A Case of Cerebral Tumor—
The Surgical Treatment

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The chief features of interest in the case, to which the attention of the Society is directed, are, that during life the existence of a tumour was diagnosed in the brain, and its situation localized, entirely by the signs and symptoms exhibited without any external manifestations on the surface of the skull. This growth was removed without any immediate injurious effects on the intelligence and general condition of the patient. Although he died four weeks after the operation, the fatal termination was due, not to any special effects on the nervous centres, but to a secondary surgical complication. The case, moreover, teaches some important physiological, pathological, and clinical lessons, and suggests practical reflections which may prove useful to future medicine and surgery.

History

The patient was a farmer, 25, who applied for advice to the Hospital for Epilepsy and Paralysis, Regent’s Park, on November 3rd, 1884. His chief complaint was paralysis of the left hand and arm, which incapacitated him from work. He stated that his family history was unimportant, that he had always been temperate and in robust health, and that he never had suffered from syphilis or a day’s illness of any kind in his life. About four years ago, while in Canada, a piece of timber fell from a house, struck him on the left side of the head and knocked him down. He thinks he lost consciousness for a few moments, after which he so far recovered as to be able to resume his work. On the following day he was quite well. With the exception of occasional slight headaches he afterwards remained in good health for a year, at the end of which time he first began to experience a feeling of twitching in the left side of his mouth and tongue. This soon developed into attacks of a paroxysmal character, which gradually became more pronounced and frequent, and continued to occur at irregular intervals. Some months afterwards he had a “fit” which began with a peculiar feeling in the left side of the face and tongue, and turning of the head to the left side. The sensation ran down the left side of the neck to the arm and leg, and culminated in loss of consciousness and general convulsions. For a few days subsequent to this the patient suffered from headache, and felt generally unwell, but ultimately regained his former condition. For two and a half years, although maintaining his robust health, he was subject to daily recurrences of the paroxysmal twitchings of the left side of the face without loss of consciousness, and also to the more severe general convulsive seizures with loss of consciousness, which occurred on an average about once a month. Six months before admission spasmodic
twitchings of the left hand and arm, without loss of consciousness, were observed and these have continued daily, alternating with the already mentioned twitchings of the face, the two, however, rarely occurring at the same time. Shortly afterwards weakness of the left fingers, hand and forearm was experienced, which gradually increased to complete paralysis. Since the upper extremity began to be affected, there had been no recurrence of the general convulsive attacks with loss of consciousness. The patient was able to continue at work till August, 1884, when the weakness of the arm prevented him using his tools. Since then twitching of a like nature has taken place in the left leg, which usually supervenes upon, and is accompanied by, similar attacks in the arm on the same side. Quite recently the left lower extremity has been weak and the patient has walked a little lame.

Present Condition

On examination the patient was found in robust general health. His intelligence was unimpaired. All his organs and functions were normal except those about to be described. He suffered from frequent violent paroxysmal attacks of lancinating pain in the head, not localized but diffused over the vertex. There was nothing abnormal to be detected on the scalp or skull, and there was no special tenderness. On deep and hard pressure there was an area, not strictly defined, which seemed to be more sensitive than the neighbourhood. This was situated in the parietal region, close to the right of the sagittal suture, on a level with a line drawn vertically from the anterior portion of the external meatus of the ear. The movements of the eyeballs and pupils were normal; vision was normal, the patient being able to read No. 3 of Jaeger’s types at twelve inches with the left, and No. 5 with the right eye. Examination of the fundi showed all the usual appearances of optic neuritis on both sides, most marked on the right, in the retina of which a number of small haemorrhages were discernible. There was slight comparative immobility of the left side of the face, chiefly elicited by attempts at forced movements. The tongue when protruded pointed slightly to the left. Articulation was normal. The hearing was asserted by the patient to be normal, but was less acute in the right ear. A watch which on the left side was heard at three feet, was only detected on the right at eight inches. The common sensibility of the head, and the other special senses were normal. There was complete paralysis of the left fingers, thumb and hand. The movements of the elbow-joint were very limited, and those of the shoulder impaired. There was no attempt at supination or pronation of the forearm. There was no trace of rigidity or wasting of the muscles. The irritability to mechanical stimulus of those of the forearm was markedly increased, and the temperature of the skin was lower on the left as compared with the right side. The left lower extremity was stated to be weaker than the right, but, when the patient lay in bed, its movements seemed much the same as those of the other, but were performed with more hesitation and less alacrity. When walking there was slight lameness, the toes were not completely cleared from the ground, so
as to necessitate slight swinging of the leg in progression. The limbs were of equal size and the muscles of normal appearance. Their mechanical irritability and the knee-jerk phenomenon were greater on the left side, though somewhat excessive in both. The temperature of both legs was equal. The sensibility of the skin was everywhere normal, and the appearance of both sides of the body was the same.

