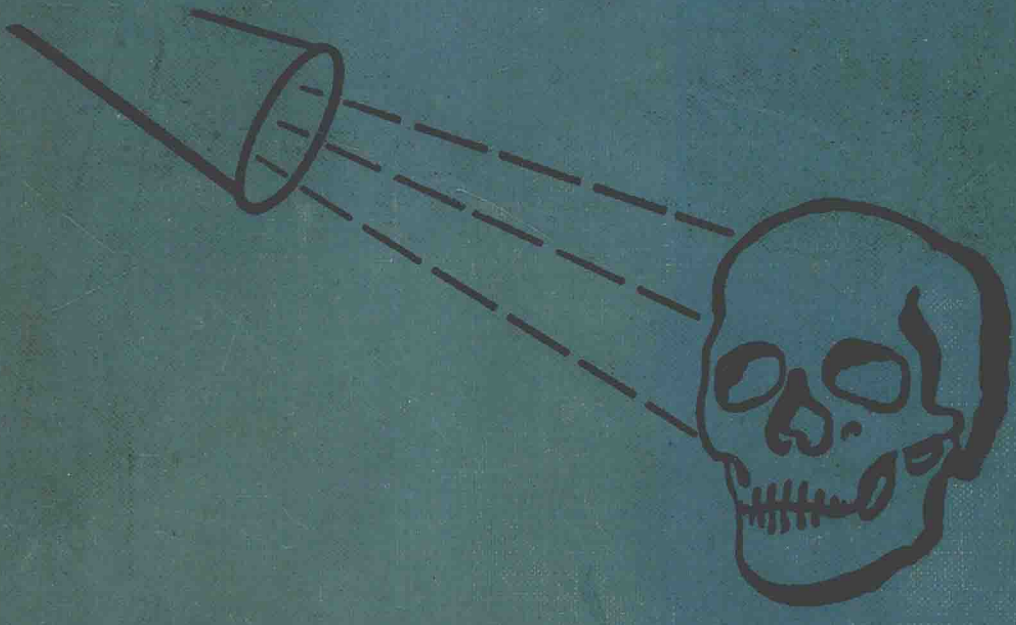

An Atlas of
SKULL ROENTGENOGRAMS

BY

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AND

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603 Illustrations on 315 Engravings

LONDON
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25 BLOOMSBURY WAY, W.C.1

PRINTED IN AMERICA

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Dedicated to

C. R. E.

AND

I. F. D.

PREFACE

THE word "atlas" is defined as "a book of large charts or illustrative plates," and it is the hope of the authors to conform to this definition in the present volume. The emphasis was placed on the plain skull roentgenogram throughout. It is our belief that pneumoencephalography and cerebral angiography have been adequately handled elsewhere, and that in all efforts to encompass the entire field of neuro-roentgenology in a single volume, many important details which can be observed in the plain films have been neglected.

The illustrations were selected for their quality and have been reproduced in as large a format as possible consistent with a volume of reasonable size. They have been carefully chosen to illustrate each point in its multiple variations and except for a few, which have been borrowed from friends, they represent cases falling within our own experience. The reproductions were made from the original roentgenograms by double printing to bring them back to the appearance of the original negatives. No retouching and no photographic manipulation were done to improve upon the quality of the original. Wherever possible, the obvious changes seen in the illustrations were described in the legends with the secure assurance that the reader will be able to identify them without special devices. We did not, however, hesitate to use arrows to indicate finer details, especially where the reproduction, which is bound to lose some of the sharpness of the original film, fails to bring out the abnormality or the variation clearly enough to catch the eye at once.

In conformity with our aim of keeping this volume an atlas, the text has been reduced to a minimum and the descriptive material largely confined to the legends accompanying the illustrations. Although no bibliography has been appended, the authors freely acknowledge the help obtained from the experience of others as described in texts and original papers in the literature.

The illustrations were drawn from our private files, as well as from the cases coming into our hands in the radiological and neurosurgical departments of the Jewish Hospital of Brooklyn, the Beth Israel Hospital of New York and the Mount Sinai Hospital of New York. We are indebted to the heads of the radiological departments of these hospitals, namely Drs. Milton G. Wasch, Arthur A. Bendick and Bernard C. Wolf. The few films loaned to us by friends to illustrate points not available from our own material will be acknowledged in the legends corresponding to these illustrations.

