

be employed as above described, in admixture with solutions of soluble salts.

When the fabric has been thoroughly impregnated and dried, and formed into the desired hood shape, it is not necessary to treat it with ammonia as described in the former specification; it may at once be subjected to the action of heat, care being taken to apply the heat first to its upper part, and then gradually downward, as may be done by lowering the burner flame within the hood or raising the hood. It is of advantage to strengthen the hood by drawing through it in various directions stronger threads, themselves impregnated with the illuminant substance, or fine platinum wires may be used. The hoods may be made as tubes, woven or knitted, some parts, especially the upper parts, being made stronger by using in these parts meshes of smaller size than the meshes generally, or by double weaving or knitting of the parts that require greater strength. Also, the hood may consist of several thicknesses of fine open fabric, or of a single fabric plaited or folded; or, instead of using fabric, a number of separate impregnated threads may be hung from a ring of platinum wire so as to surround the flame. The attachment of the hood or threads to the suspending ring should be strengthened by serving the upper part before burning with a mixture of nitrates of the metals employed and magnesium nitrate. Usually the hood is protected by being inclosed within a glass chimney like that of an Argand lamp, but when a chimney is not used it may be surrounded by a cage of fine platinum wire.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

In hoods prepared as illuminant appliances for burners, the use of oxide of thorium alone or in admixture with oxides of zirconium, lanthanum, yttrium, neodymium, erbium, magnesium, or aluminum, substantially as herein described.

Complete Specification (A.D. 1886.—No. 9,806).

*Method of obtaining Compounds of the Rarer Metals from their Earths for Use as Incandescence Bodies for Illuminating Purposes.*

This invention relates to the treatment of the earths of the rarer metals, such as minerals containing cerium, didymium, lanthanum, thorium, and zirconium, in order to obtain therefrom solutions suitable for the production of incandescence bodies such as are described in the specifications to patents Nos. 15,236 of 1885 and 3,592 of 1886.

In treating cerite, orthite, and other similar minerals containing cerium, didymium, and lanthanum, for obtaining these in a separated condition, the minerals are in the first instance heated to a red heat, with free admission of air in those cases in which iron is contained therein in the form of protoxide, in order to oxidize the iron of the cerite compounds to a higher degree, and thus avoid various difficulties in the subsequent operations. This heating process is, however, only applicable when the percentage of cerium compounds is considerable, and when the mineral is a silicate, and not fusible in ordinary temperatures. A number of such minerals comply with these conditions. In particular may be mentioned cerite, the treatment of which will now be described by way of example.

The raw material, as extracted from the earth, is heated to a red heat in lumps about the size of a fist, with free admission of air, for about an hour.

The mineral is thereby changed in such manner that its original reddish gray color has been converted into yellow, and that it has taken up oxygen. The lumps, while hot, are plunged rapidly into water, whereby they crumble to pieces, thus greatly facilitating the following disintegrating process in which the material is crushed partly to powder and partly into small particles of about the size of hemp seed. The finer particles being separated from the coarser ones, both parts are stirred in suitable vessels together with ordinary concentrated hydrochloric acid, whereby the finer particles become decomposed under evolution of heat, while the coarser particles only become slightly heated. After some days the finer particles will be entirely decomposed, and if the proper proportion of acid has been used, this will have become entirely exhausted.

The decomposition of the coarser particles takes place more slowly, and is only completed in about a fortnight. It is advantageous to draw off the lye formed after a few days, to levigate the sludge with water, and to mix it with a fresh supply of concentrated hydrochloric acid until all particles susceptible of decomposition are decomposed, which can be ascertained by the fact that the original grains of cerite will have been converted into a friable skeleton mass of silicic acid. The chloride solution obtained by the above process is precipitated by means of oxalic acid, and the oxalates are washed by decantation and through a filter cloth, and after being pressed dry they are heated to a red heat in shallow iron pans, but only to such an extent that no complete conversion into the oxides is effected.

The brown oxides, containing a considerable amount of carbonic acid, should, on being treated in the cold with concentrated nitric acid, dissolve after a short time, with ebullition, into a dark red liquid. Only when obtained in the above described manner is the preparation suitable for the following separation process.

The oxides are now stirred together with water in a fire clay vessel and heated on a steam bath, nitric acid being added in small quantities until a frothing is observed to take place after every addition.

As the composition of the minerals is very variable, even when taken from one and the same locality, the quantity of nitric acid cannot be fixed in advance.

The nitrate solution formed after the addition of the nitric acid is digested with excess of the earths. If, after about ten hours' digesting, it is not converted into a very fine yellowish red or yellowish powder, but remains of a brown color, nitric acid must again be added, and this process must be continued until the precipitate shows the above mentioned color. The supernatant lye is then of an amethyst color, and the precipitate formed is insoluble even in very dilute lye.

If, in carrying out the process, so much nitric acid has been added that the yellowish white precipitate is dissolved into a yellowish liquid on the addition of a large quantity of water, then too much acid has been

added, and quantities of the earthy sludge, obtained as above described, mixed with water, must be added until the precipitate obtained has the above mentioned properties.

In this precipitate will be contained the whole of the cerium of the original mineral in the form of a compound insoluble in water, while the lye will contain all the other rare earths.

The cerium precipitate obtained, after washing, is readily soluble in nitric acid when heated, and the dark red solution thus obtained is mainly cerium nitrate.

The principal constituents of the lye will be the elements of didymium (praseodymium and neodymium) and lanthanum.

For separating these from each other, the lye separated from the precipitate is evaporated and treated with nitric acid and ammonium nitrate, and is separated into its constituents by the formation of the ammonium double nitrates.

In order to perfectly separate the lanthanum by means of fractional crystallization, the crystallizing process must be repeated several times.

The colorless crystals of lanthanum ammonium nitrate are chemically pure, and form as solution one of the principal ingredients of the liquid for producing the incandescence bodies.

In treating zirconium this is reduced to about the size of peas, heated to a white heat under free admission of air, pulverized, and levigated, and is then digested for several days with concentrated pure hydrochloric acid, for the purpose of removing all traces of iron. The original brownish gray powder is by this means converted into a perfectly white powder, and many of the impurities originally contained in the zirconium crystals are dissolved. The fine zirconium powder is then washed and dried, and is mixed with double the quantity of calcined carbonate of soda, and, after being ground fine, it is subjected to a white heat for about three hours in a platinum crucible. The cakes of soda melt thus obtained are placed in cold clean water, when a fine white powder will be precipitated, while numerous bodies that are not useful for the purposes of the invention pass into the mother-liquor. The white powder is washed in water, dried, and treated with sulphuric acid under trituration until a sample heated on platinum clearly shows an excess of sulphuric acid.

The decomposition of the white powder by sulphuric acid takes place under considerable heating, and care must be taken that the acid is very gradually added (the powder remaining perfectly dry), as otherwise a scattering of the mass will ensue. The powder is then heated to the boiling point of the sulphuric acid, whereby the greater part of the excess of acid will be driven off. After cooling, the powder is mixed with a large quantity of cold water under stirring, whereby the zirconium will be dissolved as sulphate, together with other bodies. The undissolved precipitate is unconverted zirconium and silicic acid. This is separated by filtration and washed.