Progress of the Case

While under observation in the hospital the condition described continued. The patient suffered frequently from paroxysmal attacks of lancinating pains in the head. These lasted sometimes for twelve or more hours at a time, and they were so violent that the patient was occasionally delirious and kept the whole ward disturbed with his cries. There were intervals during which he was entirely free from pain. He also suffered from seizures of very severe sickness not specially associated with the headaches. During these he vomited all food, and when the stomach was empty continued to retch with great violence. This would sometimes last for several days, causing great distress, and much reducing the strength of the patient. During residence in the hospital the attacks of paroxysmal twichings of the muscles were frequently observed. These occurred many times every day. The most common form was a rhythmical tremor which began in the first, second, and third fingers of the left hand, which afterwards spread to the thumb and wrist as far as the elbow. This continued for perhaps a minute, and then ceased, generally by the limb being held or rubbed. Another form began in the left angle of the mouth and side of the face, and a feeling as if the tongue was being contracted. These parts also continued to twitch for a minute or two. These two kinds of attacks rarely occurred at the same time, but took place independently of one another. Sometimes, but not commonly, the movements began in the face or arm, extended from the one to the other, and from thence down the side of the neck and body to the leg, so that the whole left side was convulsed without any loss of consciousness. The leg was never observed to be affected by itself.

Diagnosis

All the circumstances of this case pointed to an encephalic growth on the right side. This was more especially evidenced by the slow and insidious invasion of the symptoms, the gradual progress and special distribution of the paralysis, the violent intracranial pain, the uncontrollable attacks of vomiting, and the double optic neuritis. Whether a tumour on the right side of the brain was caused by the blow on the left side of the head a year previous to the development of the first signs of ill-health, must remain uncertain.

It was also concluded that the morbid lesion involved the cortical substance, because certain motor phenomena were developed, and certain motor districts implicated after a definite method and in definite order; the paralysis was unaccompanied by any alterations in sensibility; and above all, because of the ex-
istence of certain paroxysmal seizures of
local convulsion, without loss of con-
sciousness, which were eminently sug-
gestive of irritation of cerebral grey
matter.

The special seat of the lesion was fur-
ther believed to be the middle part of the
right fissure of Rolando. This conclusion
was arrived at by the consideration of the
combined revelations of physiological
experiment and clinical observation.
After centuries of doubt and confusion
on the subject of cerebral localization,
quite recent investigations have at last
rendered it certain that around this
tsulcus are grouped those nervous areas
which preside over the movements of the
other side of the body. Adopting the
topography of the brain constructed by
Professor Ferrier as the result of his
well-known researches, it may be said in
general terms, that the motor centres
which govern the voluntary movements
of the lips and tongue are situated in the
lower portions of the ascending parietal
and frontal convolutions. Higher up in
the same gyri are the areas for the
muscles of the face. Occupying the mid-
dle portion and nearly the whole extent
of the ascending parietal convolution are
the centres of the fingers and hand. In the
middle of the ascending frontal convolu-
tion are those elements which originate
movements of the arm and upper arm,
including flexion, pronation, and
supination of the forearm. At the su-
perior and posterior aspect of the ascend-
ing parietal convolution is the centre for
the lower extremity, and at the upper and
anterior portion of the ascending frontal
convolution are centres for complex
movements of both the upper and lower
limbs. Now, in the case before us there
was complete paralysis of the fingers and
hand, with inability to pronate and
supinate the forearm. there was partial
paresis of the movements of the elbow,
and weakness of those of the shoulder-
joint. There was also slight paresis of the
leg and one side of the face. Accompa-
nying all these there were paroxysmal
convulsions in all these regions, occur-
rting either singly or in definite order one
after the other. These phenomena were
to be accounted for by an extensive but
not absolutely complete destruction of
the motor centres of the fingers, hand,
and forearm, with slight encroachment
on, and irritation of, those of the face,
upper arm, and leg. A very definite local-
ization of the disease was thus permit-
ted, and the tumour was pronounced to
have occupied the whole thickness of the
middle two-fourths of the ascending
parietal convolution, and a portion of the
adjoining upper half of the ascending
frontal convolution. The morbid lesion
whilst almost completely destroying
these areas, in addition modified the
functions and caused irritation of those
in their neighbourhood, without
seriously involving their structure,
many, the superior and inferior ex-
tremities of the ascending parietal and
frontal convolutions, and the postero-
parietal lobule.

