

A HISTORY OF OPHTHALMOLOGY IN JAPAN

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Prehistory

It is estimated that human habitation of the Japanese archipelago began around the time of the Third Glacial Age. In recent years there has been a succession of discoveries of various types of paleolithic chipped stone implements, but so far no excavation has turned up a complete human skeleton. One assumes that human beings were present, that they suffered from disease and that these diseases included those of the eyes. However, at present there exists not a single shred of evidence as to how the latter were dealt with.

Most scholars agree that ceramic culture in Japan originated between seven and eight thousand years before the Christian Era. Discoveries of the Jomon pottery of that period have been accompanied by skillfully executed bone and horn implements, as well as a multiplicity of stone artifacts. The inhabitants of that time, subsisting by hunting with bow and flint-tipped arrows, had learned to preserve and

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cook foodstuffs in pottery vessels, thus attaining a maximum of productivity within the restraints of the islands' natural conditions and a foraging economy.

The social groups that arose were under the dominance of a shamanistic religion. We have attestations of this period in bone and dental remains indicating the customary manner of dental extraction. The interpretation placed on these is that the members of the group were subjected to ritual dental extraction upon attaining maturity in order to reinforce group solidarity.

From the human figures excavated together with Jomon pottery, it is possible to hypothesize as to the extent of awareness that existed with regard to the various parts of the body. Of particular interest to the ophthalmological historian are the archeological figurines regarded as wearing „devices designed to cut down on glare^{1, 2, 3}“ (Figure 1). In these figurines a large portion of the face is taken up by the eyes and the other features are eliminated. These have been found only in the northeastern part of the Japanese islands, but the same type has been unearthed in the coastal areas of Okhotsk and it is thought that the eyes were very important in the cult of certain tribes there. This would account for the exaggerated, disproportionate form of the eyes⁴.

Antiquity

The appearance of the ancient state of Japan occurred relatively late, toward the Third Century of the Christian Era. However, Chinese sources record the formation of numerous social groups before that time. In the First Century more than a hundred „countries“ existed in Western Japan⁵ and in the Second Century there was a great deal of warring among these tribes. By the Third Century, these hundred „countries“ had been merged into only thirty or so^{6, 7}. Among them, the strongest was the Yamatai nation, ruled by Queen Himiko, which possessed all the attributes of a nation-state⁸.

The queen herself was a shamanistic ruler in the service of spirit worship, and this state was founded under a religion of spells and incantations. It is therefore difficult to presume that medicine made any great strides as compared with the prehistoric era. Nonetheless, the fact remains that ties had begun with China, by far the most advanced nation of the time, and there is the possibility that medicines and simple treatment techniques were imported from there. These must have been limited both quantitatively and qualitatively, and probably the majority of the inhabitants of Japan derived no benefit from them.

In the Fourth Century, the Yamato sovereignty had established itself in the Kinai area (the central part of Japan) and had mounted military expeditions to subjugate southern Korea⁹. As a result, there was a heavy influx of culture from the continent into Japan. A large role was played by the compulsory removal to Japan



Figure 1. An archeological figurine as wearing „devices designed to cut down on glare”.

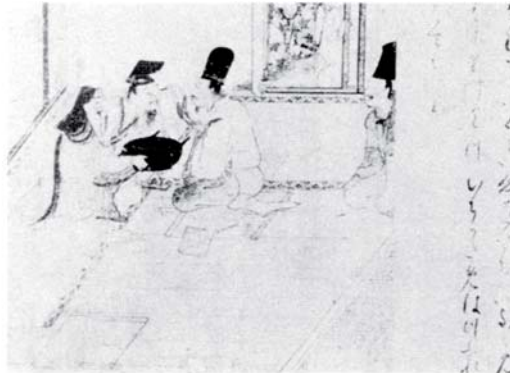


Figure 4. A scene of eye operation in the „Yamaino-soshi” (a scroll picture of diseases).

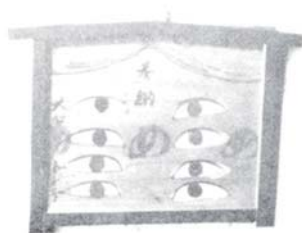


Figure 3. A votive picture „ema”

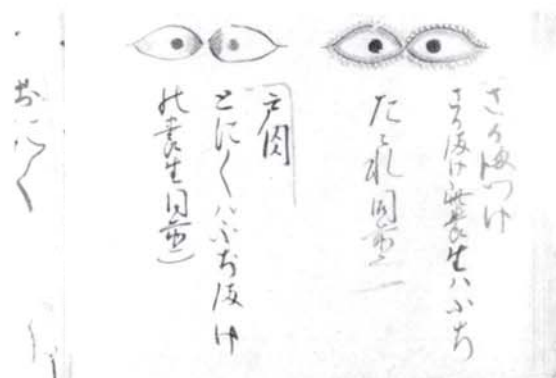


Figure 5. Colored illustrations of eye diseases in the „Gan-moku-isho” (a text of ophthalmology).

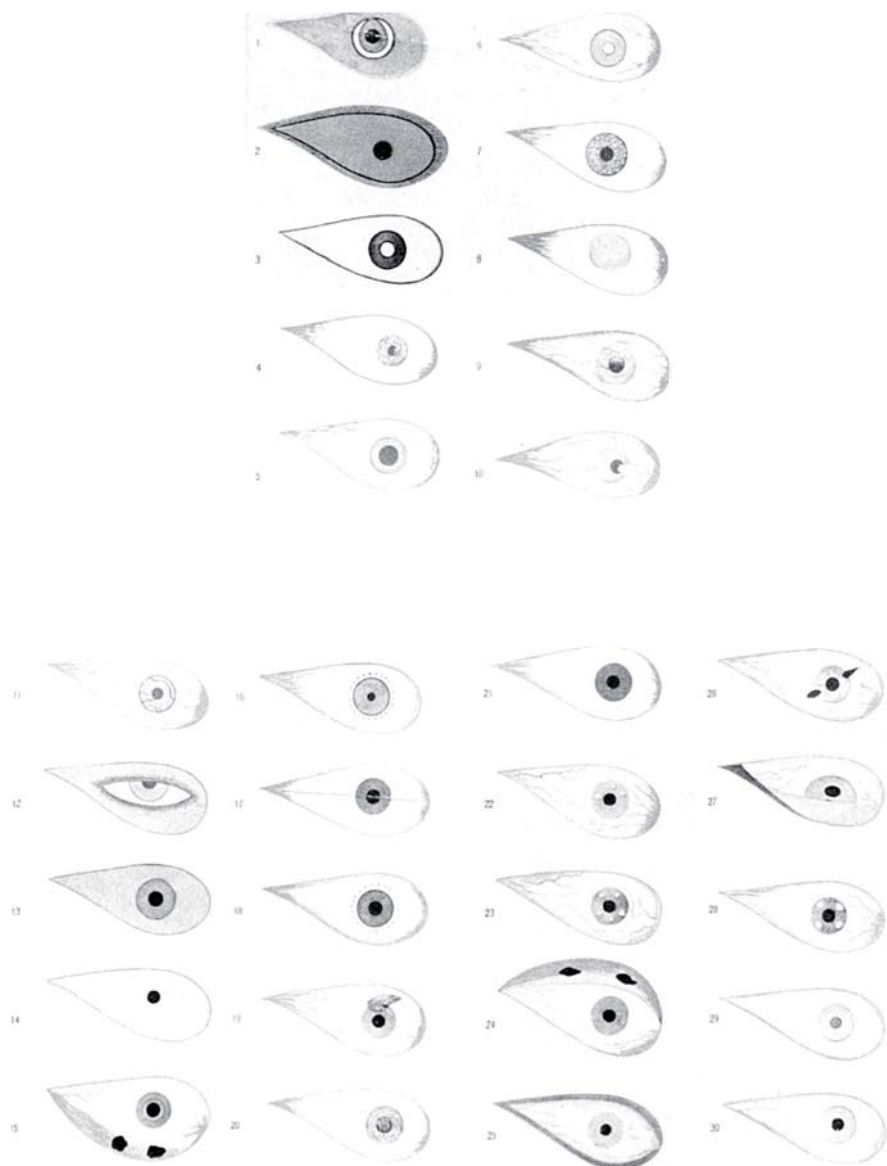


Figure 6.

1. arcus senilis 2. acute conjunctivitis 3. cataracta 4. iritis 5. glaucoma 6. cataracta 7. iritis?
 8. corneal opacity 9. pannus 10. pterygium 11. pannus 12. ptosis 13. *uwakemake* 14. pan-
 nus 15. hordeolum 16. ? 17. *tsurimake* 18. *hahimake* 19. *uwamake* 20. traumatic keratitis
 21. *mizumake* 22. parenchymatous keratitis 23. keratitis 24. hordeolum 25. conjunctivitis
 26. ? 27. ? 28. parenchymatous keratitis 29. icteric sclera 30. *tensei*.

of artisans and craftsmen from among the subjugated peoples. Scholars still disagree on the relationship of the Yamato kingdom and the Yamatai state, some maintaining they are identical, others that they are unconnected. The powerful Yamato kingdom sought to unify Japan and set about to conquer the eastern provinces. This was accomplished at the end of the Fifth Century when the Japanese islands came under unified rule, and remain so to this day.

In addition to the craftsmen from southern Korea forcibly brought to Japan, there were also those who felt themselves bound by the restrictive system at home; officials, for example, who wanted to make better use of their abilities and who came voluntarily to Japan to work as they pleased¹⁰. They became naturalized in Japan and helped to transplant Chinese culture to the islands, building an administrative system based on that of China.

Buddhism arrived in Japan at the end of the Sixth Century. With the advent of Buddhist images, the faith propagated itself rapidly. Its spread is thought to be due to the permission granted to naturalized foreigners to practice the Buddhist faith they had adhered to in their own countries¹¹. Regardless of the details, the flourishing of Buddhism in Japan led to the frequent recourse of the people to the bonzes for medical treatment.

In advanced China there already existed a systematic science of medicine and many excellent medical texts had been compiled. These texts were brought to Japan by the naturalized foreigners and missions from China¹². There is even a record that a physician has summoned from southern Korea to treat an Imperial ailment¹³.

It was thus that Chinese medicine, transplanted to Japan and undergoing a number of transformations, made up the essence of Japanese medicine until the Meiji Restoration. As a consequence, the ophthalmological history of Japan cannot be understood without reference to ophthalmology in China. Let us, therefore, briefly turn our attention to Chinese medicine.

Ophthalmology in China

The three great classics of Chinese medicine are the „Huang Ti Nei Ching¹” (the Yellow Emperor’s Classic of Internal Medicine), „Shen Nung Pen Tsao Ching²” (Herbs as studied by Shen Nung) and „Shang Han Lun³” (On Typhoid). According to the first of these, the eyes reveal the status of spirits of the Five Viscera (kidneys, liver, heart, lungs and spleen) and the Six Entrails (stomach, gallbladder, large intestine, small intestine, bladder and three burning spaces) when the balance of *Yin* and *Yang*⁴ is disturbed. In other words, any malfunction of the internal organs is revealed through the eyes. The liver was thought to be particularly closely related to the eyes. A disorder of the spirit of the liver, thus, would reveal itself in

the form of *muscae volitantes*. Each of the five organs is supposed to communicate with some other organ near the surface of the body, according to the doctrine of the Five Elements. Thus the heart communicates with the tongue; the liver with the eyes; the spleen with the mouth; the lungs with the nose; and the kidney with the ears. Eye symptoms were attacked, first of all, by treating the liver. Occasionally medication would be administered to adjust the liver function in order to treat eye disease. The belief in the connection between the eyes and the five viscera and six entrails, especially the relation between the eyes and the liver, was to persist long afterwards.

In the mystical school stemming from Taoism, spells were used to treat eye diseases. A book containing many of these incantations was the „*Pei Chi Ch'ien Chi Yao Fang*”⁵ of Sun Szemiao⁶, which appeared in thirty volumes toward the middle of the Seventh Century. According to this book, the eyes are the messengers of the mind and the mind is the dwelling place of the spirit, thus the eyes acutely reflect the state of mind. There are also sixteen ways given to protect and improve eyesight. Reading at night is prohibited, as is eye-fatiguing detailed work over long periods. This „*Ch'ien Chin Yao Fang*” was read in Japan until the Edo Period and the ocular regimes and incantations in it enjoyed wide circulation among the common people.

Medical treatments using pharmaceuticals, acupuncture, moxibustion and incantations were well developed in ancient China. Since the philosophy of diseases was based on imbalances in the *Yin* and *Yang* and the relation between the five elements and the five viscera, even external diseases were explained in these terms. Therefore, pharmaceutical treatment dominated medicine at the expense of surgical treatment, and the development of the latter field was severely retarded. In India, though, surgical techniques had been well developed since before the Christian Era. From early times lens-dropping surgery was performed for cataracts, and treatments by cauterization, sectioning, scarification, lancing and crushing were daily affairs¹⁴. At some point these techniques made their way from India to China. One book typical of those describing Indian medical treatment was „*Nāgārjuna Bodhisattva's Ophthalmological Treatment*”⁷. Nāgārjuna was a Brahman from Vidarbha in southern India, whose life spanned the Second and Third Centuries. He possessed an abundance of medical knowledge and a number of medical books attributed to him made their way to China. He was particularly concerned with the treatment of eye diseases and his influence was considerable in the later development of Chinese ophthalmology¹⁵. His name lives on as an ophthalmologist for later generations of physicians.