The before mentioned solution of zirconium sulphate is precipitated by ammonia in the cold, and is washed. If this material be now dissolved in nitric acid, so that no considerable excess of acid occurs, a brilliant white powder will after a short time be precipitated, which is a peculiar combination of zirconium, containing this metal in an almost chemically pure condition. The impurities, such as iron, alumina, etc., remain in the lye. This reaction is based on the fact that a small quantity of sulphate of ammonia present in a solution of nitrate of zirconium effects the separation of the before mentioned compound, completely so when heated, and partially when cold. As an excess of sulphate of ammonia dissolves the zirconium precipitate, this is to be avoided.

The precipitate containing the zirconium is almost quite insoluble in water, but soluble in nitric acid when freshly precipitated. When digested with ammonia it is rapidly converted into dense zirconium hydroxide, which is readily separated by washing. This body is then dissolved in concentrated nitric acid, and the solution is evaporated on a water bath, producing clear gum like crusts consisting of zirconium nitrate.

This substance dissolved in water forms a second main constituent of the incandescence body.

The presence of small quantities of iron, such as are contained in the preparation of zirconium heretofore made, is very detrimental to the action of the incandescence body.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is—

1. The method substantially as herein described of treating cerite, orthite, and similar minerals containing cerium, didymium, and lanthanum, with hydrochloric acid in the cold, for effecting the separation of the said metals.

2. The method substantially as herein described of separating the cerium from the minerals referred to in the preceding claim, by treating the chloride solutions thereof with oxalic acid, heating the oxalates obtained to redness, and treating the resulting oxides with nitric acid, whereby the cerium is obtained in the form of a nitrate solution.

3. In combination with the method for the separation of cerium from minerals containing cerium, didymium, and lanthanum, referred to in the preceding claim, the separation of the didymium and lanthanum contained in the lye after separation of the cerium, by evaporating the lye, and treating the residue with nitric acid and ammonium nitrate, whereby ammonium double nitrates of the said metals are obtained in the form of crystals, substantially as herein described.

4. The method substantially as herein described of treating zirconium for the removal of all traces of iron therefrom, consisting in first heating the zirconium to a white heat under free admission of air, and then, after finely pulverizing the same, treating it for several days with hydrochloric acid.

5. The method substantially as herein described of producing zirconium in a form suitable for an incandescence body, by first converting the zirconium into a sulphate, and, after treating with ammonia, dissolving the same in nitric acid, thereby obtaining a precipitate which, when digested with ammonia and dissolved in nitric acid and evaporated, produces zirconium nitrate.

6. The method substantially as herein described of separating a zirconium compound from a solution of

zirconium in nitric acid by means of sulphate of ammonia, whether this be present in the solution from previous processes or be subsequently added.

## THE PRESENT STATE OF OUR KNOWLEDGE REGARDING LOCALIZATION IN THE CORTEX CEREBRI.\*

By LANDON CARTER GRAY, M.D., Professor of Nervous and Mental Disease in the New York Polyclinic.

ALTHOUGH it has only been within a very recent time that cortical localization has been precise, the doctrine is yet an old one. The evidence of varied mental action, of which every people must have been conscious after the attainment of a certain grade of civilization, necessarily led the ancients to the conception of cerebral compartments. But these conceptions were confined to such vague ideas as those of the early Arabian physicians, who placed sensibility, intellect, judgment, and memory in the ventricles; or as those of Albertus Magnus, bishop of Ratisbon, who mapped out, on a brazen head of his own manufacture, the frontal region as the site of general sensibility and imagination, the vertex as that of intellect and judgment, the occiput as that of memory; or as those of Mondino di Luzzi, who in the fourteenth century thought each ventricle to be endowed with a particular form of intellectual force; or as Guy de Chauliac, surgeon to the Avignon popes, evolved a fanciful cerebral localization; or as Montagnanus, who in 1491 published a chart of the brain with regions indicated for the "sensus communis," for the imaginative cell, for the cogitative cell, for the memory cell, and for the rational cell; or as Ludovico Dolci, Thomas Willis, Swedenborg, Descartes, Vieussens, or Haller, who gave free rein to their imagination, unchecked by any foreshadowing of what the centuries might disclose. It was not, however, until the early part of the eighteenth century that the idea was clearly outlined. Haller and Zinn, in 1756, professed to have seen convulsive phenomena after injury of the cerebral white substance; but these observations were soon overlooked. It is too much the fashion at the present day to overlook the services which were then unconsciously rendered by Gall and Spurzheim. Both of these Germans were excellent cerebral anatomists, both have left works of unquestionable scientific merit, both were persecuted for opinion's sake, and both lived in the thick of the times which bred Mesmer and Hahnemann, and the pseudo-scientific, semi-mystical mixture of truth and charlatanism of which Mesmer and Hahnemann were the most illustrious exponents. But Gall and Spurzheim were above the level of Mesmer and Hahnemann, as, apart from the quality of their other work, is evidenced by the fact that they counted among their believers such men as Broussais, Bouillaud, Andral, G. Comte, and, with certain qualifications, also Reil and Hufeland. Even the great Goethe thought their system of phrenology of sufficient importance to enter into an elaborate argument against it. But it is not surprising that this idle pretense of diagnosing the mental faculties by the protuberances upon the external surface of the skull should have met with no enduring reception, or that, following the teachings of Magendie and Flourens, the medical profession should have veered to the other extreme of disbelief in any cortical localization whatsoever. It is, however, a remarkable illustration of the limitation of the human faculties that such an expert physiologist as Flourens should have failed to obtain any of the diversified and startling cortical phenomena which any tyro knows how to obtain to-day. Flourens, writing in 1824, and reiterating his assertions in 1842, stated unequivocally that removal of the brains of animals produced mental impairment in proportion to the amount of cerebral tissue removed, and not with any relation to the locality. Opposed to his teachings were the clinical observations of Bouillaud, who, in 1825, recognized that loss of the memory of words which has in later days come to be known as aphasia; of Marc Dax, who in 1836 located this symptom in the frontal lobe; of Broca, who in 1863 made a more precise localization within the third frontal convolution; of Andral, in 1834, who then reported cases of paralysis of the arm and leg from cortical disease; of Panizza, who in 1855 reported two autopsies which clearly indicated a relationship between sight and the parieto-occipital region of the hemisphere. It is noteworthy that, in the lively discussion of the subject of aphasia at the Parisian *Académie de Médecine* in 1864, much skepticism was expressed, and even the gifted Trousseau, in spite of his peerless clinical instinct, strenuously gainsaid that clinical and anatomical precision of Broca's which time has magnificently vindicated. Notwithstanding these clinical revolts, the influence of Flourens was paramount with such physiologists as Longet, Magendie, Matteucci, Budge, and Schiff until 1870—nearly half a century. Yet the same old vague line of thought was still germinating. In 1867 Theodor Meynert began his brilliant and original series of articles upon the structure of the cerebrum, and announced his theory of the projection system—*i. e.*, of a nerve tract which should connect with the cortex of the hemisphere all sensory surfaces and the voluntary muscular system. Through this tract all sensations should travel inward, all motor impulses should travel outward. As he puts it epigrammatically: "A cross section of the *crus cerebri* would therefore implicate the whole organism, which would simply be smellless and blind," inasmuch as the olfactory and optic nerves do not pass to the periphery through this channel. The motor portion of this projection tract went, he maintained, through the nucleus caudatus and the nucleus lenticularis, to the frontal lobe, while the sensory went, by way of the optic thalamus and the corpora quadrigemina, to the occipital and temporal lobes. The epoch-making experiments of Fritsch and Hitzig, in 1870, lent a remarkable confirmation to these teachings, at the same time that they revolutionized the existing ideas of cortical physiology. These original observers demonstrated, in direct contradiction of all previous experimenters, three important series of facts:

I. That a portion of the convexity of the cerebrum is

\* Read before the Medical Society of the County of Kings, March 15, 1887.