Having thus accurately localized the
position of the tumour, its size could as
a consequence be approximated. As-
suming the disease to be limited to the
cortex at the point already indicated, the
fact that the centres of the leg above, of
the face and tongue below, of the sense of sight behind, and of the movements of the eyeballs in front, were not seriously involved, proved that the growth was of limited size. A glance at the relative position and size of the convolutions of the human cerebrum indicate that a foreign body occupying such a position could not, roughly speaking, exceed some two inches in diameter. It was probable that the growth took its origin in the lower third of the ascending parietal convolution, and as it increased in size spread upwards and backwards, further involving its substance and part of the ascending frontal convolution, finally reaching the lower edge of the posterio-parietal lobule. Such disease might therefore be represented by an ovoid mass the size and shape of a pigeon's egg, lying obliquely in the Fissure of Rolando. This theoretical reasoning arrived at before the operation, subsequently proved to have been substantially correct.

The question finally arose whether the tumour was confined to the cortex or whether it was situated in the centrum ovale below, and from thence invaded the grey matter. It was not forgotten that a slowly growing mass, reaching considerable dimensions, might develop in the conducting elements of the brain, without causing symptoms capable of exact definition. It was also fully recognised that a small tumour immediately under the cortex and involving its under surface might cause precisely the same symptoms as one limited to the grey matter. From an operative point of view the existence of even a large growth, which in this case was improbable, would not necessarily interfere with the procedure, because in that case little harm could be done to the life of the patient, and his urgent symptoms, on the other hand, might be relieved by the simple process of trephining. If the tumor was small the grey matter could be incised and the mass removed. As a matter of fact this last is what actually was done in the case under consideration, the growth being found in the centrum ovale, under the cortex, involving the convolutions before determined.

As to the probable nature of the tumour, the age of the patient, the absence of syphilis, and the slow growth of the disease suggested glioma, but on this point no definite conclusions were hazarded.

Treatment

The patient was ordered the bromide and iodide of potassium, twenty grains of each, thrice daily, which he took for a month. Ice to the head gave no relief, and the vomiting was unrelieved by any treatment. The severe pain was alleviated by hypodermic injections of morphia.

The terrible sufferings of the patient rendered life intolerable to him. All remedial measures having failed, and as it was obvious that his symptoms were extending, and that a fatal termination was not far distant, it was determined that an attempt be made to remove the morbid lesion. It was hoped that even if such a proceeding was not permanently successful it might alleviate some of the more pressing symptoms. The novelty and risks of the proposed treatment hav-
ing been fully placed before the patient and his friends, they readily consented to the adoption of any measures which offered any prospects of mitigating the urgent distress or of averting a certain death.

Operation

In order to expose the cortex of the brain at the middle third of the Fissure of Rolando the following procedures were adopted. A longitudinal line was drawn between the frontal and occipital protuberances, down the middle line of the scalp. A second line was drawn at right angles to this at the level of the anterior border of the external meatus of the ear. Parallel to this a third line was drawn at the level of the posterior border of the mastoid process, which reached the longitudinal line about two inches behind the second. From the junction of the first and third lines, a fourth was drawn diagonally downwards, reaching the second at a point two inches above the external meatus. This diagonal line was believed to represent the direction of the Fissure of Rolando. The spot where theoretically the centre of the trephine should have been placed was about half an inch behind the diagonal and about one and a half inches from the longitudinal line. As there was a tender point on the scalp about two inches anterior and to the inside of this, it was determined to make the first opening in the skull between the two.

