sign occur. It is therefore evident that if the impulses sent by the relay apparatus into the second cable are to be identical in character with those sent into the first, it is necessary to reproduce the missing "beats." The instrument used for this purpose is called an "interpolator." Its action resembles that of the automatic transmitter at the originating station, with this difference, that the movements of its transmitting levers, instead of being governed by the perforations in the punched tape or strip, are governed by the motions of the relay tongue. The interpolator sends into the second cable impulses similar to those entering the first cable, and these may be either "curbed" or "plain" as required. To use this instrument to the best advantage, it is necessary that it should run in approximate synchronism with the automatic transmitter, and that the speed of the last-named instrument should be nearly uniform.

The interpolator consists of two sets of signaling levers, similar to each other but mechanically distinct. One set sends on the "dot" signals and the other the "dashes." Fig. 2 shows the mechanism of one-half of the interpolator, which acts as an automatic transmitter, forwarding the "dot" signals received by the drum relay from the first into the second cable. The electromagnet, *E*, is worked from the relay, *R'*, of Fig. 1. The other set of mechanism, or "dash" side, not shown, is worked from the relay, *R''*. When the electromagnet, *E*, is energized it pulls down its armature, removing the catch, *C*, from holding the clutch-sleeve, *A*, allowing it to revolve. The clutch-sleeve as it revolves moves the lever, *L*, so as to make contact with the lower contact point, *F*, thus putting battery to line. *S* is a spring-lever worked from a crank-pin on top of the clutch-sleeve; the crank-pin revolving, rocks the lever and operates the reverser, *R*, to which the battery is connected, and this, at stated times in the revolution, reverses the battery, which acts as a curb to the first battery current, or cutting off the battery and putting the line to earth, to act as "plain" automatic as the case may be. By moving the reverser, *R*, relatively to the crank-pin, a bias may be given the spring of the lever *S*. Such a motion will allow of the duration of the curb or earthing period being adjusted. *D* is a spiral spring to help the clutch-sleeve to ride over its lifting rollers. The clutch mechanism is driven by a small governed electromotor. The clutch is more particularly shown in Fig. 3. *S* is a rotating spindle to which the collar, *G*, is fixed. The clutch-sleeve, loose on the spindle, carries at its end the cam plate, *A*, is provided at its lower end with teeth, which are adjusted to gear with similar teeth on the collar. A spring, *B*, tends to force the clutch-sleeve into engagement with the collar. The sleeve is provided with pins or projections, one of which, *C*, engages with the arresting device, and these ride upon fixed lifting rollers, *L L* (which are shown dotted), when the sleeve is at rest, and thereby raise it out of engagement with the rotary spindle. When the arresting device is removed by the magnet, *E*, the clutch-sleeve is pulled off the rollers *L L*, by a spring pulling at the crank-pin, *D*, and thus thrown into gear with the spindle, operating the transmitting levers as previously described.

When an *h* is received from a long cable on the drum of the relay, the tongue remains in contact with the dot side throughout the four beats of the letter, simply producing one long contact on the "dot" post office relay. This long signal is split up by the interpolator and transmitted as four dots.

In place of the interpolator, an "automatic perforator" (see Plate 3) may be employed. The automatic perforator is constructed very much like the interpolator, with this difference, that in place of two there are three clutches adapted to operate punches, by means of cams, for perforating the signals on a paper tape, such as is employed when using the automatic transmitter. To prevent waste of paper, a stopping device is brought into action after the machine has fed out, say five inches of blank strip, this after the last signal has been received. The perforator reproduces on punched tape a fac-simile of the message on the punched tape used at the originating station, and the copy is immediately available for sending on by the usual automatic transmitter. By the use of this auto-perforator it is possible for a single short cable to feed two long ones, or vice versa, with a minimum of delay.

In order that slight failures in the relay apparatus may be instantly seen, it is necessary to have two local registers at the transmitting station, one showing the drum and tongue contacts, the other the signals actually sent into the second cable. The register for showing the drum and tongue contacts of the cable relay has been found to be most valuable and efficient, and automatic translation cannot very well be maintained without it, for it gives a record of what takes place in the most delicate part of the apparatus undisguised by defects of the post office relays, or the defects and corrective effects of the interpolator.