+ Gall was forbidden to lecture in Vienna, because, forsooth, it was feared that his views would disturb the minds of men in their feudal beliefs and feudal loyalty.

† Although he first published his views through his son, C. Dax, before the Academy, in 1863.

motor in its function, while another portion is not motor.

II. The motor portion, speaking generally, lies more anteriorly, the non-motor portion lying more posteriorly.

III. Electrical irritation of the motor portion gives rise to combined muscular contractions of the opposite side of the body.

They mapped out in the brain of the dog the centers for the neck muscles (Fig. 1), the extensors and abduc-

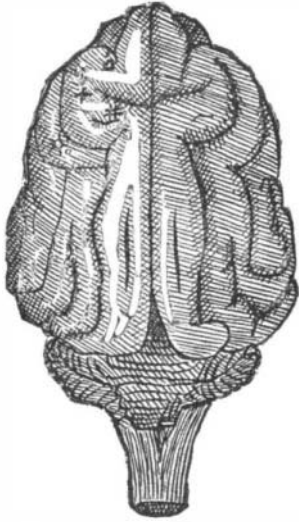


Fig. 1.—(After Fritsch and Hitzig.)  $\Delta$ , neck muscles; + (anteriorly), extensors and abductors of fore leg; + (posteriorly), flexors and rotators of fore leg; # hind leg;  $\square$  facial.

tors of the fore leg (+ anteriorly), the flexors and rotators of the fore leg (+ posteriorly), the muscles of the hind leg (#), and the facial muscles ( $\square$ ). They also removed with a scalpel the center of the fore leg, and found that the dog in walking set this foot down clumsily, seemingly without intention, sometimes to one side, sometimes to the other, and that this leg slid outward. In standing, the same phenomena appeared, and it was also seen that the foot was occasionally set down upon the dorsal surface. In sitting upon the hinder parts, both fore feet resting upon the ground, the affected fore leg gradually slid outward, until the animal lay prone upon the corresponding side of the body.

The paper of Fritsch and Hitzig gave birth to an enormous literature, to which addition is being made daily. The subject has been furiously discussed, and, in one instance, almost led to a personal altercation between two distinguished physiologists. Confirmation of the doctrine thus advanced by Fritsch and Hitzig of circumscribed cortical centers came from every side.

It was, however, soon shown that the paralysis resulting from destruction of such a center might entirely disappear, although the destruction of the center was proved by an autopsy to be complete. This seemed, at first sight, to be a serious objection to the theory; but further experimentation on the monkey tribe, as well as the results of disease in the human being, demonstrated that this recovery from the resultant paralysis of destruction of a cortical center was only observed in those animals in which the cerebrum played a subordinate part. Some lower animals, for example, run and walk soon after birth. In these, removal of the hemispheres has only a temporary effect, because in them the masses of gray matter lying beneath the hemispheres are relatively of larger development, and perform those functions which are relegated higher up in the scale of nervous evolution to the hemispheres.

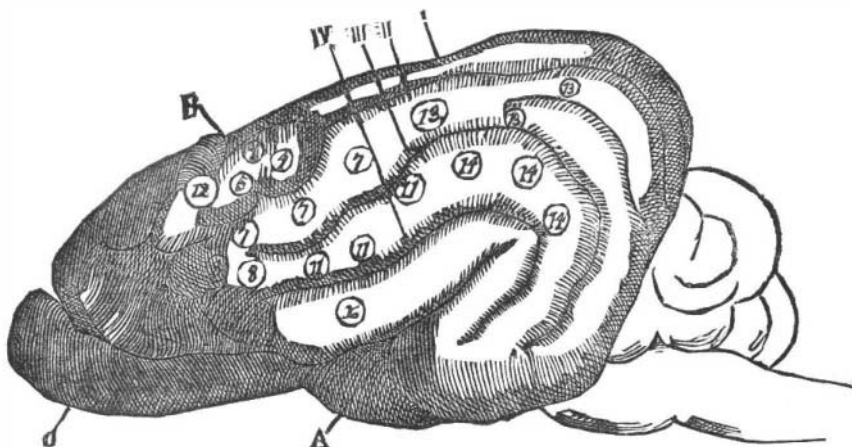


Fig. 2.—(Ferrier.) 1, opposite hind leg advanced; 3, lateral movement of tail; 4, retraction and abduction of fore leg; 5, elevation of shoulder and forward extension of fore leg; 7, closure of eye through orbicularis and zygomatics; 8, retraction and elevation of mouth angle; 9, opening of mouth and tongue movements; 11, retraction of mouth angle; 12, opening of eyes, pupillary dilatation, movement of head and eyeballs to opposite side; 13, movement of eyeballs to opposite side, with slight diagonal deviation; 14, pricking or sudden retraction of ear; 15, torsion of nostril. The figures omitted indicate centers inert in the dog, though active in monkeys, according to Ferrier.

But even those who have accepted Fritsch and Hitzig's declaration of circumscribed motor centers have not been in perfect accord with them in regard to the exact localization of each area. Ferrier, of London, has been greatly at variance with them, as will be seen by a comparison of the accompanying figure with Fig. 1. And others, while recognizing the existence of cortical centers of which electrization gives rise to muscular movements, and of which removal causes paralysis, have interpreted the phenomena differently from Fritsch and Hitzig. By one of those singular coincidences which have occurred more than once in the history of medicine—showing how public strains of thought will occasionally lead to precisely similar deductions in widely separated and differently envied individuals—Goltz in Strassburg, Munk in Berlin, Moeli in Berlin, and Tripier in Lyons, demonstrated that limbs paralyzed by removal of their cortical centers

showed a loss of sensation as well as of motion. To the excitable area of the cortex, therefore, which Hitzig had regarded as purely motor, Munk gave the name of "sensory sphere" (*Fühlssphäre*). (See Fig. 3.) But Munk carried his experiments still further, and showed that lesions of the occipital lobe produced peculiar disturbances of sight. If the area, A (Fig. 3), were removed on both sides from the two hemispheres of a dog's brain, he would see things, would avoid objects placed in his path, but would be unable to recognize