We are indebted for technical assistance to Mr. Jerry Sloven and Mr. Marvin Ehlin.

Dr. Joseph A. Epstein was kind enough to assist us with the marking and lettering of the films, which we duly acknowledge with thanks.

Our special gratitude is due to Dr. Emanuel H. Feiring for careful reading of the manuscript and numerous helpful suggestions. We are eternally in debt to Mrs. Hilda Feiring for the dispatch and accuracy with which she typed and edited the manuscript.

B. S. E.

L. M. D.

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Chapter

1

THE NORMAL SKULL

In a consideration of the normal skull, it is necessary to keep in mind variations of a very wide range, not only from one adult to another but also between adults of different race, size and sex. Further alterations occur in the skulls of normal individuals from infancy to senility, inasmuch as throughout life changes in structure are slowly and constantly taking place. These differences may be observed in the size and contour of the cranium, the thickness of the calvarium, the number and distribution of convolutional markings, and the diversities in the vascular patterns, both arterial and venous. Modifications in the size, number and position of pacchionian bodies and cranial foramina, as well as wormian bones, are among the many variations which may occur. Differences in the degrees of closure and in the patterns of the cranial sutures, and still others in the shape and size of the anterior, middle and posterior fossæ, may be found.

The sella turcica, which is one of the most important landmarks in the cranial roentgenogram, may show a wide range of contour, size, degree of density and shape, all within normal limits. Thus the limits for the normal length of the adult sella turcica is given between 10 and 18 mm. and the depth from 8 to 12 mm.

The pineal body, frequently the seat of calcium deposits which render it radio-opaque, is normally situated in the exact midline in the frontal projections. Its normal location in the lateral roentgenograms in relation to the vault of the skull has been established through the work of Vastine, Kinney, Dyke, Fray and others. The presence of mass lesions producing a shifting of the intracranial contents may be reflected in the position of the pineal body. As a rule displacement to the right or left may serve to lateralize a lesion. Less often the pineal may be shifted anteriorly or posteriorly, or upwards or downwards. This is best determined by the use of the Dyke modification of the Vastine and Kinney chart (Figs. 28, 29-A and B).

Aside from the normal bony structures which form the cranium, one may see calcium shadows, still within normal limits, due to deposits of lime within the dura, falx, walls of the superior longitudinal sinus, the choroid plexuses, petroclinoid ligaments, and in elderly people, in the walls of the internal carotid arteries. In many patients, particularly women past middle age, a localized irregular thickening of the internal table of the frontal bone and sometimes of the adjacent parietal bone, "hyperostosis frontalis interna," is so frequent that its presence is considered by many to be a normal variant.

In addition to the normal variations enumerated above, one may encounter disturbing shadows in roentgenograms of the skull which, on careful study, prove to be unrelated to the cranium or its contents. These include artifacts due to dirty casettes, the spillage of radio-opaque material on the roentgen table, or on bands and supports for the head used during the taking of the roentgenogram, greasy

preparations used as hair dressing, hair dyes with metallic contents, combs in the hair of women, tightly packed curls, bandages on the skull, ocular prostheses, calcified cataracts, doubled over conchi of the ears, and still others which may all cause confusion and difficulty in interpretation. To safeguard against the misinterpretation of such artifacts, stereoscopic examination is recommended. This permits visualization of the extracranial location of such extraneous shadows. Whenever doubt exists, the examination should be repeated, first making sure that any possible offending object has been removed.

In the succeeding pages, selected examples of variations in the normal skull will be presented graphically and described briefly.

NEONATAL PERIOD AND INFANCY

The roentgenologic appearance of the skull in the neonatal period and in early infancy presents similar patterns. The shape of the neonatal skull is often influenced by the molding of the cranium in the process of birth. This may result in elongation of the skull, with occasional overlapping of the cranial bones. In the frontal views the skull may be narrowed and the vertex exaggerated. These changes usually disappear within a period varying from one to several weeks. After this time the shape of the child's skull tends to assume the one it will bear later in life.

In the lateral views, the skull bones are quite thin, the vault still to a degree membranous, while the base is already well ossified. No differentiation into inner and outer tables can be discerned since the diploe have not yet formed. The anterior and posterior fontanelles are widely open, and the sutures appear as relatively wide straight lines. Within the suture lines occasional small bony islands (wormian bones) may be seen, which merge with the vault of the skull as growth proceeds. The vascular markings are not distinguishable at this stage of development, nor are convolutional impressions seen.