Specialized texts on ophthalmology had already appeared in China in the Tang Dynasty (618 - 907), but the ones that remained for later generations were largely those of the Sung (1115 - 1260) and Yüan (1280 - 1368) Dynasties. The

exact date of their compilation is not known but those that exerted an influence in Japan include „Yín Hǎi Chīng Wèi”,⁸ „Yǎn Kē Quán Shū”,⁹ „Xuán Jī Gǐ Wèi”,¹⁰ „Shēn Shì Yáo Hǎn”,¹¹ and so on. All were published during the Edo (1603 - 1867) Period and were widely read in Japan.

In these books China's peculiar theory of the Five Rings and Eight Enclosures appears¹². This was a combination of the Indian view that the eyelids, eyelashes, conjunctiva and pupil are concentric circles and the ancient Chinese natural philosophy of *Yin* and *Yang* and the Five Elements. In the Five Rings theory the external eye is divided into a Flesh Ring (eyelid), Blood Ring (inner and outer corners of the eyes), Air Ring (conjunctiva), Wind Ring (iris) and Water Ring (pupil). To each of the Five Rings there corresponds one of the Five Viscera and one of the Five Elements (Table 1).

On the other hand, the Five Viscera and the Six Entrails were related to the eye by way of the theory of Eight Enclosures¹³ originating in the divination described in the „Book of Changes”. In other words, the eye is divided into eight parts (Figure 2) and each of them corresponds to the viscera.

This theory of Five Rings and Eight Enclosures is thought to have arisen in the Sung and Yuan dynasties, when a succession of pathological theories were put forth under the influence of Confucianism on Chinese medicine. Until that time treatment of disease was exceedingly complicated, the pathology of the eye being explained in terms of the liver, each portion of the eye linked to various organs in a complex theory of the balance of *Yin* and *Yang*. For instance, disorders of the cornea were attributed to disharmony of these positive and negative forces in the spleen; imbalances in the kidneys produced afflictions of the pupil. The causes of eye disease were explained in accordance with a theory of the proper balances among the Five Elements (Table 3). Thus, metal gives way to water, so that when the kidneys are ascendant, the lungs will decline. When the lungs decline, this will be revealed in the conjunctiva of the eye.

As seen from the above, the Chinese theory of ophthalmology was vastly complex. And to make matters worse, the number of diseases recognized ranged from 72 to 108.

Table 1. Theory of Five Rings

Flesh Ring	—	Spleen	—	Earth
Blood Ring	—	Heart	—	Fire
Air Ring	—	Lungs	—	Metal
Wind Ring	—	Liver	—	Wood
Water Ring	—	Kidney	—	Water

Table 2. Theory of Eight Enclosures

Heaven	—	Large intestine	—	Ch'ien*	—	Northwest
Earth	—	Spleen, Stomach	—	K'un	—	Southwest
Fire	—	Right Kidney	—	Li	—	South
Water	—	Left Kidney	—	K'an	—	North
Wind	—	Liver	—	Hsun	—	Southeast
Thunder	—	Small intestine	—	Shen	—	East
Mountain	—	Gallbladder	—	Ken	—	Northeast
Marsh	—	Bladder	—	Tui	—	West

*) Chinese names for trigrams in „Book of Changes”

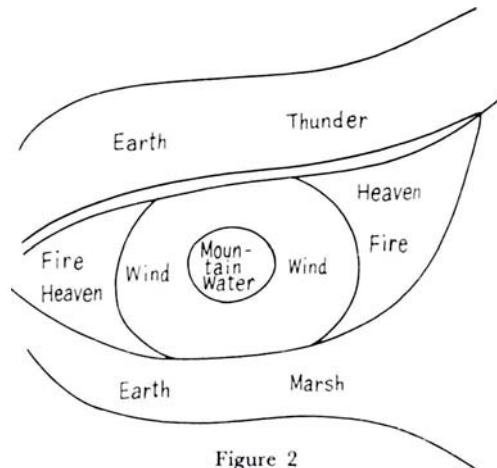
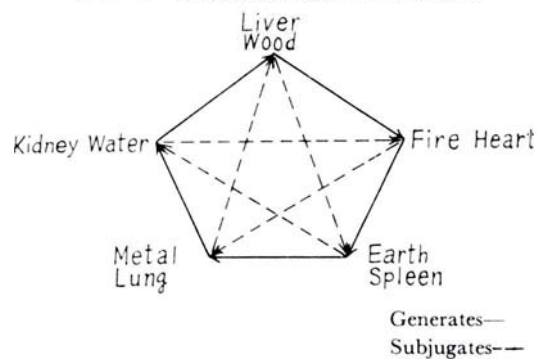


Figure 2

Table 3. Relations of the Five Elements



Ophthalmology in Japan

There must have existed in Japan a native system of treatment and theory of disease before the influx of Chinese culture. However, much of what was unique to the Yamato culture was gradually extinguished with the advent of medical and Buddhist learning from China, by far the more advanced country at that time.

With the enactment of the Taiho Code in 701, the law on medical treatment specified that all treatment of the Court and other officials would be provided by those schooled in Chinese medicine. At the same time a system of medical education was prescribed. „Ophthalmology” was a four-year program of training covering the ears, mouth and teeth, as well as the eyes. This law was based on T'ang law, so it is in doubt as to what extent it was actually followed. The system of court physicians installed at this time, while undergoing a number of alterations, persisted until the Nineteenth Century.

The Ninth Century saw the transfer of the capital from Nara to Kyoto and the flourishing of Japanese culture. The assimilation of Chinese culture into Japanese patterns and the birth of a distinct Japanese culture occurred during this period. One of the most symbolic features of this trend was the evolution of *kana*, syllabic Japanese characters.

However, in the field of medicine, the Japanese had not yet reached the stage of applying Chinese medicine freely. Physicians studied Chinese medical texts assiduously, and in 984 the court physician Yasuyori Tanba¹⁴ compiled a medical text in thirty volumes, „Ishinpo¹⁵”, based on more than one hundred Chinese references. The descriptions of disease classifications, pathology, symptoms and treatments were uniformly patterned on the Chinese medical texts, and the content was merely a collection of appropriate quotations from the Chinese medical literature¹⁶. Nevertheless, the sources of these quotes were spelled out and Tanba's work serves as a valuable indication of the state of contemporary Chinese medicine.

The majority of the medical texts quoted have since been lost, and his book thus serves as a valuable source for the entire world. The fifth volume of „Ishinpo” contains information on ophthalmology. Eighteen varieties of ocular disease, including cataract, are described, but the approach to pathology is so old that the theory of Five Rings and Eight Enclosures does not appear.

Treatment seems to revolve around the use of internal medicine, with frequent allusions also to eyewashes, collyria and incantations. There are additional indications of simple surgical procedures as well, but no description sufficient to permit them to be carried out in practice. One may judge then that surgery was not practiced at the time. All apparent references to surgery are quotes from „ophthalmological theory” (Ganron)¹⁶ and this book is thought to refer to „Nāgārjuna Bodhisattva's Ophthalmological Treatise¹⁷.”

Particularly interesting among the prescriptions for internal medicines is the use of carp gallbladders for symptoms of night blindness. It shows it was already known by experience that a gallbladder was a good kind of medicine for night blindness. For a number of eye maladies it is recommended that plantain¹⁸ (*Plantag asiatica* L.) be used. In the diaries of the nobility of the Fourteenth Century one often finds reference to the use of infusions of plantain for eye ailments.

To find out the extent to which this medical knowledge was applied at the time, one may consult the diaries of the nobles, who were closest to the court physicians. One finds that confidence in these practitioners was low. In the world of those days, diseases were regarded as curses of evil spirits. Eye diseases were no exception. Afflicted by a disease, one first summoned a bonze to pray to the Buddha and then went for a doctor. Otherwise, one first summoned a Taoist faith-curer to sive the presence of the spirits, after which they were propitiated with prayers, offerings or changes of residence. On occasion, the methods resorted to for dispelling these demons were such that they only could have aggravated the affliction in our modern view¹⁷. When these measures failed, further treatment was left to the physicians. The latter were rewarded or punished in accordance with the results¹⁸, so it was a rare soul who ventured much in the way of new treatment techniques. Moreover, medical practice that still believed in courses of gods or spirits was far from effective.

It was in this context that the Bêchadjaguru Buddha¹⁹, Physician of Souls, became an object of faith in connection with healing. Thus, the Bêchadjaguru (the Buddha of Healing) was believed to be the head of the Paradise of Buddhism, relieving the people's afflictions and healing unknown chronic diseases. This belief remained firmly entrenched in the minds of the common people until the Edo Period. They sought to cure eye diseases by offering votive pictures (*ema*)²⁰ after praying to the Buddha of Healing. These votive pictures (Figure 3) came to be almost fixtures in temples devoted to this Buddha. Even today they may be seen occasionally¹⁹.

It would be wrong to assume that medical treatment around the Tenth Century was entirely of the nature described above. Talented physicians attracted patients. Chinese people who had fled to Japan to escape the turmoil in China or who visited Japan as members of trading missions often included some who were versed in medicine. Such persons were highly respected. It is recorded that when Michitaka Fujiwara (953 - 995), the scholar and court official, was going blind, he heard that such a Chinese ophthalmologist was in Kyushu, and requested to be transferred to the office of Kyushu²⁰. At the end of the Edo Period after Japan had been opened to the West, Western physicians of no particularly outstanding accomplishment arrived in Japan and were accorded great trust by the Japanese, something one sees even nowadays.

The proliferation of physicians other than court physicians is reputed to have taken place in the Fourteenth and Fifteenth Centuries. During the continual warfare of the period, experience in tending those wounded on the battlefield produced physicians. Some monks returning from China had learned medicine and practiced as priest-physicians. Around this time, when the priest of Koya-san²¹ were wandering around the country, medicinal herbs and medicines made from them, produced in southern Kishu and sold by the priests, became popular. A system of itinerant peddling is said to have originated in this practice, although most of the peddlers selling „medicines” were charlatans. Among the peddlers was one known as „me-wo tsukuro kusushi²²” or „Dr. Sight-Giver”, who was the first Japanese ophthalmologist²¹. He was probably somebody who had learned from Chinese physicians how to treat cataracts by needles (Figure 4).

Medieval Ophthalmology

The Five Ring and Eight Enclosure theory first appears in Japanese medical texts in the Fifteenth Century. This was in the „Fukuden-hō”²³, the biggest and most famous medical book of the period. Ophthalmological diseases are dealt with in the tenth volume. The Five Ring theory is presented, with a quote from Nāgārjuna, and 72 varieties of disease are described, all of which the physician is to have mastered. Until that time, Japanese texts had recognized no more than about twenty eye diseases, but with the introduction of complex Chinese medicine, Japanese ophthalmology became much more complicated.

Surgical treatments had not yet been incorporated in the books, however.

Nevertheless, surgery as an arcane science was taught clandestinely, and was the hallmark of Japanese ophthalmological specialists throughout the Edo Period. Characteristic of this aspect of medicine was the Majima school²⁴ of ophthalmology.

*The Majima School*²²

The tradition is that one day in the middle of the Fourteenth Century a book came into the hands of the Sub-bishop Seigan of Zōnanbō²⁵, a Tendai Sect temple in the village of Mashima, and this was the beginning of the Majima school of ophthalmology. The book was probably a Chinese text, but the technique of operating on cataracts was probably transmitted from elsewhere. The Majima school was highly esteemed for its effective surgery and was visited by patients from remote areas. Its reputation was further enhanced when the eyes of the daughter of the Emperor Gomizunoo²⁶ were healed in 1633. The Zōnanbō was renamed Myōgen’in²⁷ (Temple of Clear Vision) by the Emperor’s decree, and has been so known ever since.

The nature of ophthalmology practiced in Majima in the early period is not known, but one obtains a fairly good idea of what it was like in the Edo Period from books transmitted to disciples of the school and books kept in the Majima family. The complex theory passed on in the temple included the Five Ring and Eight Enclosure theory, with the addition of the Five Viscera, Five Buddha theory, the Twelve Gods theory, and so on. It was inevitable that its views on pathology should finish by becoming still more empty academicism.

Clinically, however, this complex theory was completely disregarded in favor of clinical experience. This was true not only of the Majima school, but also of the thirty or so other schools of ophthalmology that cropped up from the end of the Sixteenth Century until the end of the Shogunate. This is one feature of ophthalmology as it developed in Japan.

Because of the emphasis on clinical experience by the Majima school, a number of improvements were made, unfettered by Chinese ophthalmology. One instance was the recognition, in addition to the Chinese classification of eye diseases that is divided into two large groups – internal impairments²⁸ (behind the lens) and external ones²⁹ (in the outer eye) – of a third class of intermediate impairments,³⁰ such as those causing deformations of the pupil.

Colored illustrations of eye diseases were produced in Japan (Figure 5) as well. These have captured details so accurately that a number of them are readily identifiable even today (Figure 6).