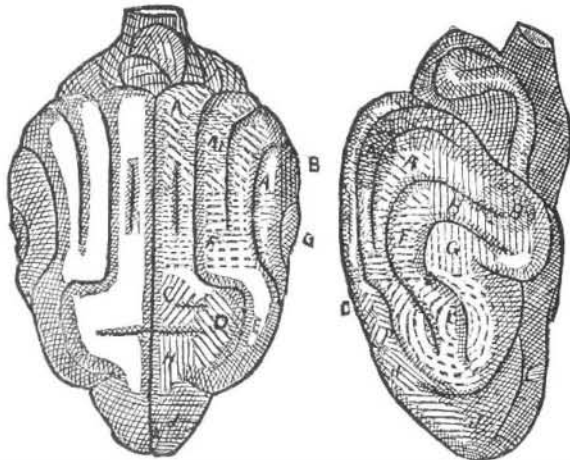


Fig. 3.—(Munk.) A, sight sphere; B, auditory sphere; C-J, sensory sphere; D, fore leg center; E, hind leg center; F, head center; G, eye center (for muscles of the eye); H, ear center (for muscles of the ear); I, center for neck muscles; J, center for trunk muscles.

these things and objects. He would view with indifference his master, other dogs, his food; would not wink at the approach of a light or a finger to the eye; would not recognize the whip, at sight of which he had been taught to go into the corner.

But if he were permitted to take cognizance of his master, his food, etc., with the other senses, he recognized them as usual—thus, he ate food after smelling it, or retreated before the whip when it was cracked. This non-recognition of objects seen was termed by Munk "soul blindness" (*Seelenblindheit*). A better name, I think, would be "mental blindness." The removal of this same area, A, on one side produced mental blindness of the opposite eye. On the other hand, removal of the area, A, which surrounds A, caused absolute blindness; and Munk professes to have determined that different sections of the retina are connected with different portions of this area, A.

He asserts that removal of the inner medial half of this area produces absolute blindness of the inner half of the opposite retina; that removal of the inner third of this area produces absolute blindness of about one third of the inner part of the opposite retina; that the anterior half bears the same relation to the upper half of the opposite retina, while the posterior half is connected with the opposite lower retinal half. But the most curious of all that Munk professes to have demonstrated in this connection is that the fibers from the *macula lutea*, the retinal point of most distinct sight, terminate in the area, A, so that the symptoms of mental blindness are associated with absolute blindness as regards distinct sight. Upon this anatomical peculiarity Munk bases an explanation of the mental blindness. Distinct sight, he says, through the fibers of the *macula lutea*, gives us usually our visual impressions.

When the cortical termination of these macula luteal fibers is removed, a certain time must elapse before we can become accustomed to receiving visual impressions through fibers from other parts of the retina, which, as

The nicety of observation, the judicial tone, the care, patience, and time evidenced by each successive communication—all combined to attract great attention to the dicta of this Berlin physiologist. Nevertheless, although he soon had many followers, he did not meet with universal confirmation. Ferrier, of London, whose experiments began in 1875, following those of Fritsch and Hitzig, and supplementing these in many matters of detail, flatly contradicted Munk in regard to the sensory nature of the excitable region, as well as concerning the optic and auditory centers and their nature.

It will be readily seen that at this stage of its evolution the subject was involved in the most inextricable confusion. It became simply a matter of bias as to what a man should believe. Each physiologist maintained that there were inherent defects in the method of experimentation of the others, and each brought forward to the support of his own views facts that either had to be denied *in toto* or else accepted, to add to the doubt (compare Figs. 1, 2, 3, 4). It is not to be wondered at, then, that Goltz, of Strassburg, afterward supplemented by his pupil, Loeb, should have voiced the sentiment of many by denying altogether the doctrine of circumscribed cortical centers. He repeated especially the experiments of Munk, and stated that he obtained entirely dissimilar results. But it may be said here, once for all, that, although Professor Goltz has been extremely useful as a censor, his experiments do not warrant his conclusions; indeed, he refutes himself, so that, in similar terms to those which Shakespeare puts into the mouth of Hamlet addressing Rosenkrantz and Guildenstern, he has fretted the advocates of cortical localization, but he has not played upon them—he has not stopped their way.

But the continuance of the study upon human beings has been rewarded by more permanent conclusions. Pathology has gone hand in hand with physiology. Each has its advantages. The skull of a dog or an ape can be trephined at will, and just as much removed of the cerebrum as the operator desires; the animal can be kept constantly under observation, and often, when there are no fatal results, for a considerable length of time, and the operation can be repeated. Focal alterations of the human brain are rarely so localized, and cannot, of course, be produced at will, or kept so well under observation; so that conclusions which may rest upon a few months of physiological experiment cannot be contradicted or verified except by years of widespread and isolated observations upon the human subject.

On the other hand, human beings, with their superior intelligence, are infinitely better subjects for testing the manifold details of motion and sensation. It is therefore, I think, the better proof of the truth of the doctrine of localization that the experiments of physiologists upon the dog and monkey tribe should have failed so well with the experiments of disease upon the human being. The individual facts of the latter kind, upon which my conclusions are based, are too numerous to be considered in a work of this kind. Any one who desires to review the testimony will find full references in the appended bibliography. It must suffice my purpose to indicate the conclusions.

Regarding the human brain, there are two sets of facts—one set that is indisputable, another that is still under discussion. Let us first consider the former.

Look at Fig. 4, in which the different convolutions

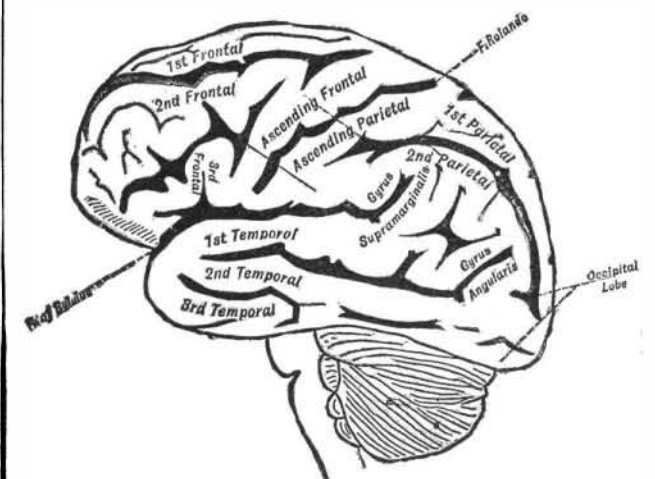


FIG. 4.—(After Ecker.)

are indicated. The ascending frontal and parietal convolutions are divided into three equal parts. Of these, the upper third, with the adjacent portion of the base of the first and second frontal convolutions, contains the center for the lower extremities; the middle third, with