On November 25th, a trephine one inch in diameter was applied to this region and a circle of bone removed. The centre of the aperture was one and a quarter inches from the middle line and half an inch behind a line drawn vertically from the meatus of the ear. The dura mater was found normal in appearance. In this a crucial incision was made, through which the brain substance bulged, as was thought, abnormally. The surface appeared somewhat more yellow in colour than natural, but was otherwise apparently as in health. A second trephine opening was made, slightly overlapping the first external and slightly in front of it, and the angles thus left were rounded off with a chisel and hammer, the brain being protected by a copper spatula. The incision in the dura mater was prolonged, exposing an increased surface of brain but without further revelations. The trephine was applied a third time so as to join the two former openings posteriorly and when the edges were chipped off a triangular aperture with rounded angles was left, measuring two by one and three-quarter inches. The incision in the dura was then prolonged, exposing a surface of brain nearly the size of the opening in the skull, which presented the same appearance as that already described. Occupying most of this space and crossing it obliquely from above and behind, forwards and downwards, was a convolution, down the posterior aspect of which ran a large blood vessel. Into the centre of, and parallel with this convolution, an incision about three-quarters of an inch in length was made with a scalpel. From an eighth to a quarter of an inch below the surface, a transparent lobulated solid tumour was seen, thinly incapsulated, but perfectly isolated from the surround-
ing brain substance. After prolonging the incision in the cortex, the surface and sides of the growth were easily separated by means of a narrow spatula of steel so tempered that it could be bent into any shape required. The mass was conical in shape the base being upwards. After its superficial portion was isolated, the finger was, as far as possible, inserted behind the tumour and attempts made to enucleate it. In doing so the upper half broke across. A large Volkman’s sharp spoon was then employed to scrape out the deeper parts of the growth; and this was continued till all the morbid material was removed and apparently healthy brain matter only remained. This part of the operation was rendered difficult by the rapid welling of blood into the wound. No artery of any size spouted but there was a general oozing, which accumulated rapidly as soon as the sponge was removed. The cavity thus left was about one and a half inches in depth and of a size into which a pigeon’s egg would fit. The haemorrhage was arrested by applying over the cut surface a suitable electrode from an electro-cautery. The dura mater was then drawn together at its anterior part by a few carbo-lised silk sutures, and a drainage-tube of moderate calibre, made of india rubber, was inserted into the wound beneath the dura at its posterior border.

The skin was brought accurately together, except where the tube lay, by silver wire and silk sutures. During the entire operation the carbolic spray was used, and both before and after, all the ordinary antiseptic precautions were taken.

It may be questioned whether it was advisable to arrest the haemorrhage from the interior of the wound by means of the galvano-cautery. Such a proceeding leads of necessity to the formation of a considerable amount of detritus which may afterwards prove detrimental. The bleeding moreover was not severe and would no doubt have become arrested by natural means. The advisability of introducing a drainage-tube may also be questioned. It was not judged safe to completely close so large a wound, distended as it must have been with accumulated serum and blood. Moreover, had putrefaction not occurred it is not likely that the soft india-rubber tube would have caused any serious irritation. The argument in favour of complete closure of the wound, so strongly advocated by those whose experience is confined to operations on the brains of monkeys is, it is maintained, not convincing when applied to a large injury in the human subject, the more rapid healing of the tissues of the lower animals being a matter of common knowledge. Another point of doubt is the propriety of introducing sutures into the dura mater. The wound was dressed with carbolic acid gauze, completely covering the scalp and firmly fixed in position with bandages. During the entire operation, which lasted two hours, the patient took chloroform without a bad symptom, and no nervous phenomena were developed. Subsequent examination proved the tumour to be a glioma about the size of a walnut, presenting the usual microscopical appearances of that disease. The most important matter for
discussion, however, is the occurrence of putrefaction, which undoubtedly appeared in the wound some days after the operation. This, it may be maintained, was the cause of the inflammation and consequent hernia cerebri. All the usual antiseptic precautions were taken during the operation, and the only flaws in its strict application which suggests themselves are, first, that the scalp was not sufficiently purified prior to the operation, and second, that no special measures were taken to carbolise the galvano-cautery apparatus. In future operations of this nature it is strongly urged that surgeons should not only employ carabolic acid, but also a solution of corrosive sublimate as antiseptics, and that the scalp should not only be rubbed with these, but soaked with them for some hours previously. There may have been other sources of septic contagion in the washing of the sponges, or from the blisters on the neck which escaped observation. It may be doubted whether the putrefaction was ever completely subdued: the fact of the meningitis occurring at last, and that of a smell having again become apparent after the attempts at removal of the second protrusion, point probably to a continued septic infection. As to the hernia, two observations only have to be made. First, it was remarkable that the discharge continued for such a long time to be so copious and so watery, which suggested the idea of its being cerebro-spinal fluid. Secondly, there was a difficulty in shaving it off owing to the enormous size of its base, and to the danger of serious haemorrhage.

