Brains of Prominent People: History, Facts and Significance

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The historian of neurology notes with no small surprise that an ever-decreasing interest in the study of the so-called brain of the elite has led in the last decades to an almost total disappearance of the subject from brain-anatomical and brain-anthropological research laboratories and from published material. The historian is able to cite several reasons for the growing unpopularity of the investigation of brains of prominent people. First of all, it is undeniable that the results of the studies of these brains, once undertaken with a naive optimism and enthusiasm, were rather disappointing and discouraging and certainly not in proportion to the time and effort invested. Furthermore, the overwhelming part of these investigations can be traced back to the time when the anatomical method used in this area of brain research was that of gross morphology or pure inspection. With the rise and growth of histological and particularly cytoarchitectural knowledge and methods, the gross-morphological study of the so-called brain of the elite lost much and, in the eyes of some investigators, even all of its credit.

Ever since cytoarchitectural areas became the new constituents or structural units of the cortex and proved to have borders that seldom coincide with the convolutions, once studied so eagerly and in such great detail as to their limits, courses, sizes, anastomoses, branches and occasional submersions, all these morphological criteria have largely lost their meaning. It is only occasionally recognized that the number of cytoarchitectural areas having a *known* physiological significance remain surprisingly small in proportion to the great number of cytoarchitectural areas distinguished in the human and mammalian brains.

Moreover, the doctrine of cerebral localization of *functions,* on which the whole idea of the brain of the elite ultimately rests, has been increasingly compelled in the last decades to retreat behind the doctrine of cerebral localization of *symptoms* which is all the physician has to deal with in his attempt to reach a regional diagnosis in life as well as in post-mortem examination. With the growing insight into the history of nervous function and the *chronogenetic* and successive involvement of wide cerebral areas in the maturation of even the apparently elementary functions, little hope remained for a circumscribed seat of nervous functions, particularly the so-called highly evolved functions, such as language, mental abilities, etc. These functions defied any attempt to assign to them a few square millimeters of brain tissue as their restricted local residences. In other words, little hope was left for a revival of the once so popular doctrine of the seat of the soul in neuroanatomical terms. Thus, at this crucial point of growing understanding the new concept of *integration,* i.e., the cooperation of *all* parts of the nervous system, if not of the whole organism, in the final activity of each single part became incompatible with the once cherished idea of the brain as a compound of *isolated* functions and structures.

In restudying the brains of emi-

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nent people, I have been fully aware of the limit set to this type of investigations, as well as to its scope and teachings. Ultimately, one deals here with the age-old problem of the interrelation of mind and body. I believe that this problem cannot be discussed solely in anatomical terms and that its solution (insofar as it is possible) belongs before another forum. The shift in method from purely morphological to histological investigations might therefore be of lesser importance for the basic problems and principles implied in these studies than one might be inclined to think. It is with all these restrictions in mind and in this spirit of humble caution that I submit in the second part of this paper the results of my findings in the brains of two prominent people.

The first to investigate brains carefully whose bearers had been known for their outstanding accomplishments was Retzius (1905). It is true that many years previously Rudolph Wagner (1860) had compared five brains of scientists from Göttingen with brains of "ordinary" people. He reached the conclusion that neither weight nor richness nor complication of the fissural pattern were criteria of outstanding mental ability.

After Retzius, Klose (1920) reviewed all brains of the so-called elite and of such individuals who had exhibited certain one-sided gifts. To this material Klose himself added the description of the brain of a musical prodigy. The brain of Ernst Haeckel has been the subject of a detailed investigation by Friedrich Maurer (1924). The latest investigations were devoted to the brain of Pilsudski, described by M. Rose (1939), and the brain of C. von Monakow, described by R. Anthony (1935). The Moskow Brain Institute reported on the brains of Gorky, Pavlov and other Russian scientists and artists (Blinkov and Poliakov, 1938). We have not been able to obtain any details.

What has been the result of these investigations? In the first place, the number of negative cases is far less than that of the positive ones. Only Sernow (1879) and Stieda (1908) were not able to find any peculiarities in the cerebral surface of brains of distinguished people.

The investigations of Retzius appear to have shown such peculiarities, especially a particularly rich development of the fissures. Thus, Retzius writes about the brain of the histologist and physiologist Christian Lovén

> . . . that the external morphology of his brain is quite in accord with his well recognized intellectual gifts. We are, however, not yet able by studying the differences in the behavior of the gyri to draw conclusions from these differences concerning the special gifts of a particular individual.

