Some of Harvey Cushing's contributions to neurological surgery

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To the older group of neurological surgeons in this country and abroad and to many members of the Society which is sponsoring the Journal of Neurosurgery, the name of Harvey Cushing has stood for a large proportion of the advances which have been made in this specialty since the time, some fifty years ago, when Sir Victor Horsley may be said to have established it as a separate branch of surgery. Indeed, a large number of those practicing neurosurgery today had the privilege of seeing Dr. Cushing at work, of hearing many of his addresses to medical societies, or of benefiting immediately by the contributions which he was making continuously to his chosen field. To those who followed his career and to others who have been concerned with the advances in neurological surgery, a recital of his outstanding accomplishments would be as out of place as it would be unnecessary, since they are well known alike to his pupils and to his many admirers. However, during the last decade a large, younger generation of neurosurgeons has arisen, and it is perhaps particularly to them that this communication may be of interest.

It would be impossible in the space of a short review such as this to do more than touch upon what have seemed to be Dr. Cushing's major communications as they have influenced neurosurgery directly. Many of his brilliant experimental and laboratory studies have been omitted or merely mentioned since I have undertaken to confine myself for the most part to his purely technical contributions. At times, however, the laboratory and the clinic overlap so intimately that the story of one would be quite incomplete without the other.

In other words, at the turn of the twentieth century it was evident that a large new field of surgery was opening, indeed had been opened, but that in this new field no one had as yet appeared who fully appreciated and was able to develop a surgical technic which was sufficiently delicate and meticulous to make operations, particularly on the brain, produce results at all comparable to the results of operations elsewhere in the body. It was at this juncture that Harvey Cushing in Baltimore began to devote himself almost entirely to the study and practice of neurological surgery at The John Hopkins Hospital and in the Hunterian Laboratory of the medical school.

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The results of this study and practice began almost immediately to appear. In 1900, Cushing published the details of a method for the total extirpation of the gasserian ganglion. In essence, it was a refinement of the so-called Hartley-Krause procedure, but because of this refinement a complete removal of the ganglion could be accomplished for the first time with certainty, whereas by the older methods, removal almost always had been either incomplete or uncertain. The operation described in this article is, to all intents and purposes, the same subtemporal approach which is used today for division of the sensory root behind the ganglion. Cushing's illustrations show that not only the ganglion but also the sensory root of the trigeminal nerve was extirpated, but it was not realized until the work of Spiller and Frazier a year later that it was necessary only to divide the root, thus making removal of the ganglion superfluous.

During the next five years there were several notable contributions. In 1901, Cushing's announcement of a regulating mechanism in the vasomotor center for the control of blood pressure during cerebral compression was an epoch making event. This study was and is so important for the understanding of clinical states, operative complications, traumatic brain conditions and the like that it must be included here, although this review is primarily from the clinical standpoint. As Cushing himself stated, the fact that cerebral compression occasions a rise in blood pressure is universally known, but it does not seem to have been recognized that the degree of this elevation occurs pari passu with the degree of compression (measured in millimetres of mercury) to which the medullary centres are subjected.

The article contains beautiful kymographic records showing synchronised blood pressure and intracranial pressure tracings. The author summarized his findings as follows,

As a result of these experiments a simple and definite law may be established, namely, that an increase in intracranial tension occasions a rise of blood pressure which tends to find a level slightly above that of the pressure exerted against the medulla.

In 1903, Cushing's first formal paper on the routine taking of blood pressure during operations and in the clinic was read at the Boston Medical Library. He had introduced the Riva-Rocci blood pressure instrument into this country in 1901 and had made reference to its use in his Mütter Lecture in Philadelphia the same year. The importance of this measure as a routine in surgical anesthesia charts needs no emphasis since it has become a standard procedure in every first-class hospital. In this, as in other important innovations, Cushing had to reiterate his plea many times before routine blood pressure determinations during operations were adopted. In 1905 at Cleveland, he gave the following pertinent reasons for blood pressure readings, "Such a record not only furnishes instructive... general data, but often furnishes a means of properly interpreting the effects, beneficial or otherwise, of the various operative steps."

A minor contribution in 1904 was the description of a pneumatic tourniquet for the control of scalp bleeding during operations. This was an improvement on tourniquets previously used, but he himself later discarded it for a simpler device which was used until tourniquets were entirely discarded, probably because of the advent of Novocain and adrenalin anesthesia at the time of World War I.

In the following year (1905) two highly significant papers appeared. The first of these was concerned with the operative treatment of intracranial hemorrhage in the newborn. Until that time this unfortunate condition had been considered hopeless and the pitiable victims who survived the hemorrhage were destined to various states of spastic paraplegia, usually with seriously impaired mentality, blindness and other evidences of cerebral damage. Cushing was able to report four operative cases with two recoveries from serious subdural hemorrhage in infants from three to eight days old. Subsequently (1910) he reported 12 further cases with recoveries in about half the patients and without the development of spastic paraplegia. In this second article he likewise stated that one of the infants upon whom he had operated in 1905, "is now a healthy and normal child of five years of age."

Cushing's other important paper in 1905 related to palliative decompression for inaccessible brain tumors. It had long been known, through the work of Horsley, Sänger and others, that an opening in the skull accompanied by incision of the dura in patients harboring a brain tumor would almost always relieve headaches and other pressure symptoms and preserve eyesight by allowing choked discs to subside. Heretofore, however, these operations had been performed, as a rule, either at the supposed site of the tumor, whether or not the tumor had been found, or, as advocated by Sänger (1902), in the right postcentral region in right-handed persons. In other words, the procedure had been used by others apparently as an adjunct to either possible or probable tumor removal, or had been done in an area which was covered only by scalp, and in the latter instances often caused unsightly protrusions or even made incipient paralyses worse because of hemorrhage or edema in the protruding herniation. Cushing's invaluable contribution was, first, the fact that he advocated decompression often as a purely palliative measure when there was no expectation of the ability to remove an inaccessible tumor, and secondly, his advocacy of the use of an area that was protected not only by scalp but also by muscle, that is, the low right temporal region in right-handed persons for supratentorial growths and the suboccipital region for tumors below the tentorium. Referring to his 1905 paper, he himself has expressed the situation regarding "decompression" at the time when this subject was so much in vogue, and summed