The greatest change with respect to Chinese medicine was the reduction of the number of eye diseases to the ones frequently encountered clinically. The Majima school recognized fourteen types of diseases of the eye: *makume*, *chime*, *hoshime*, *uchime*, *nikume*, *hōso*, *sakasamatsuge*, *fūgan*, *gaishō*, *naishō*, *tsukime*, *shubutsu*, *torine* and *tsuki-no-wa*. This is a far cry from the 72 varieties in Chinese medicine. *Makume* is further subdivided into 42 varieties. However, most of these are symptoms involving changes of conjunctivitis and are basically similar in appearance.

Chime refers to hyperemia of the conjunctiva or subconjunctival haemorrhages.

Hoshime is chiefly opacity of the cornea, including keratitis stellata.

Uchime refers to ocular contusions.

Nikume indicates chiefly pterygia. These were treated surgically from a very early time on.

Hōso covers eye diseases following measles, chicken pox and smallpox.

Sakasa-matsuge is trichiasis.

Fūgan is acute purulent conjunctivitis (Gonococcal ophthalmia neonatorum). It is a disease that was feared because it led to blindness.

Gaishō refers to injuries to portions of the eye in front of the iris, in general, but in the narrow sense it is understood to refer to diseases of the cornea.

Naishō is a general name of disorders behind the iris, and is subdivided into seven sub-categories: blood-, stone-, yellow-, white-, black-, green- and red- *Naishō*. The fact that the Japanese terms for cataracts and glaucoma to this day are white- and green-*Naishō* reflects the persistence of the terminology of traditional ophthalmology.

Tsukime indicates punctures of the eye.

Shubutsu are swellings of the outer eye or tumors of eye.

Torime is nyctalopia.

Tsuki-no-wa refers to crescent-shaped opacities of the cornea, thought to be *ulcus corneae* and *hypopyon*.

The classification of eye diseases described above was recognized by most ophthalmologists during the Middle Ages.

There were only nine methods of treatment though, depending on the objective. Pharmaceuticals used were not much different from those employed in China. Surgical techniques included cauterization, incision by hooked scalpel, aspiration, trichiasis surgery, as well as operations for cataracts. Techniques for treating cataracts, however, were guarded as secrets by each school of practitioners. Acupuncture followed the Chinese practice of using needles vertically, but the famous Mitsui school³¹ proposed horizontal needles³² and was rather more successful in treatment.

Introduction of Western Medicine

Until the middle of the Nineteenth Century, when Western ophthalmology was introduced, the Japanese were unaware of it to any great extent and its influence was small. But, looking back at history, it was probably in September of 1543 that the Europeans first reached Japan. A few Portuguese landed on the coast of Tanegashima, an island to the south of Kyushu. The news of their discovery of Japan set off a scramble among Portuguese merchants, who hurriedly embarked for Japan to take advantage of the lucrative market. Six years later Saint Francis Xavier came to Japan with his Jesuit companions. He landed at Kagoshima on August 15, 1549. From that date onward the missionary work of Christianity was begun in Japan, and the introduction of medicine followed the missionary work. It was called „southern barbarian medicine“. However, the suppression of Christianity began in our country in 1587, and grew vitriolic toward the beginning of the Seventeenth Century. Upon the issuance of the Exclusion Order of 1635 by the Tokugawa government, Japan entered a long period of national isolation. Contacts between

Holland and Japan starting in 1600^{2,3} continued, however, as the Hollanders, unconcerned with the propagation of Christianity and chiefly interested in trade, were permitted to maintain trading offices, first at Hirado, later on the island of Deshima in Nagasaki.

For more than two hundred years, until 1854, Deshima served as this isolated country's small window to the world. European culture arrived only in the form of trade with Holland.

Deshima was a sort of artificial island, connected with the town of Nagasaki by a single bridge. Passage was forbidden to all but special groups of Japanese, including the government officials at Nagasaki, the Dutch-language interpreters, prostitutes and the like.

The Dutch East-India Company had stationed at Deshima the trading mission, consisting of a chief commercial officer, commercial personnel, and one or two physicians to serve the resident Dutchmen. While they viewed the island as a sort of Japanese national internment camp, they managed to use it to monopolize the immense profits.

At this time exposure to Western medicine was only through a few Dutch books imported by Dutch companies and only a few fragmentary techniques were available.

Under these circumstances, external surgical techniques, including those for ophthalmology, lagged far behind the West. It was called the „Red-haired” school of surgery. The school was so called because of the hair color of many of the Dutchmen who introduced it. A representative text of ophthalmology of this school, „Joryu no Ganka-sho^{3,3},” was particularly interesting in that it contained the eye disease resulting from syphilis. This book represented no advance over Chinese medicine however.

In the beginning the interpreters were allowed only to converse, the reading of Dutch books being forbidden. This regulation was later relaxed, and ordinary peoples as well as the interpreters began to learn and speak Dutch.

The first Western anatomical texts were imported and the illustrations therein were found to be completely at variance with the traditional Chinese Five Viscera and Six Entrails theory. Naturally there were those who were puzzled as to which was right. At the time it was forbidden to dissect the human body, although there were those who sought to ascertain the truth by dissecting animals. Finally, in 1754, official permission was first granted in Japan to a court physician Toyo Yamawaki (1705 - 1762) in Kyoto to dissect the body of an executed criminal. As a result, the Western anatomical books were corroborated and the Japanese discovered that the ancient Five Viscera and Six Entrails theory did not correspond

to reality. Yamawaki published this fact in 1759 in his book „Zoshi³⁴ (notes of viscera).” Subsequently, dissections were widely performed and interest in Western medicine grew. One decisive element was the publication in 1774 of „Kaitai-shinsho³⁵” (The New Book of Anatomy). This was a translation from the Dutch edition (1734) of Johann Adam Kulmus’ „Anatomische Tabellen” by the Japanese physicians, Ryotaku Maeno, Genpaku Sugita and others.

During the whole time of National Seclusion, Japan had contacts only with Holland and China. This meant that all things Western came into Japan by way of the Dutch language. Until the publication of „Kaitai-shinsho.” all interpreting and translating had been done by the interpreters at Nagasaki.

Maeno, Sugita and a few other physicians in Edo gathered and boldly began the work of translating Kulmus’ book in 1771. They had virtually no background in Dutch or dictionaries at their disposal, except Maeno had learned a little Dutch at Edo and Nagasaki. It was „as though we were on a boat with no oar or rudder, adrift on the great ocean,” recalled Genpaku Sugita in his later years²⁴. Still, they already recognized that anatomy was the key to medicine, and embarked on the translation of this book with a sense of mission. The translation of Kulmus’ book took about two years to finish, and it was published three years and five months after the translation was begun.

Viewed from the vantage point of today, there are many mistranslations, but „Kaitai-shinsho” had a value in corroborating Western methods that is still keenly felt. Its contents probably were not fully understood at the time, but most readers probably were able to perceive its spirit adequately. Moreover, it must have admirably served the purpose of awakening people to the fact that an alternative to Oriental medicine existed in the West.

With respect to the eye, the structure of the eyeball and the relation between its movement and the oculomotor muscles were first clearly demonstrated in terms of anatomy, but the function of the lens and optical theory were misunderstood altogether and these portions ended in mistranslation. Unable to grasp the concept of „light,” the translators rendered it as „the images of phenomena³⁶.”

After the publication of „Kaitai-shinsho,” many who realized the extraordinary advances of Western science gathered around Sugita and Maeno in Edo to learn how to translate Dutch and began to read Western books. In Nagasaki people came to study under the interpreters, and the interpreters began to publish the books translated by themselves. Western things began to be introduced into Japan at a great rate.

It was during this period that ophthalmological works from the Occident made their way into Japan, the first being „Doctrina de Morbis Oculorum” (1787) by Joseph Jacob Plenck (1733 - 1807). This book reached Japan from Holland seven

years after its publication, in 1794, and the translation was completed in 1799 by Genshin Udagawa, a disciple of Sugita. This translation in five volumes was entitled „Taisei Ganka-zensho³⁷” (A New Book of Western Ophthalmology), but it was not published. After the passage of sixteen years, Ryukei Sugita, a son of Genpaku Sugita, revised it, added his own anatomical drawings of the eye (Figure 7), and issued it in 1815 under the title „Oranda Ganka-shinsho³⁸” (A New Book of Dutch Ophthalmology). The same year it was reissued under a new title, „Ganka-shinsho” (A New Ophthalmology). To this day it remains the first publication in Japan of a Western ophthalmological text.

Earlier, however, in 1798 the interpreter Tadao Shizuki published a book on astronomy and physics, originally written by Johann Keill in 1741, under the title „Rekishō-shinsho³⁹” (A New Book of Astronomy and Physics). It contains an explanation of the optics of the eye, although it is not a medical book.

After the publication of „Ganka-shinsho”, there was a succession of new titles: Daien Yamada’s „Ganko Teiyo⁴⁰” (Summary of Ophthalmology) in 1817, Shisei Higuchi’s „Ganka Senyo⁴¹” (Compilation of Ophthalmology) in 1826, Shin’ichi Honjo’s „Ganka Kinno⁴²” (Ophthalmological Treasury) and „Zoku Ganka Kinno⁴³” (Ophthalmological Treasury, Continuation) in 1835. Most of them were based on the „Ganka-shinsho” of Ryukei Sugita.

At this time, although one was able to read medical treatises from the Occident, and grasp parts of Western theories from translations, it was impossible to learn directly from Westerners, except in special cases.

Generally it is conceded that the first European to teach Western ophthalmology personally to the Japanese was a German, Philipp von Siebold (1786 - 1866). For six years, beginning in 1823, he served as the resident physician for the Dutch East-India Company at Deshima. Because of the government’s isolation policy, all Hollanders coming to Japan were semi-confined to the small island of Deshima. Von Siebold, however, was given an exceptional privilege. He was allowed to examine patients and teach medicine. Physicians and aspirants to „Rangaku”, or Dutch studies, gathered at his school from throughout the country. Among these students were two eye doctors, Ryosai Kō and Shoteki Itō.

Von Siebold was born in the city of Würzburg in Bavaria, studied there, and graduated as a physician. From his student days he had been interested in the study of the Orient, including isolated Japan, which had been described by Engelbert Kaempfer, K. P. Thunberg, etc., but still remained shrouded by a veil of mystery. In addition, Von Siebold was versed not only in medicine, but also in natural science, anthropology, ethnology, Oriental history and other related disciplines. Once in practice at Heidingsfeld, he obtained his rare opportunity.

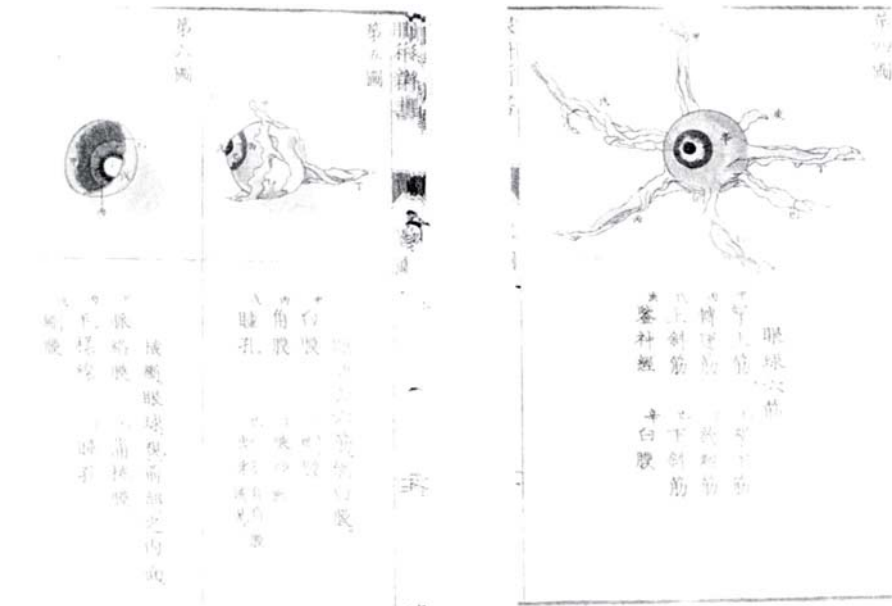


Figure 7. Anatomical drawings of the eye by Ryukei Sugita, in the „Ganka-shinsho”.

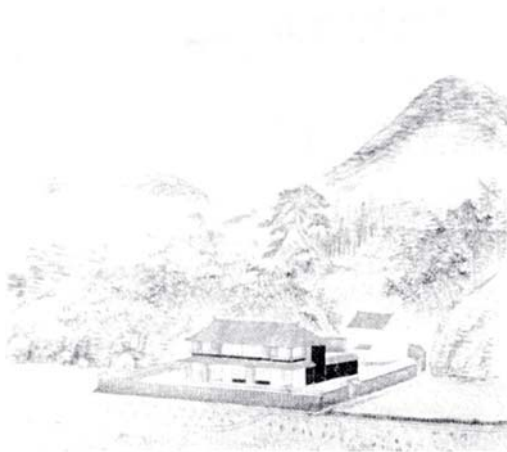


Figure 8. Narutaki-juku (the medical School of Siebold).



Figure 9. A model of eye ball possessed by Kō Ryosai.