Such a record is seen in slip *A* of Fig. 4. These signals were recorded by a direct writer, worked straight off the drum cable relay. It shows the quality of the contact, and gives an outline of the signals as they arrange themselves on the drum when everything is in correct adjustment. By observing such a record, the relay may be kept in adjustment and faults in transmission easily detected.

Slip *A* is a record of signals received from a cable relay direct at 140 letters per minute over a duplexed cable of 3.2 K. R. under actual traffic conditions. It will be observed that there are no "beats" in the signals when the same follow each other on the same side of the line, the tongue of the relay having held over in these cases without breaking contact.

On the other hand, slip *B* shows signals recorded by a direct writer worked off local circuit with the interpolator; here we have all the signals clearly recorded. Such a record was received from a relay over a cable of 2.8 K. R., simplex working at 210 letters per minute under actual traffic conditions.

In Fig. 5, slips *A* and *B* show records of signals received on the drum cable relay apparatus, worked from a duplexed cable of 2.8 K. R. at 150 letters per minute; the sending battery was 60 volts. The signals were translated by the relay apparatus through an arti-

cial line of 3.5 K. R., the signals being written by a siphon recorder.

Slip *A* shows signals as received on the siphon recorder when an automatic transmitter was used at the originating station; the message was sent on from the relay by a "curb" interpolator. Slip *B* shows signals as received when a couple of sounders were joined up like a hand-key to be worked by the relay in place of the interpolator. Slip *C* shows signals transmitted under similar conditions as slip *B*, but a hand-key was used in place of the automatic transmitter at the originating station.

Having finished the description of the cable relay translation apparatus, I wish now to describe briefly the "magnifying relay," a relay that was the forerunner of the "drum cable relay." I invented the "magnifying relay" in the year 1898. It is not, at present, employed on any of the cables, but I know no reason why it should not be of great use to the cable companies in the future.

As shown in Fig. 6, the instrument consists of a permanent magnet, or direct-current electromagnet, *A*, and an alternating electromagnet, *B*. In the field of the magnet, *A*, is suspended a "recorder" coil, *a*, say of about 500 ohms resistance; in the field of the alternating-current magnet, *B*, is suspended another and similar "recorder" coil, *b*. The suspended coils, *a* and *b*, are coupled together by silk fibers, as is shown in the drawing. The arrival current from the cable, *C*, flows through the coil, *a*, to the earth-plate, *E*, causing the coil to move, and as the suspended coil, *b*, is joined to it by the fibers, *b*, will follow the motion of *a*. *G* is an electric battery. *W* is a current reverser that turns the direct current from *G* into an alternating one. *H* is a condenser of suitable capacity, placed in the circuit so as to neutralize the self-induction and stop sparking at the current reverser, *W*.

If *W* is revolved at a proper speed, the magnetic lines of force will be moving in and out of the iron of the magnet, *B*, say at periodicity of 100 $\times$, threading through the suspended coil, *b*, when it is all moved out of its normal or neutral position, and inducing a voltage, proportional to the angle, or more correctly, perhaps, to the sine of the angle of deflection. By these means energy may be generated in the coil, *b*, which may be hundreds of times greater than that employed to move the coil, this greater energy increasing and diminishing in exact proportion to the rise and fall of the controlling current. I should compare this action, if I may be allowed the license, to a driver directing the energies of a horse by a pair of reins. *R* is a rectifier revolving on the same shaft as the current reverser, so as to turn the alternating current induced in the suspended coil, *b*, into a direct or unidirectional current in order that it may operate a "siphon recorder," "direct-writing recorder," or any other suitable instrument, as the case may be, the instrument being placed in circuit with the lead, *S S*.

If the circuit of the coil, *b*, that hangs in the alternating-current field possesses only resistance, the induced current will produce no disturbance on the period of the coils, or on the sensitiveness of the suspension.