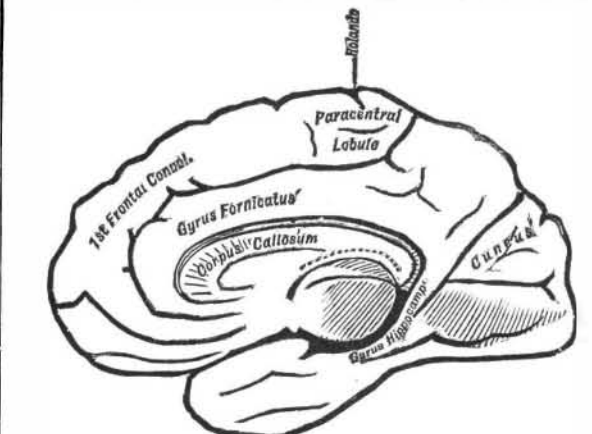


FIG. 5.—(After Ecker.)

the adjacent base of the second frontal convolution, contains the center for the upper extremities; the lower third, with the third frontal convolution, contains the center for the face, neck, and speech muscles. Fig. 5 represents the medial surface of the hemispheres. The so-called "paracentral lobule" is the medial surface of

\* This absolute blindness Munk would have us call "cortical blindness" (*Bindenblindheit*), a perfectly meaningless and pedantic term, it seems to me, that can only serve the purpose of making the confusion of cerebral nomenclature worse confounded. Munk himself has felt obliged to attach a parenthetical explanation almost every time he has used it.



the upper part of the ascending parietal and frontal convolutions, and therefore contains the center for the lower extremities, although lesions of this medial surface are comparatively rare. It will be perceived that this paracentral lobule is the only part of the motor convolutions that reaches to the medial surface of the hemispheres. This area upon the convex and medial surfaces is that of what may be called the "facio-phonetic-skeletal region." Lesions of it produce impairment, in the manner indicated, of the upper and lower extremities, of the facial and neck muscles, and of the motor mechanism of speech. It may justly be regarded as proved that the paralysis of the limbs and the face is still motor and sensory, that the motor and sensory paralysis are not always of equal intensity, that the one may occur without the other, and that the area within which sensory paralysis may be produced is of larger extent than the motor area, inasmuch as the former embraces the two parietal convolutions (Fig. 4). It will be seen that I have mapped out these areas somewhat indefinitely.

In matters of this kind one is greatly tempted to draw precise circles for each center, and, doubtless, positivism of this kind saves much trouble to those of great faith; but I cannot reconcile facts to such a sharp delimitation. In truth, the areas overlap one another, just as the convolutions pass imperceptibly into one another, and the time will never come when a man will be able to mark a line on a convolution and say that it is a precise boundary line between two centers, so that at one hundredth part of an inch to one side there will be certain symptoms, and totally different ones at one hundredth part of an inch to the other side. The centers can only be approximately demarcated, not absolutely.

There are also good clinical reasons for believing that each different kind of sensation—the tactile, pain, temperature, and muscular senses—has a cortical center of its own; but it has as yet only been determined that the muscular sense has probably its center in the parietal convolutions.

The center of sight is to be found in the occipital lobe and the angular gyrus (Fig. 4). There has been a fierce discussion regarding this center between the followers of Munk and those of Ferrier, the former denying that the angular gyrus had any part in this center, the latter affirming that any visual impairment must implicate both angular gyrus and occipital lobe. But the experiments of Luciani and Seppilli, and the cases collected by these gentlemen, warrant the assertion that the center embraces both angular gyrus and occipital lobe, although with this distinction, that lesion of the angular gyrus alone produces mental blindness, while lesion of the occipital lobe produces absolute blindness of the same half of the two retinae (lateral hemiopia\*). Brill has reported a case of color blindness in which the lesion was in the cuneus, the medial portion of the occipital lobe, and Seguin and Hun have reported cases of hemiopia due to disease of the cuneus and the adjacent temporal convolution. It is not yet certain whether disease of the angular gyrus causes visual symptoms by implication of the optic tract, which passes just beneath it, or whether the angular gyrus is itself a true terminal center of some fibers of the optic tract.

The center of hearing may be located in the first and second temporal convolutions (Fig. 4), although this area does not seem to be so constant a center as some others in the cortex, for the writer and Kussmaul, perhaps also Westphal, have reported cases in which a lesion was located here without the expected auditory symptoms. It is curious, however, that the left lobe seems to be mainly affected, the right side seeming to be of greatly subsidiary importance, Luciani and Seppilli stating that it is never affected alone, while the lesion is very seldom in both temporal lobes. It is curious, too, that the cases have so far always presented the symptom of mental deafness analogous to the mental blindness, as described above, and never any absolute deafness.

The cases of cortical production of loss of smell or loss of taste have been too scanty to define the centers of those two special senses, although it is probable that the olfactory center is in the hippocampal convolution (Fig. 5).

As Goltz has combated the physiological advocates of cortical localization, so has the distinguished Brown-Sequard vigorously opposed the clinical defenders of the same doctrine. But Brown-Sequard's collection of cases is opened to two fatal objections: First, his cases antedate the period of accurate knowledge of cerebral topography; secondly, he fails to take into account the fact, which had been demonstrated by the embryological researches of Flechsig, that the motor tracts do not decussate or pass over to the opposite side in all human beings, and that consequently a paralysis may be on the same side as a cerebral lesion, and yet not militate against the doctrine of localization.

Let us now consider the facts that are still under discussion.

In some cases a lesion outside of what has been deemed the center will produce the symptoms which result from lesion of the center itself; and, again, lesions of the center that are ridiculously minute will produce as marked symptoms as if the whole center were implicated. For these reasons Exner constructed the following chart (Fig. 6), in which it will be perceived that lesions at divers points of the cortex have produced the same symptoms, although there is for each function a certain area within which the lesions are mainly grouped. This area of densest grouping of lesions Exner regards as the true center.

The figures which represent the experiments on dogs and monkeys of Luciani and Seppilli tally remarkably with the pathological data collected by Exner, as will be seen by Fig. 7. What, then, is the meaning of the production of similar symptoms by lesions outside of the center? I take it to be that lesions at a distance from the true center can inhibit the action of that

center. These phenomena of inhibition are very familiar to us in the peripheral nervous system. All practitioners are aware of the many nervous disturbances which are removed by removal of a tight and redundant prepuce, a urethral stricture, a diseased ovary, a post-nasal catarrh, errors of ocular refraction, tumors of peripheral nerves, etc. In these instances the nerve tract to the spinal cord or the cerebrum is a comparatively long one. But in the cerebrum the commissural

optic nerves, and probably also for the auditory nerves.

The question now arises, What is the meaning of these centers in the cortex? It is simply that each center is the cortical area in which certain nerve tracts terminate. Mind is, to a certain extent, a mystery, and will probably remain so, to a certain extent, for many generations, perhaps ages, yet to come. But this mystery called mind is dependent for its healthy



FIG. 6.—(After Exner.) o, upper extremity; +, lower extremity; □, facial; #, hypoglossus; ●, speech; •, sight.

tracts, connecting different areas of the cortex, are far shorter and more numerous than those leading from the nervous axes to the periphery. How much more effective, then, must be the inter-cortical inhibition. But this very probability also makes evident—what has been singularly disregarded by writers upon localization—that the locality of a lesion can only be diagnosed with probability, not with certainty.