It is to be expected that the peculiarities of the fissural pattern become clearer the more distinct and the more localizable are the peculiarities of the individual whose brain is examined. In other words, as certain special characters emerge within the total pattern, it should become possible to recognize their morphological expression in the brain. This has been demonstrated particularly well in the brains of outstanding musicians examined by Auerbach (1906, 1908, 1911) in the Frankfurt Neurological Institute. The acoustic sphere was indeed particularly well developed in these brains. Auerbach was inclined to consider the superior temporal gyri as important for the understanding of music. Those of the left hemisphere are probably more important than those of the right one, although their dominance may not be quite as pronounced as in the case of language. In principle, Klose (1920) corroborated this assumption. He found in the brain of the pianist Goswin Soekeland an exceedingly good development of the superior temporal gyrus, including Flechsig's acoustic gyrus and also the central gyri, particularly the precentral one, predominantly their middle third. The special development of the temporal gyrus was regarded as an expression of outstanding sensory gifts, that of the precentral gyrus as an expression of outstanding technical abilities. Moreover, Klose found a well pronounced supramarginal gyrus, considered as a substrate of an ability for musical invention and composition. Spitzka (1907) reported a particular development of the occipital lobe in visually gifted people. It seems to be in accord with these findings that the brain of Ernst Haeckel showed abundant convolutions of the outer aspect of the occipital lobe and a large development of the calcarine fissure. Haeckel was an outspoken "visual type."

It is widely believed that for creative acts not only the inferior parietal lobule but also the frontal lobe is important. Spitzka pointed to its high development in philosophizing persons. Maurer found the frontal lobe and the angular gyrus especially well developed in Haeckel's brain. In the brain of C. von Monakow, Anthony (1935) found a general increase in volume and weight of the left hemisphere and a much more complicated fissural pattern on the left than on the right side. Particularly remarkable was the doubling of the left second frontal gyrus. The left insula, too, was extremely complex.

I was given the opportunity and the honor of studying the morphology of the brains of two prominent scientists. The brain of Ludwig Edinger, a foremost representative of comparative neurology, was studied with Kurt Goldstein (Riese and Goldstein, 1950).

Ludwig Edinger was decidedly an original thinker as is proved by his classification of cerebral structures according to their probable phylogenetic age, as well as by his theory of nervous diseases due to wear and tear (*Aufbrauchskrankheiten*). It was his wealth of ideas

which made him so unusually attractive to his students and which continually caused him to attack new problems. But he was not concerned with abstract ideas. Purely conceptual thinking was foreign to him. As a true type of a modern biologist, he focussed his attention on observables. His life's work brought into strong relief two of his unusual gifts: namely, his visual abilities, and his manual skill. In the light of these personal traits, the configuration of Edinger's brain is very remarkable. Considerable asymmetries, increase in the surface of the right frontal, parietal and occipital lobes were found. There can hardly be any doubt that this asymmetry is correlated with Edinger's left-handedness. Our findings agreed remarkably with those which Hansemann (1907) reported on the brain of the left-handed painter Adolph Menzel. It is tempting to look upon the special development of the *precentral* as well as of the postcentral *gyrus* as important instrumentalities, although by no means as the only condition for Edinger's manual skill, and to look upon the high development of the *occipital lobe* as a morphological correlate of his visual gifts, although it should not be forgotten that Edinger's gifts were far larger than what goes under the title of physiological optics in the stricter sense of the word. In contrast to the morphological behavior of those parts which mirror Edinger's natural gifts, the *temporal* lobe is structurally much less outstanding. Edinger was indeed acoustically poorly endowed. Although with some reservation, one can bring the enlarged *frontal lobe* and the enlarged *parietal lobe* (particularly its inferior part) in connection with Edinger's creative gifts (fig. 1).

Of course, neither the mass of the entire brain nor one of its parts is a reliable criterion for the *quality* of the so-called higher mental functions. Moreover, most of our knowledge about the frontal lobe is based on animal experimentation, on neurosurgery and on neuropathology. The functional disorders which have actually been observed in these conditions throw no direct light on the role this or any other part of the brain may play within the framework of the always total action in an intact organism.