The paranasal sinuses and mastoid cells are poorly developed. Small air spaces are usually seen in the region of the antra and ethmoidal sinuses on carefully positioned and properly exposed films. The floor of the anterior fossa is relatively short but of good bony density. Its shape tends to be rather more convex than seen later in life, and as a rule is inclined obliquely forward and upward. In its lateral aspect this structure forms the roof of the orbit. Approaching the midline, it appears relatively radiolucent, sloping toward and continuous with the cribriform plate.

The anterior clinoid processes tend to be quite prominent and rather bulbous, and are directed somewhat inferiorly. As a rule they are superior in location to the posterior clinoids. The sella turcica is sharply outlined in relation to the solid structure of the sphenoid. The posterior clinoids are relatively short and usually do not possess expanded processes. The dorsum sellæ is fairly dense and can be readily traced to the spheno-occipital suture. Just posterior to the spheno-occipital junction are the relatively solid masses of the petrous bones. It is sometimes possible to visualize the auditory and the semicircular canals. While the mastoid tip is not easily identified, occasionally a small cluster of rudimentary mastoid diploic cells may be recognized.

The foramen magnum itself cannot be definitely visualized but its position may be estimated from the location of the body of the first cervical vertebra in relation to the atlanto-occipital junction. The temporo-occipital suture is readily apparent

posterior to the foramen magnum. The occipital bone behind this is usually quite heavily calcified, and may vary somewhat in shape. It thins out as it passes upwards towards the apex of the lambdoid suture. The indentations of the transverse dural sinuses are often present, though not clearly defined. Between the upper and lower parts of the squamosa of the occipital bones, the mendosal sutures may occasionally be seen in both frontal and lateral views. Another synchondrosis, running horizontally across the midline at the inferior margin of the squamous portion of the occipital bone at its junction with the condylar part, is often observed, especially in the lateral view. Before the occipital bone fuses in the midline near the apex at the lambdoid suture, a vertical fissure exists and may at times be seen in the Towne's view (Fig. 1-B).

The facial bones are proportionately small relative to the remainder of the cranium.

In the frontal view the petrous pyramids and lesser wings of the sphenoid are ordinarily visualized through the orbits. Alteration in projection to depress these structures permits a more adequate demonstration of the occipital bone (variations in Towne's views). In the standard film, the open fontanelle and its contiguous sagittal suture may be seen at the vertex. Extending laterally on either side are the parietal bones, which are thickest inferiorly. The vault thins out again at the temporoparietal sutures and then thickens again towards the base.

Within the borders of the parietal bones is the narrower parallel frontal vault. This may be somewhat thicker than the parietal bones.

THE SKULL DURING CHILDHOOD

Closure of the posterior fontanelle usually occurs between the sixth and eighth month of life. The anterior fontanelle normally becomes obliterated between the fifteenth and eighteenth months. At the inferior angles of the parietal bones, both anteriorly and posteriorly, small openings are found in young infants which are sometimes referred to as the lateral or the sphenoid (anterior) and mastoid (posterior) fontanelles; these too usually disappear at about six months of age, so that a two-year-old no longer shows any evidence of any of these openings.

The coronal, sagittal and lambdoid sutures present a rather variable appearance as they begin to assume the serrated adult configuration. The serrations are sometimes separated by a thin layer of unossified membranous bone which may give the appearance of a slight separation of the sutures and must be distinguished from the actual spreading due to increased intracranial pressure. At this stage the squamosal suture is usually difficult to identify. This may be due to the fact that the edges of this suture overlap to a pronounced degree.

Occasionally one sees shadows of sutures consisting of two superimposed lines, one straight, the other zigzag. This appearance is due to the fact that the inner tables of two adjoining bones very often meet in a straight line, whereas the outer tables interdigitate in an irregular fashion. In the roentgenogram these two are superimposed, usually with the straight line running through the middle of the zigzag line. It is important to avoid the error of diagnosing such an appearance as indicating a fracture through the suture. In line with this observation, it should be mentioned that at or soon after the neonatal period, linear remnants of membranous tissue in the bones of the vault are sometimes seen as lines of decreased density, which can also be mistaken for fractures.