To explain this, in Fig. 7 I have drawn theoretical diagrams representing sine wave curves. *I* is the curve of magnetic induction, *A* the curve of induced volts, which is, as is well known, at right angles to the curve of magnetic induction, and *B* is the current curve, which flowing in a circuit of plain resistance would be exactly in phase with the induced volts. This being so, the amperes, as a whole, will produce no reaction on the alternating field, *a I e*, because, as is seen, the portion, *a b c*, is exactly equal to, opposed, and neutralized by, the portion, *c d e*. But it is otherwise, if there is capacity, because then the amperes will be accelerated, this acceleration being due to two E. M. F.'s impressed on the circuit, one due to the moving magnetic lines, and the other to the voltage stored up in the condenser, the portion *a b c* being less than that part of the curve *c d e*, the difference acting on the magnetism so as to cause the coil, *b*, to move out of the field. If there is inductance, the contrary action will take place, in which case the part *a b c* being greater than the part *c d e*, the coil will then endeavor to remain in the field opposing the action to move it out.

Capacity has the same effect as slackening the control of the suspensions, increasing the period of coils and making the instrument more sensitive, while induction stiffens up the coil, reducing the period. This being so, a ready means of adjustment is provided, for by plugging in induction or capacity, the control over the coils may be instantly increased or lowered, and this is so, whatever may have been the initial mechanical control, within reason.

I have arranged the instrument, on some occasions, to work with only one suspended coil, combining the alternating and direct currents on one field-magnet, the current from the cable passing through a choking coil before flowing around the suspended coil. The choking coil stops the induced alternating current from flowing into the cable, while the current from the cable is blocked, say by a condenser, from flowing past the rectifier and wasting its energy in the local circuit. Such a single-coil instrument acts as well as a double-coil one, but I do not know if it possesses any special advantage except on the score of mechanical simplicity.

On trial with the magnifying relay over an artificial cable, I have obtained some rather interesting results. For instance, the slip *A* in Fig. 8 shows signals written by a siphon recorder, worked by a "magnifying relay." The "magnifying relay" acts as a receiver at the end of an artificial line of 7,000 ohms resistance and 310 microfarads capacity. An automatic "curb" transmitter was used as sender, the speed being 150 letters per minute, the sending battery having a potential of only 3 volts. Slip *B* shows the signals received under identical conditions, but with the "magnifying relay" cut out of circuit, the siphon recorder acting as receiver direct. Again, the slip *C* shows signals written by a siphon recorder worked off a "magnifying relay," while slip *D* shows the signals as received by the siphon recorder direct, the relay being cut out of circuit. The currents were transmitted by an automatic "curb" transmitter at 185 let-

ters per minute, with sending battery of 50 volts, the K. R. of the line being 3.6.

Slip *E* shows signals received at a fairly high speed, the siphon recorder being worked off the induced currents of the "magnifying relay," as in slips *A* and *C*, the artificial line had a retardation of 3.6 K. R., the automatic "curb" transmitter was sending with a battery of 42 volts, the speed of signaling was at the rate of 280 letters per minute.

When signals at a moderate speed were being received on the particular magnifying relay used in these experiments, it was difficult to detect by the eye any motion whatever in either of the suspended coils when observed through a strong magnifying glass. Though small in amplitude, it is certain that the motion occurred from the fact that the currents induced thereby were sufficient to cause large and very visible movements in the signaling coil of the siphon recorder.

The "magnifying relay" seems to possess three main points of advantage for cable working:

1. It may be used to work the siphon recorder with the signals of the same size, and at the same speed as at present, but with greatly reduced sending battery power.

2. It may be used to work the siphon recorder with the signals of the same size, the same definition, and the same sending battery as at present, but at a greater speed.

3. I believe it may be used to work over a cable under the same conditions as regards speed and battery power as at present, but the signals may be written by a "direct writing recorder" in place of the present "siphon recorder."

Now I should like to suggest a use for this instrument or part of the instrument for electrical engineers other than telegraph men. Referring again to Fig. 7, and considering only that part marked *B b*: If the winding around the magnet is supplied with an alternating current, say of sine wave form, we have seen that if induction or capacity is introduced in the circuit of *b*, the rectifier being dispensed with, the current flowing in the circuit will be put out of phase with the induced volts, and mechanical reaction takes place between the coil, *b*, and the magnet, *B*, the coil tending to move one way for induction, and in the opposite way for capacity, *b* being supposed suspended in such a manner as to cut some of the moving magnetic lines, its motion being studied by means of a mirror reflecting a spot of light onto a scale.