Clinical Phenomena Following Operation

The patient, on recovery from the effects of chloroform after the operation, was found perfectly intelligent, the former pain in the head, and violent twitchings in the limbs, had disappeared and never returned, there was no increase of the paralysis of the face or leg, and all the organic functions remained normal. The only change which had taken place was completion of the paresis of the upper extremity, which was now paralysed throughout. This was evidently due to the unavoidable destruction of the remaining arm centres in the removal of the tumour. Otherwise the neighbouring brain matter had not been injured, as was evidenced by all other functions remaining intact. The surgical operation itself in no way injured the nervous centres with the exceptions mentioned, while it immediately relieved all the distressing symptoms. This satisfactory condition remained unchanged for four days, when the discharge from the wound was found to have a putrid smell. Coincident with this began the hernia cerebri, and following its development, arose fresh symptoms in the shape of paresis of the left leg and partial anaesthesia of one-half of the body. These were probably due to the effects of simple pressure, and possibly to the subsequent secondary softening of the conducting fibres caused by it. That the inflammatory condition which led to this was purely local was shown by the fact that, with the above exception, the condition of the patient remained in all respects as before the operation. The
temperature never reached 100° or the pulse 100 beats per minute. The intelligence was absolutely intact and the appetite and general condition in every respect satisfactory. The patient had lost all pains in his head, all traces of twitchings of the limbs, and all his severe attacks of vomiting. Even the double optic neuritis had markedly diminished. This state continued daily to improve till the twenty-first day, when suddenly the patient was seized with a rigor followed by fever and all the symptoms of meningitis from which he died a week afterwards. This inflammation was afterwards seen to be local and due to septic matter from the wound causing irritation of certain areas of the cerebral membranes. Putrefaction was the sole cause of this condition. Hope may be entertained that by its prevention in other cases a more satisfactory termination may be looked for. Although meningitis continued to a fatal end, no new nervous symptoms supervened, the absence of which was probably due to the presence of a hole in the skull, through which excess of pressure was relieved.

Revelations of the Autopsy

After death, inspection of the parts showed that the brain was practically everywhere healthy except the area injured by the operation and the membranes in its immediate neighbourhood. From its lower border a narrow tract of recently effused lymph extended downwards by the temporo-sphenoidal lobe towards the base of the skull, over a large portion of which it spread, leaving the adjacent parts healthy. It was therefore obvious that this condition was produced by irritating matter from the interior of the wound, flowing downwards between the layers of the arachnoid, accumulating at the base, and by its presence causing meningitis in its track. The local inflammation of the wound had so opened out the parts and separated the adhesions as to permit the discharge to percolate into the cranial cavity, but not till three weeks after the operation. Had this not occurred there is no reason why the healing process should not have been maintained, and the entire wound become ultimately cicatrised. The patient would then have continued permanently in a satisfactory condition, and escaped the secondary and fatal complication. The recovery from serious surgical injuries to the brain substance of man, as well as experimental researches on that of animals, show that such a termination is perfectly possible.