From this review we perceive that the doctrine of cortical localization is far too well grounded upon facts of eternal verity to be flippantly sneered at, although much remains to be done in the way that has been hewn out of primeval ignorance and acquired obstinacy. Like all truths that have lurked undiscovered for centuries, except those that do not require skilled experimentation or trained observation, it has had to

manifestation upon the structural integrity of the cortex, and of the whole of the cortex. Hence the cortex is justly called the organ of the mind. This mind can only come into communication with the world that lies outside of the skull cap by the material highways of the nerves, some of which carry impressions into it, others of which carry actions out from it. Thus, mind sees by means of the optic nerves, hears by means of the auditory nerves, tastes by means of the gustatory, feels by the tactile, muscular, pain-bearing, and temperature-telling nerves, acts by means of the motor nerves, and educates itself by means of them all; and the so-called "centers" are simply the areas of the cortex in which these different nerve tracts terminate. These centers are the cortical stations for the great trunk lines of the peripheral nerves. It is easy to understand that there may be regions of the cortex in which there are none of these terminal nerve stations, none of these centers, and that lesions of these regions may therefore not produce any impairment of the peripheral nerves of sense and motion, but rather give rise to purely mental symptoms, disconnected with motion or sensation.

It is also easy to understand that, as has been indicated, lesions of the cortex outside of the centers should impair the action of the center itself by inhibition along commissural nerve fibers connecting one cortical area with another. Nor is it difficult to unravel the seeming complexity of certain symptom groups which have puzzled clinicians until a recent date. For example, aphasia may be both motor and sensory. When the lesion is seated in the third frontal convolution (Fig. 4), the aphasia is motor, the patient's mind is unable to act upon the muscular machinery of speech, and he cannot give expression to words. When the lesion is in the first and second temporal convolutions, the patient loses the memory of words, fails to recognize spoken words; he has the so-called "word-deafness," although he may hear perfectly well, and although he may be able to articulate words well enough. If both the third frontal convolution and the two temporal are diseased, the patient can necessarily neither articulate nor recollect words. If a lesion implicates the angular gyrus, he may fail to recognize objects that he sees, or, in some instances, the non-recognition of objects seen may be confined to words; and if the lesion extends into the occipital lobe, this non-recognition of objects seen may be complicated with blindness of one half of the retinae (hemiopia). Mind itself, in all these symptoms, may be intact, left isolated, as it were, in the cortex, shut off from its motor and sensory communication with the outer world.

Note.—The writer desires it to be understood that there are many facts pointing to more localization than has been indicated in the foregoing article, and some of them seemingly quite precise too. For instance, Dr. A. Fraenkel describes (Charité-Annalen, 1886) a case observed in the Charité Hospital of Berlin in which, during life, a diagnosis was made of meningitis because of the retraction of the neck, and in which there was found post mortem a softening of the base of the second frontal convolution extending into the middle third of the ascending frontal (see Fig. 4), thus confirming in a remarkable manner the localization of the center for the neck muscles made by Wernicke several years ago, after careful consideration of the experiments upon apes and monkeys (see Fig. 1, A, and Fig. 3, H). But again and again has experience taught us, in the seventeen years that have elapsed since the original discovery of Fritsch and Hitzig, that it is not safe to locate a center upon one or two observations. The writer has, therefore, only spoken of those localizations which he believes to have been adequately settled.—*New York Medical Journal*.

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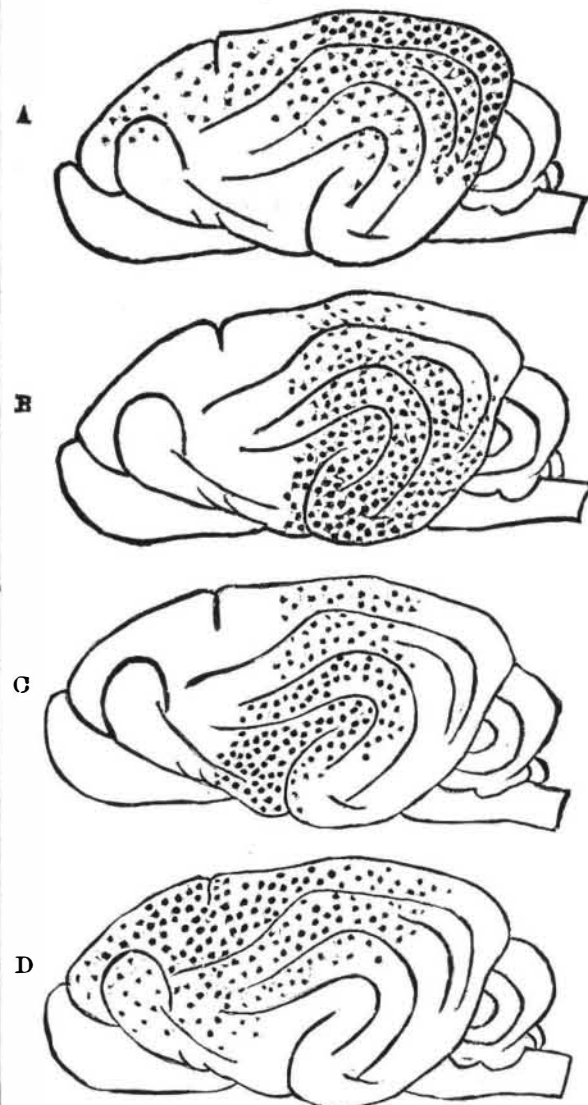


FIG. 7.—(After Luciani and Seppilli.) A, center of light; B, center of hearing; C, center of smell; D, sensory sphere.

rely upon the testimony of a cloud of witnesses, each one varying in competency or bias, and the result has been the ordinary one of a long trial of issues of fact before an ordinary jury—a failure to convince every one. But the jurors of science can wait for all time, the trial is never closed, and no verdict, however conclusive it may seem at the time it is given, will stand for one hour in the face of a newly discovered fact. In spite, therefore, of uncertainties about minor points of detail, we must admit that we have localized the cortical centers for the motor and sensory nerves of the limbs and face, for the mechanism of speech, for the

\* Hemiopia is derived from the two Greek words "ἡμιότις, half," and "ὄπτασις, to see," meaning therefore half sight. There is another somewhat similar word which has led to much confusion—hemianopsia, from "ἡμιότις, half, ἄν (for ἄρα), each, and ὄψις, sight," meaning also half sight. It seems to be agreed at the present day that by arbitrary custom hemiopia shall mean the condition of the retina, while hemianopsia shall be applied to the crossing of the rays of light in the media in front of the retina. Thus, a left hemiopia will indicate that the left halves of both retinae are blind, so that the patient, not being able to see objects to the right of either eye, shall be said to have a right hemianopsia.



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#### RECENT ADVANCES IN PREVENTIVE MEDICINE.\*

By GEORGE H. ROHE, M.D., of Baltimore, Md., Professor of Hygiene in the College of Physicians and Surgeons.