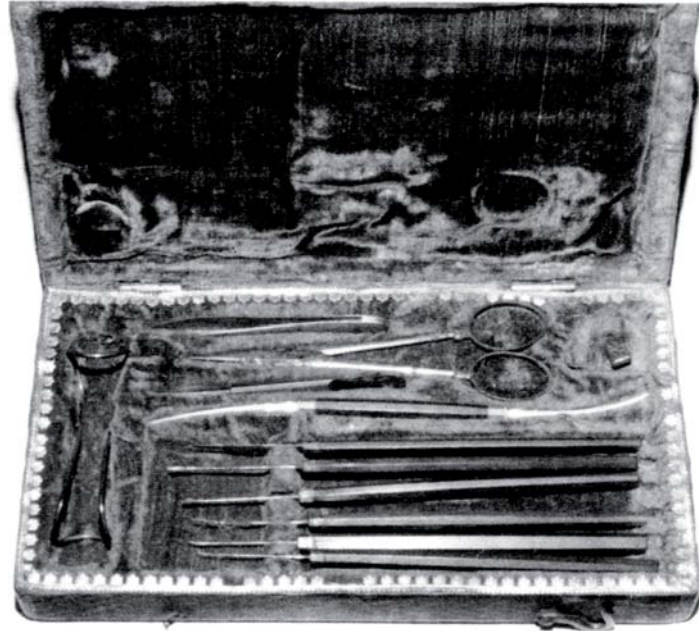


Figure 10. A set of ophthalmological instruments, given by von Siebold to Itō.

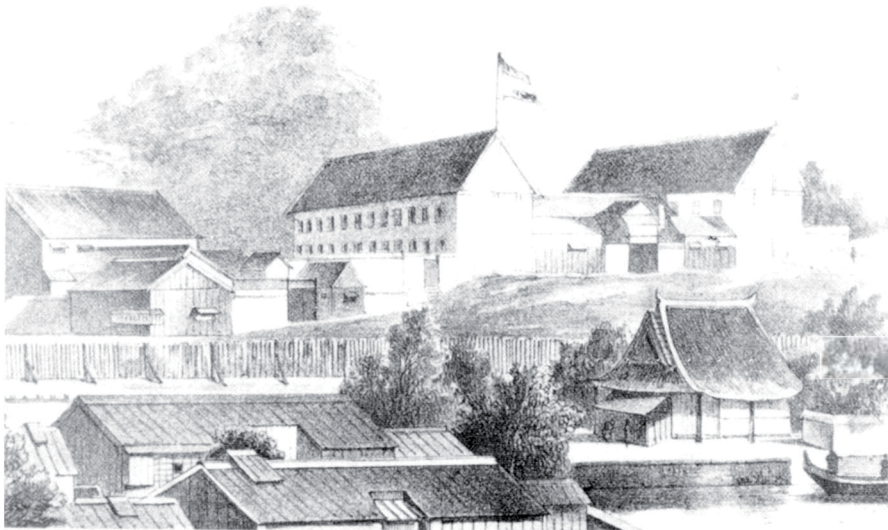


Figure 11. The medical school of Nagasaki founded in 1861.

In 1822 he received permission from the king of Bavaria to serve as a physician for the Dutch with no loss of citizenship. He was appointed a surgeon major in the Dutch Army attached to the Dutch East-Indian Company, and requested to make a natural history study of Dutch colonies at the same time. Therefore, he did not come to Japan for the purpose of teaching medicine to the Japanese, but rather to do research on Japan. Thus, there was no particular concern about leaving lecture texts or notes behind. The nature of ophthalmology as taught by von Siebold can only be surmised now from the writings of Ryosai Kō. From von Siebold, Kō also learned J. Beer's technique of optical iridectomy, which he successfully attempted on a patient.

Cataract surgery followed the method of extracting the lens as discovered in 1745 by J. Daviel. This failed frequently, and Ryosai Kō taught that the traditional Japanese dropping method was superior and safer. The extraction method was brought to Japan by von Siebold, and adopted in practice, but its wide application had to await the arrival in Japan of Pompe and Bauduin, as will be mentioned later.

From von Siebold Kō received a model of the eyeball (Figure 9) and a set of ophthalmological surgical instruments. They have been preserved in a perfect state by his descendants.

Von Siebold sought information from his Japanese students, not only on Japanese medicine and botany, but also on the inhabitants, their history, laws and customs. Ryosai Kō was his most prodigious student and von Siebold placed a great deal of trust in him. It was probably as a token of this that Kō received the instruments.

While studying under von Siebold, Ryosai Kō translated several books as seen in Table 4.

Table 4. Texts and translations on ophthalmology by Ryosai Kō

1.	„Dutch Secret Record of the Eye” – 6 vols. Translated from Johann August Tittmann's „Chirurg. Verandlehre”
2.	„Ophthalmological Usage” – 6 vols. Revised, supplemented version of the preceding.
3.	„Essentials of Western Ophthalmology” – 4 vols.
4.	„Essentials of Occidental Ophthalmology” – 4 vols. Contents of 3 and 4 were the same. „Usage” was supplemented with the clinical practice of von Siebold and Kō.
5.	„Practical Ophthalmology” – 2 vols.
6.	„Detailed Theory of Eye and Ear” – 1 vol.
7.	„An Essay – Leisure by the Porthole” – 1 vol.
8.	„Theory of Internal Impairments” – 1 vol.

When Kō had completed his studies of surgery, including ophthalmology, of course, he was given a certificate by von Siebold.

Shoteki Itō was a court physician of the Yonezawa Clan. Before studying with von Siebold, he had studied in Edo under one of the most famous ophthalmologists of the time, Genseki Habu (1768-1854). However, hearing of the fame of von Siebold, he went to Nagasaki to study under him. He also received a set of ophthalmological instruments from von Siebold, which also have been preserved (Figure 10).

As was the custom, a group of Dutchmen, including von Siebold, traveled to Edo from Nagasaki for an audience with the Shogun in 1826. On the way to Edo, von Siebold found „*Scopolia Japonica*” in the collection of botanical specimens shown by a naturalist, Hobun Mizutani, in Nagoya. Von Siebold used it as a mydriatic when he demonstrated an experiment of mydriasis in front of physicians, including Genseki Habu, in Edo. They were surprised to see the effects of mydriatics and desired eagerly to obtain them. This was in 1828, twenty-seven years after Karl Himly had discovered the dilatary effect of *Atropa belladonna*.

Genseki Habu was born in 1768 in a family that had engaged in ophthalmology for generations. At first he learned Chinese medicine, but later, realizing the superiority of Occidental techniques, he instructed himself in them, referring chiefly to Sugita's „*Ganka-shinsho*”. He performed many successful operations. Because of his fame he obtained the highest medical honor of the time, appointment as a Physician to the Shogunate. Seeing that the cataract operation would be immeasurably facilitated by the application of the drug used by von Siebold, Genseki Habu desired eagerly to get it. However, von Siebold declined. After repeated requests, an exchange was agreed upon, whereby von Siebold would teach Habu how to use it in return for a *haori* (a Japanese coat) with the Tokugawa crest on it, which von Siebold desired. This *haori* had been given to Habu as a gift from the Shogun, and to pass it on to anyone else, particularly a foreigner, was unthinkable. Genseki Habu was aware that he might incur a terrible punishment. However, determined to obtain this mydriatic drug, he gave the *haori* to von Siebold. Two years later, just before von Siebold was to return home, the boat carrying the articles he had collected overturned. The discovery of things that were forbidden to remove from the country resulted in the so-called Siebold Incident. In the course of this, the *haori* from Genseki Habu was found and he was imprisoned, a fall from grace indeed.

Von Siebold's influence on Japanese ophthalmology can be summarized as follows.

(1) Western ophthalmology, which had been acquired previously only from texts, was taught in practice. First Western clinical lectures in ophthalmology.

(2) Diseases of the eye were classified on an anatomical basis.

(3) Students were taught the practice of optical iridectomies and cataract extraction surgery.

(4) Use and preparation of Western ophthalmological pharmaceuticals were transmitted, particularly of collyria.

The Eclectic School

After the introduction of Western ophthalmology, there appeared a school based on the combination of only the effective and useful elements of traditional medicine with Western treatment. Called the Kanran (Chinese and Dutch) eclectic school, one of its practitioners was Genseki Habu. Most of the eminent physicians of the time adhered to this school of thought, which sought to fill the lacunae of traditional ophthalmology with Western techniques and introduced new surgical methods.

Genseki Habu rejected the old Five Viscera-Eight Enclosure system and reduced the number of diseases^{2 5} to 34 commonly encountered ones. He proposed 17 pharmaceuticals and 11 types of surgery. Whether drugs or surgery, he adopted only those which had been empirically found effective. He found that pearls, long regarded as highly effective in treating ocular afflictions, were of no effect and rejected their use.

Among these 34 diseases, there are those which are considered identical to those of today, but some of which show different symptoms with the passage of time.

Surgically, Genseki Habu supplemented traditional techniques used by other schools with artificial pupils and piercing of the cornea. It is said that these were devised by accident. Failing in cataract operation in which he tore the iris, he was suddenly told by the patient that he could see. This led to the artificial pupil technique. The corneal-piercing technique was inspired by the sight of a veterinarian inserting a hook into the cornea of a horse^{2 6}.

While the fame of Genseki Habu was spreading, a superb physician emerged from the Majima school. He was the 28th generation Majima, Enjo Majima (1802 - 1855). Unfettered by family tradition, he was eager to incorporate any technique that was good. The use by the Majima school of atropin type mydriatics, suction on soft cataracts, opening up of lacrymal ducts, etc., began in Enjo's time. As with other Majima techniques, these new ones were transmitted secretly and did not contribute to any startling advances in Edo ophthalmology.

Even those steeped in traditional ophthalmology were unable to ignore the prestige of Western medicine, but the quickest to recognize the value of Western medicine was the Shogunate itself. In 1849, after the Siebold Incident, fearing the spread of „Rangaku” (Dutch studies), the Shogunate forbade the use of Dutch

medicine. Under this order, official physicians were not to use Dutch techniques, except those of surgery and ophthalmology. In other words, even at this time the necessity of Western surgery and ophthalmology was accepted.

In 1858, when the Shogun fell into a serious illness there were among those close to him repeated calls for treatment by physicians trained in Dutch medicine. Inevitably the prohibition order was undermined and Dutch medicine penetrated to the heart of Shogunate itself.

Beginning of Western Medical Education

Once the Shogunate had realized the worth of Western medicine, plans were made for Western medical education in Japan. In 1854 two hundred years of isolation came to an end, and with the aid of Holland a Naval Institute was established at Nagasaki, and the Shogun's government set about the unprecedented creation of a navy. Medical education was also included. In 1857 it was decided to employ a naval surgeon and a request was forwarded to Holland. Thus Pompe van Meerdervoort (1829 - 1908), a Dutch medical officer, came to Japan. Pompe had to teach with no facilities for medical education, from the basics to the clinic. His students did not even have the prerequisite secondary education to follow a course in medicine. Both teacher and students were called upon to make great efforts. Pompe managed to explain the necessity of a hospital for clinical instruction, and eventually in 1861 the first Western-style hospital in Japan was formed (Figure 11). Pompe stayed in Japan for five years and published his experiences under the title of „Vijf Jaaren in Japan” in 1867. Many of his observations on eye diseases in Japan at the time are worth quoting.

„Eye diseases also occur quite frequently in Japan. Nowhere in the world does one find so many blind people, which to a large extent has to be attributed to a complete ignorance of ophthalmology. Many diseased people, had they initially been treated correctly, would soon have been cured, but now end up with complete loss of sight. Diseases of the retina are particularly frequent, also cataracts; I saw a few cases of granulation (trachoma), but not an epidemic. For that matter, there is hardly any eye disease one can think of that does not occur. In part I attribute their cause to excessive drinking, to the hot baths during which the whole head is kept dry and which therefore gives rise to many congestions, to abdominal full-bloodedness as a result of insufficient exercise (walking for pleasure without a specific aim is almost unknown in Japan), to sexual debaucheries, and to intestinal worms which abound. Therefore, it is more the pattern of living of the people than the climate which gives rise to eye diseases.

I can heartily recommend a trip to Japan for anyone who would like to make a special study of chest complaints and eye diseases. At present the hospital provides an excellent opportunity for research. Today the journey is not too difficult;

when making use of the overland mail it takes fifty-five days from Paris to Japan, and this journey is in itself rather interesting^{2 7}."

He was amazed at the prevalence of eye disease. Regarding ophthalmological training and surgery, he wrote:

"Ophthalmology was taught both in theory and in practice; there was a lot of material for operations. As I have mentioned, in no other country in the world are there as many eye diseases as in Japan, and if I had to supply statistics, I would say, on the basis of my experience in Nagasaki, that approximately 8 percent of the population suffer from diseases of the eye. This will surely be different in other places, but eye diseases do occur with great frequency throughout the nation. Japanese ophthalmology does not mean much. It is not known how the sight mechanism works, and the large number of blind people one sees wandering about in Japan can to a large extent be attributed to incorrect treatment. For anyone who wants to make a special study of ophthalmology, Japan supplies the best opportunity, especially because it requests help from European experts more and more frequently. Often I have come across afflictions which in the Netherlands occur only very rarely, and which I had only known from the literature; in particular, I saw some very important cases of cancer of the eyeball (Cancers in general occur frequently). The Japanese gladly submit to eye operations, even if there is only the slightest hope for a good result.