The cortical substance at the edges of the wound in the brain was firm and healthy, except at the inferior border, which was slightly softened, probably from infiltration of the meningeal effusion. The deficiency in the grey matter was clearly defined and the portions of absent convolutions could be accurately limited. On the subject of central localization only general conclusions can be drawn, as the destruction was not limited to the cortex, but in great part was situated in the centrum ovale below. The fibres, however, thus injured were those corresponding to the grey matter above, and may therefore be said to represent the conducting media of the higher
centres. The symptoms immediately before the death of the patient, as far as they go, entirely harmonize with those which have already been determined by experimental inquiry to arise from corresponding lesions of cortical matter, with others superadded, which can be easily explained by the processes of pressure and softening in the neighbourhood. The inferior extremities of the ascending frontal and parietal convolutions being found only very slightly involved, accounts for the almost total absence of orolinguai symptoms during life. The almost total destruction of the remainder of the ascending parietal convolution explains the complete paralysis of the fingers and hand, and the partial paresis of the face. The lesion of the middle third of the ascending frontal convolution produced the immobility of the elbow and shoulder joints, and the loss of pronation and supination in the forearm. The almost complete immunity from disease of the lower part of this gyrus permitted the nearly natural movements of the face, lips, and tongue during life. The bases of the three frontal convolutions were perfectly healthy, but a day or two before death temporary conjugate deviation of the eyeballs was observed, both being turned towards the left, which was probably due to irritation of these regions by the neighbouring disease. At no time was there any paralysis of the muscles of the eyeballs. The posterioparietal lobule was found almost intact, its anterior margin only being involved in the wound. For some days after the operation the patient moved his left leg freely, and it was only after the appearance of the hernia that the limb became paralysed. This was therefore due not to destruction of the cortical centre of the lower extremity, but to pressure and softening within the wound. This was evidenced by the sinking in of the healthy convolutions on the inner aspect of the hemisphere at a point exactly corresponding with the situation of the conducting fibres of this region. The anterior portion of the supra-marginal gyrus was absent. This convolution Professor Ferrier associates with the sense of sight. In this case there was no evidence of any serious impairment of vision or hemiopia, although the patient saw better with the left than with the right eye. There was, however, double optic neuritis, most marked on the right side. The deficiency in sight was evidently due to this and not to a central lesion, in which case the weakness of vision would have been chiefly in the opposite or left eye. It is therefore probable that no appreciable loss of function could be attributed to the disorganization of a portion of the right supra-marginal gyrus. It is, however, to be observed that the convolution was only partially destroyed, and Professor Ferrier has shown that even when it is completely obliterated on one side the consequent blindness on the other is only temporary, the opposite centre apparently rapidly compensating for the loss. Shortly before death the patient, though sensible, talked very volubly, carried on conversation with imaginary persons, and recited the most elaborate and yet perfectly coherent adventures. May these not have been the result of visual hallucinations, and due to irritation of this centre?
Although the right superior temporo-sphenoidal convolution was somewhat softened it was not so to any great extent, and it was probably recent and due to mechanical infiltration. During life the hearing of the left ear was perfect. The comparative deafness on the right side was due to deficiency in the auditory apparatus and not to a central lesion.

The destruction of the centrum ovale for the main part corresponded with that of the cortical substance above. Its exact limits were difficult to define owing to the gradual softening in the neighborhood. The internal capsule, corpus callosum side and basal ganglia were, however, intact. So also was the remainder of the brain. The intellect, other senses, with all the organs and functions of the body except those already detailed, remained normal till the last.

Such are the main points of interest and reflections concerning a case which throughout has been a source of great anxiety and responsibility. This has chiefly been due to the fact that we have not had the advantage of any precedent of a like nature to guide us in our methods of procedure. Operations on the brain substance have not been uncommon in the history of medicine, but these have hitherto been performed either for the relief of surgical injuries, or for disease indicated by local manifestations. We have nowhere been able to discover the recorded example of a case where a cerebral tumour was diagnosed by the symptoms observed, without visible or tangible external signs, and was in consequence operated on and successfully removed. Since this has been accomplished in the present instance, the public papers have asserted that the same has already been carried out on several occasions in the Royal Infirmary of Glasgow. To this it can only be said that up to the present date no report of such proceedings is to be found in medical or scientific literature.

In conclusion, we would observe that, although unfortunately in this instance life was not permanently preserved, the experience we have gained by this case leads us to the belief that there is an encouraging prospect for the future of cerebral medicine and surgery, and that as a tumour of the brain can be diagnosed with precision and successfully removed without immediate danger to life, we confidently anticipate that under more favorable circumstances the operation will be performed with lasting benefit to the patient.

The Art of Medicine

The practice of medicine from its very nature is destructive to consecutive thought: its continuous practice weakens the very power to think consecutively . . . upon problems relating to the nature of disease, a matter very vital to progress. —Sir Thomas Lewis, Observations on research in medicine: Its position and its needs. British Medical Journal 1: 479-483, 1930.