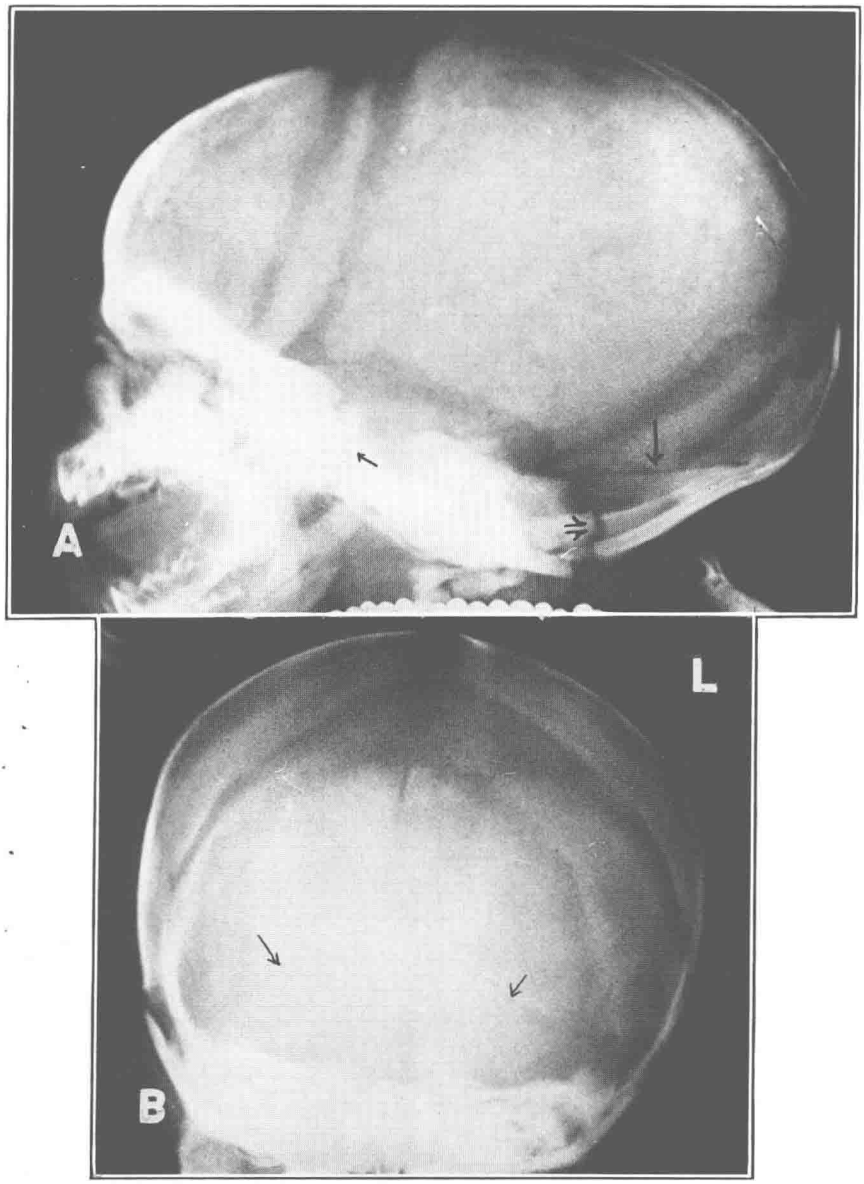

FIG. 1*A*.—Lateral roentgenogram of newborn skull. The head is elongated. Note open anterior, posterior, sphenoidal and mastoid fontanelles, wide sutures, absence of aeration of frontal, sphenoidal and mastoid cells. There are no vascular or convolutional markings. The walls of the sella turcica are dense. The anterior clinoids are bulbous and longer than the posterior ones. Note the open spheno-occipital suture (short arrow). The anterior fossa slopes, is short and its floor is rather steeply convex upwards. The face is proportionately small compared with the skull. The mendosal (false) suture is present (long arrow). The synchondrosis between the supraoccipital and lateral-occipital region is clearly visible (double arrow).

FIG. 1*B*.—Same case as Fig. 1*A*. Towne's view showing mendosal sutures (arrows) and the mid-occipital suture at the apex of the occipital bone.