"I kept all patients with eye operations in the hospital for some time; this is necessary because so much depends on proper aftercare, without which many eye operations fail. A special ward equipped for eye patients was greatly needed, and such a ward was still lacking when I left. Dr. Bauduin succeeded in filling this need, and he performed many very important operations which gave the school at Nagasaki such a reputation that at present almost all blind people from the surrounding areas go there to seek help^{2 8}." The lectures on ophthalmology by Pompe in Nagasaki were finished in July of 1862. It was the first time that Japanese students had studied Western ophthalmology systematically. His lectures were based on the newest text on ophthalmology, published in Prussia in 1860. This meant that it came out after Pompe had arrived in Japan. He had it sent to him from Holland to serve as his course text. Pompe's lecture notes were later translated into Japanese and published under the title „Ganka Tekiyo^{4 4}," which was widely read after the Meiji Restoration until the spread of modern ophthalmology.

Pompe returned home in 1862 after the arrival of his successor, Antonius F. Bauduin (1822 - 1885). Some students of Pompe, including Genpaku Itô (1831 - 1898), went with him to study in Holland. This was the first formal study in Europe by Japanese students.

Hearing of the Meiji Restoration in 1868, Itō and the others returned immediately to Japan. In 1869, however, Itō once more left for Holland to continue his medical studies at Utrecht. He studied under Franciscus C. Donders (1818 - 1889) and together with E. Landolt did research on peripheral vision^{2,9}, discovering that the lower periphery was best. In 1873, Itō's vision chart was published as „Genpaku Itō's Snellens Lettertafel im Japanischen". Naturally, this was the first vision chart in Japanese.

Pompe died in 1908 in Brussels, Belgium.

A. F. Bauduin had taught at the Military Medical School in Utrecht and had far more educational experience than Pompe. As soon as he arrived at the Nagasaki Medical School, he was determined to reform medical education, and summoned a teacher for chemistry and physics, Koenraad Wouter Gratama, confining himself to teaching medicine only. A separate laboratory was set up. After acquiring basic knowledge in physics and chemistry, the Japanese students would proceed to their study of medicine. The arrival of A. F. Bauduin was extremely important in the ophthalmological history of Japan. He was particularly well versed in ophthalmology, and brought with him a variety of instruments and medicines. He brought to Japan the first Helmholtz ophthalmoscope.

Bauduin, in addition to cataract surgery, taught a variety of techniques, from strabotomy to palpebral plastic surgery. To do this, he set up an ophthalmological operating room in the hospital. He also taught the use of atropine, morphine, henbane, calabarine, and other pharmaceuticals. His reputation was much enhanced by his skillful surgery and use of silver nitrate in trachoma.

Records of his lectures show that he dealt broadly with oblique illumination eye disease diagnostic procedures, measurement of intraocular pressure, direct and indirect ophthalmoscopy, concave and convex lenses, prismatic treatment of strabismus, palpebral plastic surgery, strabotomy, cataract surgery, including extraction, depression or reclinon of the lens.

A. F. Bauduin helped Japanese ophthalmology approach the level of the West, and Japanese physicians throughout the country trained by Bauduin were able to perform cataract surgery and other operations. Beginning around the same time, treatment through the use of silver nitrate of trachoma, which was very prevalent, began under his guidance.

He left Nagasaki for home in 1867, but returned in 1868 in order to found a medical school in Edo. However, the Edo government fell and then he was summoned to the Osaka Provisional Hospital (predecessor of Osaka University Medical Faculty). In 1870 Bauduin taught for three months at the Daigaku Tōkō (predecessor of Tokyo University Medical Faculty), leaving Japan in October of 1870. He died in his own country in 1885.

He was followed at the Nagasaki Medical School by Dr. C. G. van Mansvelt, who arrived in Japan in 1867. Like his predecessor, he was well versed in ophthalmology. The outline of his lectures remains in the form of „Ganka Yōron⁴⁵” (Essentials of Ophthalmology).

Mansvelt left Nagasaki in 1871 to teach medicine in Kumamoto, Kyōto, Osaka, etc., before leaving Japan in 1879.

Bauduin and Mansvelt both were thoroughly familiar with ophthalmology and made a great contribution to the development of this field in Japan. Unfortunately the Edo government fell and the Meiji government was born after their arrival in Japan. In this period of political change, the students' minds must have been in a state of turmoil and they probably were not concentrating fully on their studies.

However, the Japanese ophthalmologists taught by Siebold were able to study more systematically in the medical courses of Pompe and actually to engage in Western ophthalmology under Bauduin. Their influence was further supplemented by Mansvelt.

With the coming of the Meiji government, the system of medical education was patterned on the German system instead of the Dutch. Numerous students went abroad to Germany and Austria to study ophthalmology, and returned to build modern ophthalmology in Japan. The Medical Law³⁰ enacted in 1874 saw the total demise of Kampo, the Japanized Chinese medicine.

Modern Times: Meiji (Latter Half of Nineteenth Century)

Soon after the Meiji Restoration the new government took the position that Japanese medicine in the future should be Occidental, not Chinese. The government set up a medical licensing system. No longer could one simply hang out his shingle without a license. The examination subjects were all derived from Western medicine. Those who had been schooled in Oriental medicine, completely different in philosophy from Western medicine, stood no chance at all of passing these qualifying examinations. Quite naturally, this drew strong opposition from the practitioners of Chinese medicine, but the government persisted in its new policy. The future of Japan's traditional Oriental medicine was cut off. Naturally, this also meant the end of the road for traditional ophthalmology.

The work of providing medical school facilities for fully up-to-date medical training was undertaken. The Military Medical Hospital served as the matrix, and the small-scale Western medical facilities that had grown up under the old Shogunate were subordinated to it. In the beginning all education at the Military Hospital was in the hands of the British physician, William Willis, just after the wars of the Meiji Restoration. When the government decided to pattern Japanese medicine on the German model, he was asked to leave and German professors were brought over

from Germany. The dispatch of the German physicians, however, was delayed because of the Franco-Prussian War. In 1871 Army Medical Corps Major Leopold Müller (1824-1894) and Navy Medical Corps Second Sublieutenant Theodor E. Hoffmann arrived in Japan. Subordinate only to the Minister of Education, the two set about organizing medical education in Japan. First they restricted the number of students and established age limits³¹. Students were selected strictly and taught exactly as in the German curriculum. This was a very difficult task both for the German teachers and for the Japanese. The majority of Japanese physicians until that time had been trained in the Chinese fashion, and suddenly there was a great need for large numbers of Western-trained physicians. For the reorganization of the medical system Müller and Hoffmann steadfastly pursued their principles, however. The results were that under the new regimen, Japanese medicine reached a higher level much more quickly than anticipated, which was one factor that permitted eventual independence from foreign professors.

Müller's specialty was surgery, but he also lectured on anatomy, gynecology, and ophthalmology. When his and Hoffmann's term was up in 1875, the second group of German professors came to Tokyo: E. A. Wilhelm Schultze and Albrecht Wernich. They were not granted the same vast authority as their predecessors. Schultze's specialty was also surgery, but he lectured, diagnosed and performed therapeutics on ocular diseases. His assistants, Tetsuzō Suda and Tatsuya Inoue, later went into practice and made an immeasurable contribution to the development of Japanese ophthalmology.

As Schultze's successor, Julius Scriba taught surgery at Tokyo Imperial University from 1882 till 1901. Until 1884 he was in charge of lectures on ophthalmology and also diagnosis. These three German teachers were not ophthalmologists by specialty, and did not teach ophthalmological techniques that surpassed those of A. F. Bauduin.

In 1878 the first class, twenty persons, graduated from the Medical Faculty of the University of Tokyo. Three of the most talented were sent to Germany at national expense, each to study in a special field. One of the three, Kinnojō Ume was ordered to specialize in ophthalmology. He studied at Berlin University under J. S. C. Schweigger, and gained his clinical experience at the Brecht Ophthalmological Clinic, returning to Japan in 1884. At this time, "eserin" was first introduced to Japan. Ume was more interested in physical methods rather than surgery, and was very much interested in problems of refraction. Once back in Japan, he immediately replaced Scriba in charge of ophthalmology. In 1886 he resigned due to his long-standing case of pulmonary tuberculosis, and died the following year at the age of only 29.

During Ume's tenure, Tetsuzō Suda and Tasuku Kōno worked under him and passed on his ophthalmological teachings.

After Ume's resignation, a selection was held for his successor as professor of ophthalmology. Jujirō Komotō, who had specialized for two years in surgery, was chosen. Soon Komotō went to Freiburg to study under Wilhelm Manz, then to Würzburg under Julius von Michel, and finally with J. Hirschberg and J. S. C. Schweigger in Berlin. He met a succession of eminent German ophthalmologists. He also visited famous ophthalmological departments all over Europe. Returning to Japan in 1890, he was immediately named professor and held the post for 32 years until 1922. Many of his students later became eminent in this field. This resulted in the modernization of ophthalmology in Japan. The department of ophthalmology in Tokyo University was the Mecca for this specialty in the whole of Japan, and played a central role in the modernization of ophthalmology. However, one should not overlook the success of an American missionary, J. C. Hepburn (1815 - 1911), in the private sector. In 1861 he set up a clinic at Kanagawa, and the number of patients grew to so many in a few months, that the Shogunate ordered him to close it, fearing his popularity. He was skilled in ophthalmology and eye disease patients were particularly plentiful. During this five-month practice he performed operations on thirteen cases of cataract and three cases of pterygia, and an enucleation of the eyeball. After the Meiji Restoration he practiced medicine in Yokohama and saw 100 - 200 patients a day. In the course of providing treatment, he instructed his students in medicine. One of his students, Ginkō Kishida, became a famous journalist later and amassed a great fortune selling collyria which he learned from Hepburn.

Another American, Dr. Willis Norton Whitney, established a hospital in Tokyo primarily to treat eye diseases. He participated in the Japanese Ophthalmological Association, occasionally presenting papers there. Catalogs of medical equipment of the period include the forceps named after him.

Aside from foreigners a number of Japanese doctors opened up ophthalmological hospitals, in many of which took place the postgraduate education in ophthalmology. Three contemporaries of Kōmoto became known at the time as the Three Great Ophthalmologists of the Capital: Shinkichi Miyashita, who went into business on his own after studying in Germany, Tetsuzō Suda and Tatsuya Inoue, who had withdrawn from the University of Tokyo. Their clinics were very popular, and a number of residents were trained in ophthalmology under them.

By the beginning of the 1890's medical education facilities were more or less in place and the medical licensing system was developing steadily. The academic level was still far below that of Europe, and Japan had to acknowledge it.

The visit of Julius Hirschberg (1843 - 1925) in 1893 proved to be a great stimulus to ophthalmology in Japan³². Many Japanese had studied under him overseas and his name was both familiar and respected here. However, when he himself came to Japan, it was an occasion of great interest. Today it is not unusual for experts in

various fields to visit Japan, but at that time medical doctors who made the long trip were not so well known in their own countries. When a top-ranked ophthalmologist visited Japan, as Hirschberg did, his every action in our country was reported in detail. Everywhere he went there were convocations to greet him or lecture meetings. After his return home Hirschberg wrote an enormous history of ophthalmology³³, and it is said that much of his information in the section on Japan was obtained during this trip.

As a sequel, interest in Europe was further heightened. Japanese doctors continued to study ophthalmology overseas, mostly in Germany and Austria, and some even published valuable papers there. Of these, the work on the pathological anatomy of the corneal arcus senilis by Mikito Takayasu and the experiments on electric cataract by Kyoji Kiribuchi were highly regarded³⁴.

In Japan a general medical journal had been published since around 1880, but no specialized journal on ophthalmology. In 1895 there appeared the first issue of *Ganka Zasshi* (Ophthalmological Journal), the predecessor of the Acta of the *Ophthalmological Society of Japan*.

Physicians familiar with the European situation began to proclaim the need for an academic society to further the development of ophthalmology, and the Japan Ophthalmological Society was founded in 1896. Specialized societies in the medical world did not exist in Japan at the time, so this was the first. The next year, „Ganka Zasshi” became the official journal of this society and carried the Society’s lectures and papers. However, the majority were supplementary experiments on European examinations and treatment techniques, or reports on cases newly observed in Japan of eye diseases described in ophthalmological texts. Otherwise, there were summaries of foreign papers, reports gleaned from ophthalmological journals, which served to disseminate information from European sources and enlighten the Japanese ophthalmologists at large.

As described above, the latter half of the Nineteenth Century saw the complete abandoning of Oriental medicine and the switch to Western ophthalmology. The famous ophthalmological family-schools with their long traditions faced the choice of learning Western ophthalmology or perishing. At this time they were caught up in the need to learn Western ophthalmological techniques, and regardless of how many times they were able to restore vision, they were still unable to steep themselves in basic scientific research. Of this large group, Nagayoshi Nagai, who had studied pharmacy in Germany, succeeded in extracting ephedrin from jute (*Ephedra distachya*, Li.) in 1885³⁵. The famous physician Kinnosuke Miura, a student of physiology at the time, studied its use and reported that it could be used as a mydriatic (1887 - 8)^{36, 37}. Tatsuji Inoue and others used it clinically, but it never replaced atropine and ended up being discarded. It was later found that ephedrin could be used to expand the bronchial tubes. It found wide applications in the

treatment of asthma, etc., but this was all in the hands of the Americans. If the Japanese of the time had examined these results more creatively and with greater interest, they would have probably discovered the true nature of ephedrin. Caught up as they were in all things European and American, they attached little value to the works of Japanese, with the result described.