The second brain of a prominent scientist (Riese, 1953) which I was able to study was that of an American scholar, physician and author known for his numerous books and papers. He, too, was an

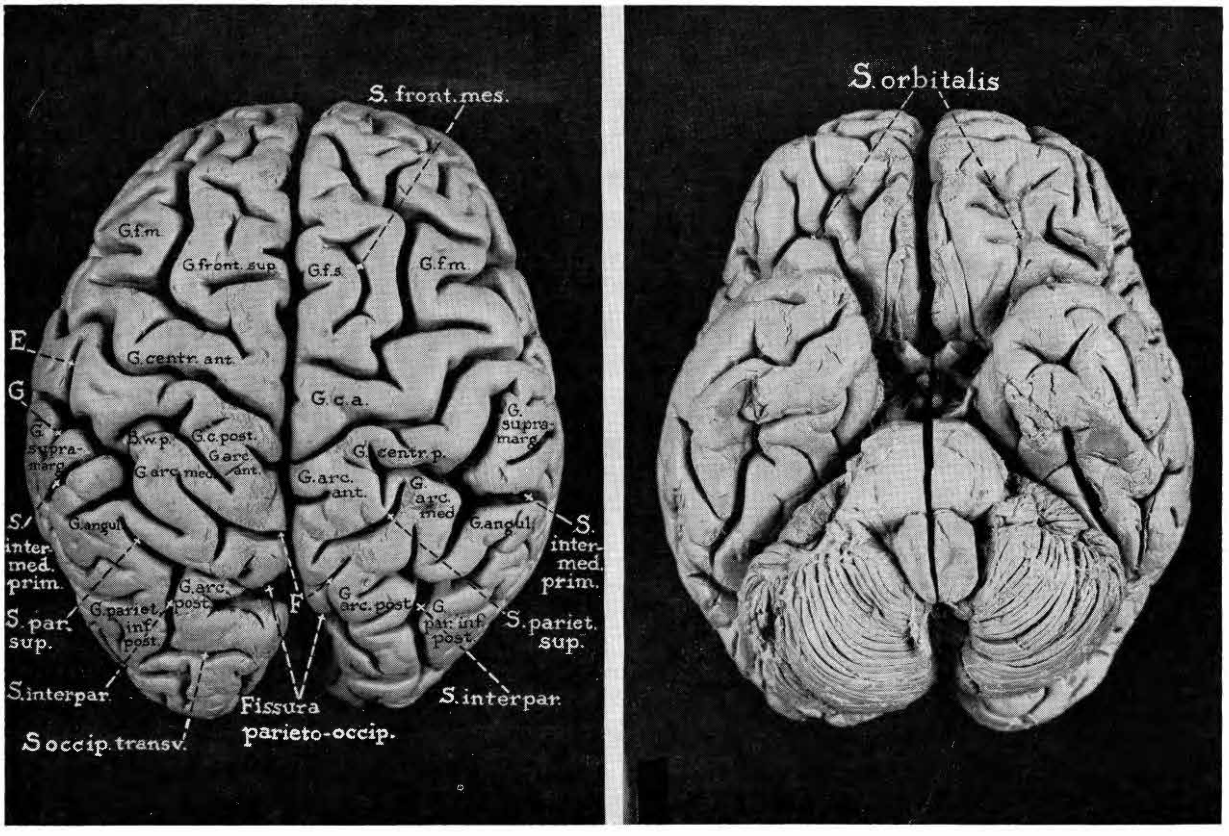

Fig. 1—The brain of Ludwig Edinger. Strong asymmetries in the frontal and parietal areas. Edinger was decidedly left-handed (figs. 2 and 3, W. Riese and K. Goldstein, *J. Comp. Neur.* 92: 162).

original thinker, somewhat esoteric and speculative, though also experimentally minded.