PROGRESS in any branch of science or art may be measured either by the number and character of new discoveries made or by the gradual advances in the application of knowledge previously acquired. Judged by either of these criteria the record for state medicine during the past year is a creditable one.

In the field of epidemiology and endemiology, the progressive extension of the fifth great pandemic of cholera first claims attention. Extinguished in the portions of Italy, France, and Spain ravaged in 1885 and 1886, it has slowly invaded southeastern Italy, Hungary and other Austrian possessions, and has been imported into South America, whence it threatens the United States by several routes. The danger of invasion of this country is at present greater than at any time within the past three years.

Yellow fever inoculation, as practiced by Freire in Brazil and Carmona in Mexico, has claimed a large share of the attention of sanitarians during the year. The claims made in favor of this method of preventing this scourge are now being subjected to an official investigation authorized by the United States government.

Diligent search has been made for the specific organism supposed to be the infective agent in vaccine virus, but without definite success. The results obtained are not entirely negative, however, and one may cherish the hope that a solution of this problem will soon be reached.

The relation of a peculiar disease of cows to scarlet fever, and the discovery of a specific microbe in the blood in the latter disease, have attracted much attention. The restriction of scarlet fever will doubtless be more thoroughly effected so soon as physicians are convinced of its bacterial nature, and clearly comprehend its mode of transmission. Statistics are given showing what has already been accomplished in this field.

Sternberg, Frankel, and Weichselbaum have studied the specific microbe of croupous pneumonia, which the former regards as identical with his *micrococcus Pasteuri*; in which opinion both the other authors mentioned coincide. Dr. Baker, of Michigan, has also shown that croupous pneumonia seems to be dependent upon a cold, dry atmosphere.

Measures for the restriction of pulmonary tuberculosis are adverted to. Tuberculous patients should not be treated in the same hospital wards with non-tuberculous individuals, and prompt disinfection of the sputa and other discharges should be practiced in order to diminish opportunities for infection. General sanitary measures should however not be neglected in the warfare upon the bacillus. There is danger that a too exclusive attention to the microbial factors of disease will narrow our views of epidemiology and preventive medicine.

It seems to be established that the micro-organism discovered in the intestinal lesions and discharges in typhoid fever is the cause of this disease. The fact that this microbe may preserve its vitality for a considerable time in water and ice has been shown by Bolton, Wolffhugel, Prudden, and others. This, together with the well known history of outbreaks of this disease, undoubtedly depending upon pollution of drinking water, should make prompt measures of disinfection imperative in every case. The physician fails in his duty who neglects measures for the thorough destruction of the typhoid infection existing in the intestinal discharges.

The importance of disinfection of bedding, clothing, and other personal and household articles in contagious diseases demands that health authorities should have under their control establishments where disinfection can be carried out on a large scale and at public expense. Such institutions are now in use in Berlin, Dusseldorf, Göttingen, Strassburg, Breslau, Leipzig, Danzig, and other cities in Europe. The results are pronounced to be exceedingly beneficial. Steam under pressure is regarded as the best disinfecting agent.

Quarantine, a word which for more than five centuries has been synonymous with barbarism, is becoming under modern methods a safeguard to the public against infection and an advantage instead of obstruction to commerce. The results achieved at the model quarantine station at New Orleans encourage the hope and almost warrant the prediction that the days of the quarantines of detention, whether by sea or land, are past, and that quarantine in future will mean simply thorough disinfection of fomites, and, of course, effective isolation of persons already infected.

Cremation of garbage seems to be the best method yet devised for the inoffensive destruction or final disposal of solid city wastes.

The irrigation system of sewage disposal has steadily won favor. In Berlin, Breslau, and Danzig in Germany, Birmingham in England, and Pullman and other places in this country it has been in successful opera-

tion. Chemical precipitation and purification of sewage has also been adopted with satisfactory results in various German cities. A board of distinguished engineers recently recommended the same system for the city of Providence, R. I.

Professor Vaughan's discovery of a very poisonous ptomaine in cheese, ice cream, and milk undergoing certain chemical changes has been confirmed by a number of investigators in various parts of the country. Vaughan's suggestion that tyrotoxin may be found to be the poison which produces cholera infantum opens a new field for investigation in which every physician must of necessity be interested.

Analyses of food and drugs made during the year in Massachusetts and New York show the wide extent to which adulteration is practiced and how the people are defrauded. Among the most startling instances are olive oil, of which 68 samples out of 91 were spurious. Vinegar was adulterated in 79 samples out of 116; mustard 124 times in 211; white pepper 63 times in 128; black pepper 41 times in 71; mace 29 times in 45. Of nine samples of horseradish examined, only one was found genuine. A precipitate of uncrystallizable sugar and coloring matter and chloride of tin (poisonous) is sold to candy makers for making confectionery. Citrate of iron from respectable manufacturers contained 3½ per cent. of quinine instead of the 12 per cent. demanded by the pharmacopœia. Authority and means should be given to the health authorities to protect the public from these frauds, many of which are a source of danger to life and health.

Statistics collected by the speaker show that five sixths of the inhabitants of cities in this country have no facilities for bathing except such as are afforded by a pail and sponge, or an easily accessible river, lake, or other body of water. The establishment of public baths is urgently recommended, both as a sanitary as well as moral measure. Tub or pool baths are objectionable, both on account of expense and lack of privacy in the latter. The spray baths in use in the German and French army barracks are recommended. These are not expensive, either in first cost or administration, and allow each bather absolute privacy and the opportunity for a thorough cleansing in clean water. Public baths should be open the year round, and not only during the summer.

A number of instances are grouped together showing how the enforcement of appropriate sanitary measures has saved life. In Michigan the saving of life from one disease (scarlet fever) has amounted during the last eleven years to 3,718, or 338 per year. In 1886, appropriate sanitary measures saved the lives of 298 persons who would have died of diphtheria if such measures had not been enforced. In England and Wales, the average annual saving of life due to sanitary measures has amounted in the five years ending 1885 to 62,000. In Baltimore, a marked reduction of deaths from infectious diseases has followed the enforcement of certain sanitary precautions. In Memphis the death rate has been reduced in six years from 35 per thousand to 23.80 per thousand. In Chicago the reduction in mortality in the last five years has been from 25.69 per thousand to 19.46 per thousand a net saving of 17,214 lives in that city during that period.

While all advances in sanitary administration have doubtless contributed to produce these good results, the main influence is to be attributed to three factors. These are: *Compulsory notification of infectious diseases; prompt and effective isolation of the sick and infected; and thorough disinfection of all infected articles and sources of infection.* These must be the watchwords of the practical sanitarian of the future.

#### THE CUTANEOUS PUNCH.

DR. E. L. KEYES has described an instrument which he invented, and which he calls the cutaneous punch.



It is about three or four inches long, with a hole in the end similar to that in an ordinary punch, and with a sharp cutting edge defining the hole. He uses it to remove the stained specks of skin in the face due to gunpowder; also for corns and other small growths. To remove the gunpowder specks, he presses the punch with a rotary motion through the entire thickness of the derma and removes each piece. His results were satisfactory. In a case of corns, he presses the punch down through the center of the growth, cutting out all the sensitive part of each corn. His results were good. A number of sizes, from 1/16 inch up, are required.