First Half of the Twentieth Century

From the beginning of the Twentieth Century, development of educational institutions proceeded rapidly, and the number of imperial universities increased from one to eleven. While some existing medical schools with poor standards were closed, at the same time independent medical schools were newly set up, and in 1933 the total number of schools, including the university schools of medicine, had increased to twenty-six. Up to then the academic society of ophthalmology had centered around Tokyo University, but this began to change gradually as research results were accomplished independently by the ophthalmology departments of each imperial university and medical school.

At the beginning of this century, professors in medical schools always studied in Europe, sent their research findings to the ophthalmological journals of the country in which they studied, and presented papers at conferences held in various places, so that at last Japanese began to become active in Europe.

Domestically, activities of the academic society grew more vigorous year by year from around the end of the last century. Specialized journals of ophthalmology were published one after another, containing articles not only on the domestic ophthalmological situation, but also the European situation, and abstracts of the contents of German ophthalmologic journals. It was largely due to (governmental) medical policy that Western ophthalmology took over throughout Japan within only a few decades after its introduction, but the role which these journals played was also significant in raising its standards.

Out of this situation, research on diseases peculiar to Japan and creative works began to come into existence.

Beriberi and Ophthalmic Disease

Since beriberi is widely found in East Asia, it was considered to be a local disease of that area up until the Nineteenth Century, and many Japanese physicians were conducting research to detect its pathogenic organisms and to establish its treatment. Being a systemic disease, it did not at first become a particular research target of ophthalmology departments, but after 1889 when Sadao Hori (1860 - 1929) investigated the ophthalmological symptoms of beriberi and published his findings, these ophthalmological symptoms began to attract attention. Hori gradu-

ated from Tokyo University in 1887, entered the Army, and established the Army's ophthalmology department, which played a great role in the development of Japanese ophthalmology³⁸.

In 1896, Tasuku Kono (1855 - 1932) discovered a central scotoma which appears peculiarly in beriberi³⁹. The study of beriberi grew full-scale when a special committee on beriberi was set up in the Army in 1908, but with a decrease in the military budget, it was dissolved in 1924. However, this committee left an important accomplishment. In the ophthalmology department, *Ishizu's scotoma* was discovered. Hiroshi Ishizu (1884 - 1936) found that a central scotoma takes the shape of a stick or a racket in beriberi, and comparing it with central retinitis, he reported the possibility of differentiating and diagnosing it⁴⁰.

Up until then, it was known that central scotoma existed in beriberi, but there had been a heated argument over whether the presence of central scotoma necessarily indicates beriberi. Ever since Ikujiro Asayama (1861 - 1915) of Kyoto University discovered central retinitis in 1898, Asayama's faction insisted that cases with central scotoma were central retinitis and not beriberi, and held fast to their opinions. However, after Ishizu discovered a type of central scotoma which was peculiar to neuritis axialis such as beriberi, this argument was put to an end.

On the other hand, as for the cause of beriberi, there had been a bacteria theory, a poisoning theory, and a malnutrition theory, but in 1910 Umetaro Suzuki (1872 - 1943) succeeded in extracting oryzanin from rice bran. In the following year C. Funk (1887 - 1967) of England also extracted a constituent effective against beriberi from rice bran, and thus the solution to this problem was settled. Funk, saying that this constituent was an amine which is necessary for life, named it *vitamine*, and interest in this constituent in Europe and the United States rose very quickly. This was also reflected in Japan, and oryzanin, which had been discovered by Suzuki, began to receive new attention. In 1911, Kenta Ōmori, creating beriberi artificially by feeding vitamin B₁-deficient food, proved that beriberi is caused by vitamin B₁ deficiency.

In ophthalmology, studies on the relationship between vitamin B₁ and eye symptoms were also carried out continuously. It was apparent that vitamin B₁ is effective against beriberi amblyopia, but Takashi Takeda (1903 - 1967) reported in 1934 that vitamin B₂ is also effective for diffuse superficial keratitis⁴¹.

Further, Ishizu, immediately after graduating from Tokyo University in 1912, joined the Army and tackled the study of eye symptoms in beriberi. In 1923 he published a paper, entitled „Eye Symptoms of Beriberi”, for the Special Committee on Beriberi. Ishizu also developed in 1932 an irradiation device called „ophra”, using long-wave infrared rays, and this has been used for a long time for the treatment of corneal and other intraocular diseases.

Oguchi's Disease and the Mizuo-Nakamura Phenomenon

In 1905 when Chuta Oguchi (1875 - 1945) was a surgeon colonel in the Army, he found an unusual symptom of the fundus in a soldier with nyctalopia. This patient had been suspected of malingering, but Oguchi determined that he certainly had nyctalopia, and moreover a stationary case with peculiar symptoms of the fundus. By checking the patient's family history, he found nyctalopia in his parents, whose marriage was consanguineous, and also in his brothers. He reported on this case in 1907⁴². In 1911 Jujiro Kōmoto found a similar case and reported on it⁴³, and at this time he suggested naming this type of nyctalopia Oguchi's Disease. Since then, this type of nyctalopia has been found in various parts of the world.

Although this symptom was at first thought to be stationary nyctalopia, it was found that if the patient were kept in a dark room for a long time, his fundus returned to that of a normal individual. It was Bunpei Nakamura (1886 - 1969) of the Osaka Higher Medical School who discovered this phenomenon, but it was reported by his professor at the time, Gentarō Mizuo (1876 - 1913), in 1912⁴⁴. Therefore, this phenomenon is called the Mizuo-Nakamura Phenomenon.

Immediately after the general meeting of the Japan Ophthalmology Association was held in the following year, Mizuo died of cerebral apoplexy. His future had been promising ever since he had reported on ophthalmic changes in plague at the International Ophthalmology Convention held in 1909 in Italy. At that time he clarified the relationship between plague and the eyes for the first time, stating that *Pasteurella pestis* penetrates through the sacculus conjunctivae and causes systemic infection, and that the primary eye symptom is that of typical conjunctivitis with *ophthalmoblennorrhoea*, but that sometimes this can occur as acute dacryocystitis.

In 1911 Mizuo also reported on a method of gonioscopy which he happened to discover during diagnosis. His future activities were eagerly anticipated, but he died at the young age of 37.

The discovery of the Mizuo-Nakamura Phenomenon was not merely an unusual finding. With the stimulus of this discovery, studies on physiological and symptomatic conditions of the control functions of the optical center were conducted one after another.

Masuda's Central Serous Choroiditis

In 1917, a case which differed from the usual central retinitis upon observation of the fundus was reported by Takashi Masuda (1885 - 1925)⁴⁵. Its characteristic was a round opacity of the retina in the macular area. This was manifested in observation of the fundus which was clearly different from that seen in syphilitic central retinitis. It became clear that this disease was different from syphilitic

cases, especially since opacity of the vitreous body seldom appeared, and it came to be called Masuda's Disease.

Takashi Masuda graduated from Tokyo University in 1911, joined the ophthalmology department of Tokyo University immediately thereafter and took a position as a professor at Kyoto Prefectural Medical College in 1916. He hand conducted research on the diseases of the macula lutea ever since he had been at Tokyo University, and he discovered the aforementioned disease while he was in Kyoto.

Harada's Disease, Vogt-Koyanagi Disease

In 1922 Einosuke Harada (1892 - 1946) encountered a patient who manifested detachment of the retina with acute choroiditis⁴⁶. He found three additional cases in 1924, and reported on five similar cases in 1926⁴⁷. At this time he named the disease acute diffuse choroiditis, and pointed out that its symptoms begin with neuroretinitis or choroiditis accompanied by a serious degree of detachment of the retina, proceed to general choroiditis or chorioretinitis, and even when the ciliary body and the iris have been involved, the anterior uveitis is slight. Systemic symptoms include headache, anorexia and sometimes nausea, vomiting, tinnitus and deafness, and depilation or bleaching of the hair may occur.

Since that time, some have called this Harada's Disease, while sympathetic ophthalmia of nontraumatic origin (which is similar to Harada's Disease and notably accompanied by uveitis and bleaching) has been called Vogt's Syndrome. The term „Vogt's Syndrome" was used for the first time when Minoru Takahashi of Kyoto University reported on these diseases at the General Meeting of the Japanese Ophthalmological Society in 1929. This was derived from Vogt's report in 1906 of serious uveitis accompanied by bleaching of the eyelashes, but Yoshizō Koyanagi opposed calling the disease Vogt's Syndrome, because Vogt was not the first person who had reported such a case, nor had he recognized it as a separate disease.

Afterwards, Harada suggested that since it was Yoshizō Koyanagi who first presented general remarks about idiopathic uveitis accompanied by systemic symptoms⁴⁸, it was appropriate to call this Koyanagi's Disease, so this term came to be used. Though some were of the opinion that the essence of Harada's Disease and Koyanagi's Disease was the same so it was not necessary to assign two names, since their prognoses are totally different, the opinion which held that it was appropriate to divide them clinically was accepted. As a result it was decided that within acute diffuse serous uveitis, Harada's type and the Vogt-Koyanagi type exist.

Harada graduated from Tokyo University in 1917, specialized in ophthalmology from 1921, and he had the good fortune to discover the so-called Harada's Disease during the following year. He moved to Nagasaki in 1929 and opened a private practice. Within a short time after he moved to Nagasaki, the argument arose as to

whether or not to recognize Harada's Disease. Since Shinobu Ishihara (1879 - 1963) strongly supported the use of the term, the above conclusion was reached. It was A. Salus who used the term Harada's Disease for the first time overseas⁴⁹. Salus, in his report, also called a case with idiopathic uveitis Kōmoto's Disease, but he had misunderstood Koyanagi's paper to have been written by Kōmoto and Harada, taking a hint from Salus's coining of the term, therefore suggested the name be Koyanagi's Disease.

Yoshizo Koyanagi (1880 - 1954) graduated from Kyoto University in 1908, became a disciple of Ikujiro Asayama, and was called one of Asayama's trio of disciples, along with Kiyoshi Ichikawa and Sadao Suganuma. These three all pursued their studies in ophthalmological pathology under the guidance of Asayama, and in later years came to be the leaders of Japanese ophthalmological pathology. Koyanagi became a professor in the ophthalmology department of Tohoku University in 1919 and held the position until 1942. As mentioned earlier, it was he who directed his attention to idiopathic uveitis accompanied by peculiar systemic symptoms. Prior to that he had studied congenital deficiency of the uvea embryologically. For deficiency of the uvea, Zeefelder's theory of growth retardation of mesoderm structures had been accepted as the popular view; however, Koyanagi advocated the theory of the excess growth of the retina proper, that is, of the entoderm structure.

Also, he put his heart and soul into the study of the developmental pathology of albuminuric retinitis, and made great contributions on the relationship between the eye and hypertension. Therefore, he was invited to the symposium of the 15th International Congress of Ophthalmology held in Cairo in 1937, where he presented a paper entitled, „Anatomopathological Study of Retinal Hypertension”.

Takayasu's Disease

The so-called Takayasu's Disease was discovered by Mikito Takayasu (1860 - 1938). He recognized an abnormality in the fundus of a young woman who was an outpatient at the Kanazawa Medical School, and this led to the discovery. The patient's main complaint was impaired vision and she gradually developed cataract. When Takayasu reported this case at the 12th congress of the Japanese Ophthalmological Society in 1908, Yoshiakira Onishi (1865 - 1932) responded by mentioning his encounter with a patient with the same eye symptoms whose radial artery pulse could not be felt, and Shimekichi Kagoshima (1868 - 1926) also reported his experience with a similar case^{50, 51}. In 1916, Sonshu Chikamori also reported a cataract patient whose pulse could not be felt, but in this case it was noted that the carotid pulse also was not palpable⁵².

In 1921 Minoru Nakajima (1893 - 1951) reported on a similar case⁵³, and this case report was much more detailed than previous reports of the disease, including

various examinations. Among systemic symptoms, other than the above, chest pains, headaches, and psychological episodes were also discussed. Since patients suffering from this disease mainly complained of visual disturbances, they first visited ophthalmologists. In 1937 a patient with this disease visited Tokyo University and was examined carefully in both the internal medicine and surgery departments. It was found that for some reason this disease causes a blockade of blood flow in the carotid artery, so that the cerebral blood flow was conducted instead by the vertebral artery⁵⁴.

In 1948, Kentaro Shimizu and Keiji Sano conducted a comprehensive investigation of this disease, named it „pulseless disease”, and determined that the three symptoms of undetectable pulse, fundus examination findings of arteriovenous anastomosis, and rise in the sinus reflex are the indentifying triad⁵⁵. Later, the name was changed to „Takayasu's Disease” to honor Mikito Takayasu, who first reported it.