The study of the *convolutional pattern* revealed regional over-developments determining, in their turn, considerable asymmetries of the fissural pattern. Some of these overdevelopments were found on the left, others on the right hemisphere. This individual was decidedly right-handed. In this respect the more massive aspect and more tortuous course of the left *sensory-motor area,* including both pre- and post-central gyri, cannot be overemphasized. As a rule, the overdevelopments did not affect a given lobe as a whole; nor were the parts affected within the same lobe always on the same side. Thus, in the *frontal* lobe, the gyrus frontalis medius was much richer in convolutions on the right, while the gyrus frontalis inferior and the precentral gyrus were overdeveloped on the left hemisphere. Four gyri fronto-polares could be identified on the right hemisphere. In the *parietal* lobe, the post-central gyrus, especially its lower part, was more massive and more tortuous on the left, while the convolutions of the superior (gyri arcuati med. and post.) and, above all, those of the inferior parietal lobes (gyri supramarginalis and angularis) were much better developed on the right hemisphere. In the *temporal* lobe the left supra-temporal plane showed three instead of two Heschl convolutions. The *island of Reil* was more massive on the right hemisphere. While in the *occipital* lobe cuneus and praecuneus were more massive, more fissurated and more convoluted on the left hemisphere, a very marked operculum occipitale was found on the right hemisphere. The visual areas (areae striatae) were found to be morphologically as well as cytoarchitecturally very extensive on both sides, reaching beyond the occipital pole and cutting far into the lateral aspect of the two hemispheres.

There is no doubt that these overdevelopments must be considered as *cerebral gifts* with which this person was endowed from the beginning. However, any attempt of correlating the unusual intellectual capacities with regional structures must be made with utmost caution though the morphological gifts in the *frontal and parietal areas* of this brain cannot be overlooked.

The overdevelopment of the left and so-called dominant sensori motor area of this strongly right-handed individual, the presence of an additional Heschl gyrus or acoustic area (area 42) on the same side and the unusual extent of the visual areas (area 17) on both hemispheres stand out as a precious and an undebatable body of information obtained from the study of this brain made in correlation with the basic structure of this personality.*

CONCLUSIONS

In conclusion, in the brains of outstanding right-handed people (Haeckel, Monakow, Pilsudski) the more complicated convolutional and fissural patterns were found on the left hemisphere; in those of outstanding left-handed people (Menzel, Edinger) on the right one. The second brain reported here revealed some overdevelopments on the right, others on the left hemisphere.

Strangely enough, very little is known about side-differences in the average brain. It seems that the middle frontal convolution and the inferior parietal lobe are more developed on the right hemisphere, the inferior frontal convolution on the left one. Nothing is known about the handedness of the bearers of brains showing these side-differences.

Should one cling to the specific functional significance of regional areas of the cerebral cortex, one may be more willing to admit this significance for those relatively elementary functions (movements and sensations) susceptible of expression in terms of space than for those (thought, creative activities) resisting the latter. On this ground, the study of the brains of prominent people as well as the recently obtained knowledge of the side-differences in the anonymous brain (Connolly) would lead to the following conclusions: judging from the cortical morphology, the human brain is built asymmetrically. This asymmetry is due to regional overdevelopments. Though the latter attained an impressive degree in the brains of outstanding people, they were also found in average or anonymous brains. It seems certain that more or less extensive overdevelopments of the sensori-motor cortex are to be encountered constantly on the left hemisphere in right-handed people and vice versa. So far, no brain has ever been described in which the sensori-motor area or parts of it were more developed on the right hemisphere in a right-handed individual or on the left hemisphere in a left-handed individual. But overdevelopments of frontal and parietal areas readily related to the more elaborated and so-called higher psychic functions (semantics, language) appear on the left hemisphere of outstanding right-handed people, but also on the right hemisphere in the anonymous brain. It is tempting to conclude that many an anoymous brain belonged to an individual who, due to circumstances, was not allowed to use his cerebral gifts. This is but a brain-anthropological expression of the well known fact that many gifted people remain undetected and undeveloped.

Structures are only *instruments* which do not decide whether they may be used, to what extent and for what purpose. Moreover, the question raised by the cortical over-

* This brain is the first so-called elite brain in which a comprehensive *cytoarchitectural* examination was carried out, though only according to qualitative needs, namely for the purpose of identification, particularly of some critical or over-developed areas.

developments found in gifted individuals cannot be answered in a dogmatic manner. It depends on strictly individual constellations whether the frontal instruments of human intelligence are used, for what intellectual activities and tasks, in combination with which other cerebral instruments, by which type of individual, at which stage of his life and intellectual growth or decline, and at which stage of the history of mankind and the intellectual style proper to each period. No structure carries in itself the necessity of its permanent and exclusive use for a given performance. As far as human intelligence or any of its departments are concerned, these are ever changing functional wholes, whose anatomical counterparts or representations cannot be compressed into small compartments of our brain.

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