#### THE GENESIS OF "BRIGHT'S DISEASE."

By J. MILNER FOTHERGILL, M.D., Physician to the City of London Hospital for Diseases of the Chest, Victoria Park.

THE prevalence of the morbid change so far best known by the term "Bright's disease" (from Richard Bright, who first wrote on the subject); its certain ending, sooner or later, in death; together with the fact that its course can be profoundly modified by proper and judicious measures: all combine to give the subject an intense interest for all—physician and patient alike. "Old age is not an entity, but a set of conditions predisposing to what we call chronic Bright's disease. And though to most this comes in natural course when the prime of life is run, yet to some old age is no matter of years and of averages, but the running down of a spring set for an individual." Such is the happy expression of Dr. Goodhart in his well-known Bradshaw lecture before the Royal College of Physicians of London, in August, 1885. It is a slow, gradual growth of the lowly connective tissue of the kidney at the expense of the higher kidney tissues. But the kidney mischief is only a part of the morbid change. A like growth of lowly tissue is going on in the walls of the arteries—atheroma—rendering them inelastic and brittle. But what calls out the growth of the lowly connective tissue in kidney and artery? The irritation set up by the presence of uric acid (possibly accompanied by other forms of albumen-metamorphosis) in excess in the blood. In order to grasp the matter firmly, we must look a little beyond mere clinical facts, so as to read these last aright.

We see, in the gradual evolution of life, the reptile, the cold blooded inhabitant of tropical swamps, casting out its excrementitious matter in solid form—i. e., urates. The uric acid formation still continues in the warm-blooded bird, which also possesses a solid urine. When the mammalia appear, they are found to have a fluid urine, and their form of excretion is the soluble urea. But vestiges of the earlier formation still cling with the tenacity of original sin; and a certain, if small, quantity of uric acid is daily voided by man himself. So that we still carry with us traces of our descent in other forms than the branchial arches—the gills of fetal life. Indeed, the circulation of the fetus is that of the higher reptile; and the uric acid formation is distinctly seen in intra-uterine existence. We have long been familiar with the fact that under given circumstances the human body reverts to the early primitive form of urine stuff. As to gout, we have recognized its association with good eating, especially when accompanied by a lack of exercise.

The sensuous monk of old, lazy, fond of good living, and addicted to wine bibbing, was the typical gouty man. Now it is the country squire, whose habits were active till gout in his feet cripples him, and then its fell clutch becomes tighter and harder; or the plethoric publican, whose pleasures are those of the palate. This was the gout which came of good living. "Gout is the disease of those who will have it," said Meade. But a number of cases of distinct gout were found under widely different circumstances. They occurred in spare beings, small, fastidious feeders, whose trencher performances were conspicuous by their temperance. To this class the term "poor man's gout" was applied. It did not explain the apparent paradox, and this inability to explain it was regarded as an opprobrium to the medical profession. Doubtless a large proportion of the sufferers from poor man's gout were descendants of gouty ancestors; and only by the strictest regimen, as to meat and drink, could they elude the visitations of their hereditary foe. But the gouty ancestry was not present in all cases.

The late Dr. Budd held that sundry persons came into the world with what he called "insufficient" livers; and Dr. Murchison indorsed this view. Such livers revert to the uric acid formation very readily; and now poor man's gout stands revealed before us. Indulgence in animal food in excess reduced a normal liver to the uric acid formation.

A congenitally insufficient liver reverts to the uric acid formation under an ordinary or even meager dietary. The result is the same in each case. When the uric acid formation is established, we find one of two consequences: Either (1) the uric acid is gradually deposited in the body, in the articular cartilages by preference; or (2) is cast out by the kidneys, which, being constructed to excrete the soluble urea, are irritated by the presence of uric acid in excess; with the result of interstitial nephritis, or chronic Bright's disease. Often both are found.

Renal changes are by no means the sole morbid outcome of the uric acid formation. The cardio-vascular system feels its malign touch. A tight artery is the consequence of the blood condition, and, with that, changes in the arteries and the heart. The high blood pressure in the arterial system leads to hypertrophy of the left ventricle, and that, again, to secondary valvulitis of a progressive nature—probably due to the forcible closure of the valves; the mitral by the large ventricle; in the aortic by the recoil of the highly distended artery. Possibly in the latter there is a tendency to gouty deposits, as in the joints.

The distension of the arteries leads to a growth of connective tissue in their walls, which lose their elasticity and become brittle—the atheromatous change—and from these we get apoplexy and aneurism; while angina pectoris vaso-motora is called out by occasional spasm of the peripheral arterioles. Sooner or later the growth of connective tissue within the coronary arteries themselves cuts down the nutrition of the large heart, and fatty degeneration spreads throughout its structure. The failing heart leads, in its turn, to dropsy, albuminuria, and death.

Indeed, we get a vast number of morbid outcomes in this widespread vaso-renal change, beyond the interstitial nephritis, which is spoken of as "chronic Bright's disease," or "renal cirrhosis," or "the gouty kidney," as it is variously termed. But the consideration here is restricted to what is truly "chronic Bright's disease," a renal change started by an impure blood, as Professor Hayles Walshe asserted in 1849.\* The uric acid (and possibly other excrementitious matter of nitrogenized character, the products of albumen metamorphosis) irritates the kidney structures, and starts up a rank growth of the lowly connective tissue or packing material at the expense of the higher true structures of the kidney. Here and there in minute foci, scattered throughout its mass, mainly in the cortex at the outset, we find the destructive action at work. The lowly invader is preying upon the higher structures, like the Tartar Turk spread himself over the population of the Balkan peninsula, and with the same result—destruction. Slowly and steadily one minute portion of the kidney after another is caught within the light touch of some soft growth of connective tissue; but as the latter dries up and hardens, it contracts, and the true tissue within its clutch is ruined—squeezed out of (functional) life and (anatomical) form. Bit by bit, and often very slowly, the process goes on, until the kidneys are rendered inadequate as depurative organs, and the blood is rendered toxic by being surcharged with waste of albuminoid origin. Then follows secondary inflammation set up by the toxic blood, or other truly uramic complications, often desperate attempts on the part of the body to cleanse its blood. To call this widespread change a "kidney disease" is as much a misnomer as to apply "Pimlico" to the whole metropolitan area; and to seek for evidence of it in the renal secretion solely is as imperfect as would be an inquiry into the sanitary arrangement of Lambeth, however carefully conducted, as to the state of the whole area which discharges its sewage at Barking Creek. Casts of the renal tubules are truly the infallible evidence of renal destruction as to existence, if not as to extent. The character of the urine tells much; when it is copious and of low specific gravity, we have only too good reason to decide that the injury is extensive and widespread. Sometimes albumen is present in the urine,

\* Abstract of the address in State Medicine, delivered before the American Medical Association, at the thirty-third annual meeting, held at Chicago, Ill., June 7-10, 1887.

\* The Lancet report: Bright's disease not essentially a renal disease, but essentially and primarily a blood disease.