Trachoma

Trachoma used to be called the national disease of Japan. It was counted, along with tuberculosis and venereal disease, as one of the three major chronic infectious diseases, and countermeasures against it had long been of great concern. When Julius Hirschberg came to Japan in 1893, he was surprised to hear that the trachoma rate among outpatients at Tokyo University was 14 percent but the situation was really worse than that. A trachoma epidemic which began around 1897 and lasted about ten years was especially dreadful. It was prevalent among soldiers during the Sino-Japanese War (1894 - 1895), and as a result it spread among the general public after the war. Its spread was especially wide among schoolchildren, and in some areas a morbidity rate of 75 percent was noted. As a countermeasure, nurses were placed in the elementary schools, and eyes were washed and eyedrops applied. This was the beginning of today's nurse-teachers.

Ophthalmologists also participated actively in preventive activities. Among them, Toyotaro Inoue (1861 - 1951) established what was popularly called the Health Association, and conducted large-scale educational activities by publishing enlightening materials on trachoma prevention, such as the monthly journal „Eisei Danwa” (Conversations on Health). Inoue also created and sold „Rohto Eye Lotion”, which is still selling well⁵⁶.

It was the Army which most seriously tackled the trachoma epidemics with countermeasures. From 1910, the Army offered lectures on trachoma to its doctors who performed physical examinations for military recruitment, while at the same time investigating the trachoma rate among the examinees. As a result of this active prevention and treatment, the trachoma incidence rate among soldiers dropped from 24 percent in 1912 to 14 percent in 1921. However, in areas where no pre-

ventive measures were taken against trachoma, such as in junior and senior high schools and colleges, the result was as follows^{5 7}:

	Junior High Schools	Senior High Schools	Imperial Universities
1913	16%	42%	46%
1919	22%	49%	57%

By 1915 the Trachoma Prevention Association was established, and published the journal „Trakoma” (Trachoma). Because of the situation, the Trachoma Prevention Act was passed along with the Tuberculosis Prevention Act in 1920. This law prescribed that when a trachoma case was discovered the patient was obliged to receive treatment, that methods of prevention would be taught, and that group examinations would be conducted as needed.

There had been reports on trachoma in the academic societies as early as about 1900, and as soon as reports of the discovery of Prowazek's inclusion body reached Japan in 1907, discussions on this flourished. At the Ophthalmology Convention held in 1908, reports on trachoma were presented one after another.

In 1929 Sosuke Miyashita (1882 - 1948), participating in the 13th International Congress of Ophthalmology, presented a paper entitled „The Geographical Distribution of Trachoma in Japan and Measures for Its Eradication”. The International Association for the Eradication of Trachoma was set up at that time, and Miyashita was chosen as a member of its executive committee.

Miyashita graduated from Tokyo University in 1906, studied under Axenfeld for two years beginning in 1908, and came home after studying the new field of bacteriology. He also took an active interest in the pathology and search for the pathogenic organism of trachoma. He was a member of the editorial committee of the *Klin. Monatsblätter für Augenheilkunde*.

Research on trachoma was conducted from various aspects. Animal experimentation was hard to carry out because it was extremely difficult to infect the animals, so pathological studies were scarcely making any progress. A subcommittee for the study of trachoma was set up within the Japan Society for the Promotion of Science in 1933. Mataro Nagayo, a pathologist, became the first chairman. He was succeeded by Shinobu Ishihara, and a full-scale study of trachoma pathology was initiated. The results were published in Japanese and German in 1943, but by that time the war situation was severe and literature could neither be received nor sent abroad. Thus, these results were finally sent out to scholars overseas after World War II.

With this research it was made clear that the incubation period of trachoma is 5 - 6 days; that Prowazek's inclusion body is always present in the epithelium of the conjunctiva and the lacrymal ducts in the early phase, and that this is definitely

closely related to trachoma; that even if Prowazek's inclusion body cannot be detected in chronic trachoma, it will appear in a trachoma transplanted from it; that whether the disease is contracted through transplantation or by natural infection, symptoms of acute conjunctivitis are manifested at an early stage; and that the inclusion conjunctivitis seen among the newborn is a variation of trachomal conjunctivitis^{5,8}.

The impact of the Second World War upon Japan was severe. As foreign information which had long been unobtainable began gradually to trickle in, it was recognized that world medicine had made rapid progress during the war. For economic reasons, however, no one from Japan could attend the international conferences. Thus, when Yukihiro Mitsui took part in the WHO Committee on Trachoma in 1952, he was the first Japanese ophthalmologist to participate in an international conference after the war. Mitsui had been a leading member of the subcommittee for the study of trachoma mentioned earlier.

Tuberculosis

Today all textbooks mention the existence of tubercular eye disease. Up until 1880, however, the eye was considered to be strongly resistant to tuberculosis. After Michel pointed out in 1890 that 50 percent of uveitis cases had their origin in tuberculosis, tubercular eye disease became an object of attention. In Japan, Ikujiro Asayama reported on this subject in 1895, and Gytoku Nakaizumi (1871 - 1945) did so in 1899. Nakaizumi^{5,9} proved the disease to be tubercular through findings from pathological anatomy. Hideo Tsukushi presented a more detailed report in 1904^{6,0}. Tsukushi had been conducting research under the guidance of Asayama.

Ikujiro Asayama (1861 - 1915) graduated from Tokyo University in 1884, and took a position as an instructor in the school of ophthalmology at Kyoto Prefectural Medical School in the same year. When Kyoto Imperial University was established in 1898, Asayama was sent to study in Europe, and immediately upon his return in 1902 he was appointed as the first professor of Kyoto Imperial University's ophthalmology seminar. As was previously mentioned, Asayama discovered central retinitis in 1898 and fought against the Tokyo University faction about the problem of central scotoma. For good or ill, he formed a Kyoto University faction against Tokyo University and made the ophthalmological circles thrive. He was especially knowledgeable about pathology, and he encouraged his disciples to do pathological research. From among Asayama's disciples there emerged such authorities on ophthalmological pathology as Yoshizo Koyanagi and Sadao Suganuma.

Yasuzo Murakami (1862-1927) reported in 1906 that among cases of retinal haemorrhagia corporis vitrei, some are of tubercular origin^{6,1}. Axenfeld and Stock

later presented the same opinion, and it was also demonstrated through pathological anatomy by Sadao Sukanuma and others^{6,2}. Murakami later reported at a general meeting of the Japanese Ophthalmological Society that some cases of parenchymatous keratitis were caused by tuberculosis, but since Salvarsan had just been developed (in 1909) and since most cases of eye disease were thought to be syphilitic, little attention was paid to tuberculosis, and many opportunities for cure were missed because appropriate treatment was not given.

Yasuzo Murakami had graduated from Tokyo University in 1886, and was appointed as an instructor at Nagasaki Medical School, a post he retained all his life, except for two years, 1899 - 1901, when he studied under Professor Uhthoff at the University of Breslau.

Sadao Sukanuma (1879 - 1946) graduated from Kyoto University in 1906, then entered Ikujiro Asayama's ophthalmology class. He studied under Hess in Germany for two years from 1913. When Keio University Medical School was established in 1919, Sukanuma was appointed as its first professor of ophthalmology. He conducted studies on the pathology of eye diseases, demonstrated the tubercular or syphilitic origins of eye diseases which had formerly been classified according to their symptoms, and contributed greatly to advances in diagnosis and treatment. He was particularly expert with regard to the relationship between tuberculosis and eye disease, and his demonstration of the tubercular origin of adolescent recurrent retinal haemorrhagia corporis vitrei was a work of great merit. At the 38th General Meeting of the Japanese Ophthalmological Society in 1934, Sukanuma presented a special lecture entitled „On Tubercular Eye Disease and the Relationship between Tuberculosis and Eye Disease”.

For treatment, before specific anti-tubercular drugs became available, subcutaneous injections of tuberculin and alterative treatments were used. Bunpei Nakamura devised a procedure of injecting minimal dosages of tuberculin, and this method was widely used.

Eye Charts and Color Blindness Test Charts

In 1873 Genpaku Ito, who was studying in Holland, devised a modification of the Snellen Eye Chart using Japanese characters. This was the first eye chart made by a Japanese, but it did not become popular, and the Snellen Chart was used here in the early part of the Meiji Era. Since it was inconvenient to test patients who could not read the Roman alphabet with this chart, in 1884 Junzo Aoki revised it to Japanese style and created the „S.'s Eye Test Chart”, which came into wide use.

In 1871 Japan formed its first standing army by adopting a conscription system, and at that time a military medical structure was newly established.

The first task given to the military medical group was examination of the soldiers who were needed for the establishment of the standing army. Tests of visual acuity and color blindness were an important part of the examination for conscription. The ophthalmology department of the military medical group put its effort into research on these tests, which eventually led to internationally recognized achievements exemplified by such works as Shinobu Ishihara's Color Blindness Chart.

Immediately upon graduation from Tokyo University in 1905, Shinobu Ishihara (1879 - 1963) became an Army doctor. At first he specialized in surgery, but in 1908 he entered graduate school and majored in ophthalmology. In his second year of graduate school, he produced the Universal Japanese Eye Chart, which was the parent of the Ishihara Eye Chart which is widely used today.

While he was in graduate school, in addition to developing his eye chart Ishihara studied congenital total color blindness⁶³ and it was the starting point for the creation of his color blindness chart. He also conducted a histological study of bacterial conjunctivitis, and it was published in a German journal. In that study he reported that the bacilli only live upon those parts of the skin where erosion has developed, and are not found in the tissue of the conjunctiva.

Research on color blindness charts became necessary in the military because excessive numbers of color blind men in the Navy were diagnosed as normal when Stilling's Color Blindness Chart was used. To begin with, therefore, Chuta Oguchi revised that chart and designed „Oguchi's Pseudoisochromatic Chart", which was something of a further improvement. Fuminori Iga (1889 - 1956) revised this and produced „Iga's Color Blindness Test Chart" in 1913. This chart was widely used among general ophthalmologists until Ishihara's Color Blindness Chart became popular.

The Army ordered Ishihara to design a color blindness chart which would produce more precise results, and Ishihara embarked on the study of the colors which are confused in color blindness with the cooperation of his colleagues on the color blindness study team. He designed a color test chart in 1916⁶⁴, but since it was published secretly by the Army, he created a separate color blindness chart, using the same principle but different figures, and presented it in 1918. This was sent to foreign scholars along with an English commentary. Favorable reactions to this chart grew abroad, and in 1923 it was proposed that this chart be used in the physical examinations of seamen and railroad workers in Scandinavia. In the following year Clark, of Johns Hopkins University in the United States, published a paper highly praising Ishihara's Color Blindness Chart⁶⁵. Because this color blindness chart came to be rated highly abroad, only charts for foreign use were published in Japan. At the 13th International Ophthalmological Congress, held in 1929, Ishihara's chart was recommended as the best test chart in the world, and at the 14th Internatio-

nal Ophthalmological Congress, held in 1933, a resolution was adopted for unification of regulations regarding vision standards for airplane pilots, drivers, railroad workers, and seamen, and the following recommendation was made: „Color sense should be examined by several methods, and should always include testing by two different pseudoisochromatic charts. If possible, Stilling's Chart and Ishihara's Chart should be used." Thus Ishihara's Chart came to be used in various countries of the world, and for a long time it was the leader among the medical tests exported from Japan. Especially after World War II, because the copyright for the Stilling Chart passed to East Germany, Ishihara's Chart came to be even more widely used in the West.

In 1922, Ishihara succeeded Jujiro Kōmoto as professor of ophthalmology at Tokyo University, and held the position until 1940. During that time he continued to revise the color blindness chart and to increase its efficiency; supervising Tadao Kondo, Kota Watanabe and others, he conducted a study of color blindness with the combined use of the anomaloscope and the Ishihara chart, succeeded in measuring the brightness distribution curve in congenital total color blindness, proved that the cumulative value of the rays of different wave lengths in this disease is equal to the arithmetic total of the combination of factors, and explained anomaloscopic findings in persons with various types of dyschromatopsia⁶⁶. Besides these achievements, he provided guidance to researchers on color sense and contributed greatly to the search for its nature.

Myopia

It is well known that there is a high incidence of myopia among the Japanese. There has been an interest in preventive measures against myopia from early times, but this problem was tackled on a full scale only in 1938, when for the purpose of national strength, medical study began to focus on the improvement of physique and human resources. In 1938 a committee for the study of myopia was set up within the Japan Society for the Promotion of Science. Further, in 1941, the Ministry of Education prepared a special budget for scientific study, and research on the origin, prevention and treatment of myopia was launched. As a result, it was clarified that myopia occurring among the Japanese included axial myopia, refractive myopia and pseudomyopia; that over half of the cases among elementary school children were pseudomyopia, which could be treated with appropriate preventive measures; and that refractive myopia resulted from a morphological change in the ciliary body when pseudomyopia had persisted for a long time, and could be rehabilitated if appropriate measures were taken during the stage of pseudomyopia⁶⁷. These results were presented in 1943, when the war was growing intense, and the preventive measures could not be spread effectively among the people. When, after the Second World War, the Japanese Ophthalmological Society resumed its general meetings, in opposition to Jin Otsuka⁶⁸, who held that the

cause of school myopia was in retrolental anomalies of refraction, the myopia study committee favored the ocular axis theory, and insisted that myopia is caused by an abnormal extension of the ocular axis during the growing process.

The Influence of World War I

Japan's medical circles, which had been developing on the model of German medicine since the Meiji Restoration, were greatly affected when communications with Germany were cut in World War I.

