeting of the Scandinavian Surgical Society in Oslo. However, 2 days before his presentations, he suffered an acute fatal myocardial infarction during the Society's dinner at the Grand Hotel on June 27, 1929. Magnus' death created a vacuum in Norwegian neurosurgery that was partially filled by the professor of general surgery, Ragnvald Ingebrigtsen (1882-1975) until Arne Torkildsen (1899-1968), the father of ventriculocisternostomy, returned to Oslo in 1935 after 4 years of neurosurgical training in Montreal with one of Vilhelm Magnus' admirers, Wilder Penfield. Interestingly, Cushing unintentionally and indirectly gave credit to Vilhelm Magnus in a letter to Professor Einar Key in Stockholm dated July 6, 1928: "I have just had a most enthusiastic letter from my young pupil, Harley Newton, after his visit in Stockholm. . . . He is most enthusiastic about everything he saw, and says that the clinical work in Norway and Sweden is the best he has seen anywhere."

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References

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J. Neurosurg. / Volume 73 / September, 1990


67. Magnus V: 100 tilfælde av radikalt opererte trigeminusneuralgi. Norsk Mag f Lægevidensk 90:1215–1221, 1929
69. Magnus V: To tilfælde af amaurotisk idioti. Norsk Mag f Lægevidensk 73:1598–1603, 1912
70. Magnus V: To tilfælde af Huntington’s chorea. Norsk Mag f Lægevidensk 77:1433–1437, 1916
73. Magnus V: Tre tilfælde af herpes zoster efterfulgte af motoriske forstyrrelser. Norsk Mag f Lægevidensk 64: 877–888, 1903
75. Magnus V: Tumor cerebri med Røntgenfund. Norsk Mag f Lægevidensk 82:797, 1921

77. Magnus V: Tumor i foramen intervertebrale. Norsk Mag f Lægevidensk 89:136–140, 1928
78. Magnus V: Tyreoidektomi hos gjerder og sauer og om behandlingen af morbus Basedowi. Tidsskr Nor Lægeforen 27:373–374, 1907

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