In 1914, when World War I broke out, the Japanese who were studying in Germany came back hurriedly or escaped to England, France or other countries, and the importation of pharmaceuticals from Germany, and later from Switzerland, was completely cut off because Japan was waging war against Germany. This had great impact on routine medical care in Japan. Up until then Japan had relied almost totally upon these countries for its supply of pharmaceuticals, neglecting development of domestic pharmaceutical manufacture, and this backfired. In the field of ophthalmology, even routine treatment was hindered by a lack of atropine. Rohto Essence was used as an atropine substitute, and atropine of inferior quality was used, so accidents also occurred. Therefore, to bring good out of bad, it was decided to develop domestic pharmaceutical manufacture for the nation's benefit.

Medical researchers suffered another blow when the arrival of medical journals from Germany was completely cut off. Since Japan's contact with world medical circles up until that time had come through the German language, this was tantamount to losing all contact with the international medical scene.

When World War I ended, and the domestic situation in Germany stabilized, Japanese medical specialists again began to go to Germany to study. Among German medical specialists there were some who were outspoken in criticizing Japan for having waged war, and who behaved coldly toward Japanese students. However, the number of Japanese students who went to Germany increased every year, and again the situation in the German medical world was reflected exactly in Japan.

On the other hand, a few scholars began to study in England, the United States and France. In ophthalmology, Yoshiharu Shoji went to France to study in 1921, introduced French ophthalmology into Japan, and through sending his papers to French ophthalmological journals continuously, was made a Chevalier of the Legion of Honor by the French government in 1933.

Yoshiharu Shoji (1889 -) graduated from Tokyo University in 1914. He was a professor at Kyushu Imperial University for many years, but in 1940 he took up a position as a professor at Tokyo University, succeeding Shinobu Ishihara.

The Impact of World War II

In 1937 the Japan-China War broke out, and in the following year the National Mobilization Act was issued and science and technology were subordinated to the purpose of national defense. It has been mentioned already that research on trachoma and myopia were conducted in line with this purpose.

In 1941 when war with the United States began, the military conscription bill regarding medicalcare-related personnel was issued, and medical practitioners were forced to travel to doctorless villages and to factories to conduct diagnosis and treatment. Also, as the war grew more intense, medical practitioners were conscripted more often, to such a degree that it interfered with routine diagnosis and treatment. In addition, since imports had ceased and priority was given to the production of war supplies, the shortage of pharmaceuticals for general practitioners became extreme. Furthermore, beginning in 1944 the air raids by the United States Air Force grew more devastating. Many hospitals were destroyed, and medical care facilities in the urban areas were severely damaged.

There was great relief at escaping from a nightmare situation with the end of the war in 1945, but well known medical specialists who had been active in the Meiji and Taisho eras had been tossed about by the violent waves of the wartime and postwar periods and died successively, unable to recover from the effects thereof.

However, the Japanese medical world made a great reform with the advice of the United States Occupation Forces. Up until then, there had been thirteen medicine-related universities and forty-six specialized medical schools, but Japan now took a bold course of unifying medical education. Specialized medical schools with poor standards were closed, and forty-six new-system universities were set up.

Also, Japanese medical circles, which had been totally dominated by German influence until the end of World War II, made a complete change and began to look to the United States.

As for ophthalmology, the Japanese Ophthalmological Society had been established in 1897, and ever since its journal, the *Acta Societatis Ophthalmologicae Japonicae*, began publication, not once had a general meeting been cancelled or publication suspended, except for the general meetings of 1945 and 1946, and publication from July 1944 through the following year.

Postwar activities began in 1947, with the 51st General Meeting. At this meeting there was a report on pathological findings of the fundus in radiological diseases, which symbolized the most abhorrent memories of the war. Also, as if vividly signifying the beginning of a new era, Ken Imachi (1903 - 1949) reported on the treatment of disease of optic nerves by the use of craniotomy in approximately 300 cases in which he had performed the operation, entitled „A Study of Various

Diseases of the Optic Nerves by Craniotomy”⁶⁹. This report indicated that among the various diseases of the optic nerves whose treatment had been abandoned by ophthalmologists in the past, diseases which feature lesions in the arachnoid optic chiasm can be treated miraculously by separating and removing this part of the arachnoid.

At the 1948 General Meeting of the Ophthalmological Society, there were reports on the electron microscope image of the pathological organism of trachoma by Shinichiro Sugita and on corneal transplantation by Yasushi Nakamura (1898 - 1956)⁷⁰. Nakamura conducted 140 corneal transplants, beginning in 1941, and was commonly acknowledged as a pioneer in corneal transplantation in Japan. At the General Meeting of the Japan Ophthalmological Society held in 1950, he presented a special lecture entitled „A Basic Study of Corneal Transplantation and Its Clinical Applications”, in which he pointed out that while the operation itself is not an especially complicated technique, a major obstacle to the spread of corneal transplant operations is the difficulty of obtaining corneas. He said that to solve this problem, Filatow’s method of utilizing corneas from the dead should be popularized, and for this purpose he suggested setting up an eye bank. In 1957 the „Eye Bank” was set up within the Japan Red Cross, and in the following year a law regarding the transplantation of corneas was enacted.

Research on contact lenses, which had begun to be used for correction of vision in cases of keratoconus, progressed rapidly under the leadership of Yutaka Mizutani from about 1949 due to the great advancement in synthetic resins.

The special lecture at the 1946 General Meeting of the Japan Ophthalmological Society was Minoru Nakajima’s (1893 - 1951) „Chemistry of the Retina”⁷¹. Nakajima graduated from Tokyo University in 1919, went to Europe to study in 1928, and wrote general remarks on retinal metabolism after returning home. Thereafter, he studied the retina from the chemical viewpoint, and introduced and established the chemical method of research in Japan’s ophthalmological circles. In his special lecture, he talked about the chemical composition of the retina, photosensitizing substances, chemical changes due to light, and retinal metabolism. His speech impressed his audience greatly because even though there had been much research on the retina from the physical and optical viewpoint, there were few chemical studies.

At the General Meeting of the Japanese Ophthalmological Society held in 1949, the number of papers presented equaled the prewar record, indicating that Japan was coming out of the chaotic situation of the postwar period. Professor Misao Uemura of Keio University made the following remarks: „At any rate, what was noteworthy was that we came to have more active presentations showing that Japan is recovering from its postwar prostration. However, when we compare our standards with other countries, even if we cannot find out the details of what is going on in foreign countries, I think that more effort will be needed in order to fill in the blank caused during the war.”

Latter Half of the Twentieth Century

As Japan gradually emerged from the postwar confusion and the Japanese economy entered the high-growth period, the ophthalmological world also entered a new era. In the aspect of treatment for eye diseases which could not be completely cured despite the efforts of earlier ophthalmologists, antibiotics represented by penicillin and drugs such as sulfanilamide, adrenal cortical hormone, and ACTH proved to be effective, and methods of treatment changed remarkably.

As for the pathogenic organism of trachoma, which had long been a subject of study, Seiji Arakawa of the Research Institute for Contagious Diseases succeeded in 1951 in detecting an organism which could be confirmed as the trachoma virus, by the use of the electron microscope and immunological methods. In 1953, at the 57th General Meeting of the Japanese Ophthalmological Society, Yukihiro Mitsui presented an assigned speech entitled „Various Problems of Trachoma”, which summarized the history and the current status of research on trachoma.

From the late 1950's, as the number of people who went abroad began to increase and literature from foreign countries came in freely, it became easier to obtain overseas information. However, only part of the results of ophthalmological research in Japan were transmitted to foreign countries through sending papers and abstracts to foreign journals. In 1957 the Japanese Journal of Ophthalmology was first published by Hogara Hagiwara (1904 - 1969) and others. Finally, through this journal, research by Japanese gained wide recognition overseas.

Summary

A sketch of the transition of Japan's ophthalmology from prehistoric times to the present was made. As Japan's culture has been built up under the influence of various foreign countries, in ophthalmology, too, the physicians learned from Korea at the beginning, and then Chinese medicines were imported and Chinese-style treatment of eye diseases was conducted.

It was in the 14th century that the ophthalmologist emerged as a professional. From the beginning of the 16th century, based on a Japanization of Chinese-style ophthalmology, Japanese ophthalmology was created. Also, from around this time, Western influence began to be felt, and during the first half of the 19th century a unique ophthalmology called the Kanran (Chinese and Dutch) Eclectic School existed. This became a forerunner to the total changeover to Western medicine after the Meiji Restoration of 1868.

After the Meiji Restoration, with German medicine as a model, Japan quickly made the change to the new medicine, and ophthalmological practices which had lasted for more than a thousand years disappeared. From then to now a hundred years have passed. The first twenty-five years were spent on imitation; during the next twenty-five, treatment of diseases peculiar to Japan came into the limelight; and over the remaining fifty years to the present, creative work began to be done.

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SAKAI S. – Eine Geschichte der Ophthalmologie in Japan

Zusammenfassung

Der Autor schildert den Übergang der japanischen Ophthalmologie aus vorgeschichtlicher Zeit bis zum gegenwärtigen Zeitpunkt. Wie sich die japanische Kultur unter dem Einfluß verschiedener fremder Länder entwickelt hat, hat die Ophthalmologie in gleicher Weise vorher den Einfluß Koreas und darauf Chinas erfahren, deren Behandlungsweisen angewendet wurden.

Im 14. Jahrhundert hat sich die Ophthalmologie unter den medizinischen Gebieten herausgebildet, und im 16. Jahrhundert nahm die japanische Ophthalmologie chinesischen Stils ihren Aufschwung. Zum selben Zeitpunkt machte sich der westliche Einfluß ebenfalls bemerkbar, aber erst in der zweiten Hälfte des 19. Jahrhunderts entstand die ophthalmologische Schule von Kanran, die gleichzeitig von der chinesischen und der holländischen Wissenschaft beeinflusst wurde. Diese Schule wurde zum Vorläufer der westlichen Medizin und wurde 1868 nach der Meiji-Restauration eingeführt.

Nachdem die japanische Medizin die deutsche Medizin zum Vorbild nahm, hat sie sich sehr schnell entwickelt, und die ärztlichen Praktiken, die während mehr als tausend Jahren angewendet wurden, sind verschwunden. Ende des 19. Jahrhunderts haben die Fortschritte darauf beruht, daß der Westen nachgeahmt wurde, aber zu Beginn dieses Jahrhunderts wurden die Japan eigenen Behandlungsmethoden der Krankheiten überarbeitet. Seit 50 Jahren sind eine schöpferische Klinikpraxis und eine fruchtbare Forschung hervorgebracht worden.

SAKAI S. – L'Histoire de l'Ophthalmologie au Japon**Resumé**

L'auteur décrit la transition de l'ophtalmologie Japonaise des temps préhistoriques aux temps présents. Comme la culture Japonaise s'est développée sous l'influence de différents pays étrangers, l'ophtalmologie également a subi d'abord l'influence de la Corée et ensuite de la Chine, dont les moyens de traitement ont été appliqués.

C'est au 14^e siècle que l'ophtalmologiste s'est affirmé parmi les médecins et c'est au 16^e siècle que l'ophtalmologie Japonaise du type Chinois a pris son essor. Vers la même époque l'influence occidentale s'est également fait sentir, mais c'est au cours de la deuxième moitié du XIX^e siècle qu'est née l'école ophtalmologique de Kanran, qui s'inspirait en même temps de la science chinoise et hollandaise. Cette école est devenue le précurseur de la médecine occidentale, introduite en 1868 après la restauration des Meiji.

C'est alors que la médecine Japonaise en prenant la médecine allemande pour modèle s'est développée rapidement et que les pratiques ophtalmologiques, qui étaient en usage pendant plus de mille ans, ont disparu. A la fin du XIX^e siècle les progrès ont consisté à imiter l'occident, mais au début de ce siècle des traitements pour les maladies propres au Japon ont été mis au point. Depuis 50 ans une clinique créative et une recherche fructueuse ont vu le jour.

SAKAI S. – Una historia sobre la Oftalmología en el Japón**Resumen**

El autor describe la transición de la Oftalmología Japonesa de los tiempos prehistóricos al tiempo actual. Así, como la cultura Japonesa se ha desarrollado bajo la influencia de diferentes países extranjeros, la oftalmología también ha estado bajo la influencia, al principio de Corea y luego de China, de quienes se han aplicado los medios de tratamiento.

Es en el siglo XIV que el oftalmólogo se ha afirmado entre los médicos y es en el siglo XVI que la Oftalmología Japonesa de tipo chino a tomado vuelo. Para la misma época también la influencia occidental se hizo sentir, pero es en el curso de la segunda mitad del siglo XIX que nace la escuela Oftalmológica de Kanran, que se inspiraba de la ciencia china y holandesa al mismo tiempo. Esta escuela ha sido la precursora de la medicina occidental, introducida en 1868 después de la restauración de los Meiji.

Es entonces, cuando la medicina japonesa, tomando la medicina alemana por modelo, se ha rapidamente desarrollado y que las practicas oftalmológicas, que estaban en uso durante más de mil años han desaparecido. Al final del siglo XIX los progresos han consistido en imitar al occidente, pero al comienzo de este siglo los tratamientos para las enfermedades propias al Japón han sido puestas a punto. Después de 50 años una clínica creativa y una investigación fructuosa han visto la luz.

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