A complex circuit could be tested and compared with a standard, the deflection showing the resultant capacity or induction; or, perhaps, the capacity, say of such a thing as a coherer, could be found out by this means. I believe that such a reaction galvanometer could be worked up to measure capacity and induction in the same way as an ordinary galvanometer measures resistance.

Messrs. H. A. Taylor and A. L. Dearlove, both of the firm of Messrs. Clarke, Forde & Taylor, pointed out this line of investigation to me. They gave the convenience and necessary encouragement, and have done all in their power to help me in every possible way, and I wish to acknowledge my deep indebtedness to them.

ASEPTIC SURGICAL SHAVING PASTE.*

By EDMUND WHITE.

IN the St. Thomas's Hospital Gazette, last year, I published an account of a scheme devised for the preparation of skin areas of patients about to undergo surgical operations. It is customary to thoroughly cleanse the skin area by scrubbing with soap, or ether-soap, and in many cases this area is shaved immediately before the operation. Apart from the application of routine methods of disinfection to the hands and appliances of the hospital barber, whose duty it is to carry out this preliminary shaving, the scheme involved the rejection of the ordinary method of shaving by means of lather, since this also involved the use of a brush, which cannot be rendered aseptic. A substitute for the lathering was found in a wax-emulsion, which could be applied by the hand to the area to be shaved, and some particulars of this emulsion and of the details of the scheme will be found in an abstract in the Pharmaceutical Journal of May 3 last. The formula for the wax-emulsion was not, in the original paper, published in detail, because, although the material then in use successfully fulfilled the functions for which it was devised, I thought the emulsion might be improved in several points by further experience in use and manufacture. The formula I now publish is the result of this experience, and it is as follows:

Hard paraffin (m. p. 55 deg. C.)	22 parts by weight
Prepared suet	3 parts by weight
Soft soap	2 parts by weight
Boiling water	68 parts by weight

Place these materials in a vessel surrounded by boiling water, and when the fats are melted beat them together until a smooth, white emulsion is obtained. Continue the beating, maintaining the temperature above 70 deg. C., and shake in gradually

Tragacanth, in powder..... 2 parts

When the mixture is homogeneous, allow it to cool by removing the boiling water, and when nearly cold add

Glycerin	2 parts
Oil of lavender	1 part

I have employed the ordinary beater mixing machine for making it, but small quantities may be made equally well by means of an egg-whisk in a stone jar standing in a saucerpan of boiling water.

My first experiments were made with paraffin, water, and tragacanth alone, but emulsification was troublesome and uncertain, and I afterward found the addition of some other fat, such as suet, lard or tallow, and the use of a little soft-soap greatly facilitated the operation. The tragacanth was then added to impart the necessary viscosity and to prevent the separation of palpable particles of wax during cooling. The ad-

* Read before the British Pharmaceutical Conference, Dundee, August, 1902.

dition of a little glycerin prevents the film drying too rapidly on the skin, but only a small proportion can be used, as larger proportions render the skin sticky.

In use a small quantity is rubbed over the area to be shaved and the razor immediately applied. The amount required varies somewhat with the texture of the skin and hair, but a little practice gives the necessary indication. The material has been in use in St. Thomas's Hospital for about twelve months, and gives satisfactory results. For shaving in the hospital, apart from surgical preparations, its use is compulsory, unless the patient provides his own brush and soap, so that the transference of skin disorders, apart from general septic contamination, is reduced to a minimum.

[Concluded from SUPPLEMENT No. 1393, page 22331.]

THE RELATION OF THE PSYCHIC LIFE TO THE NERVOUS SYSTEM.*

THE beginnings of the psychic life are found in associative memory; education is in the main a training of associations, and the soul develops *pari passu* with the body.

It is found among all vertebrates that when the cerebral hemispheres are completely cut out, associative memory is lost. In sharks there is no associative memory so far as one can determine, and after the cerebral hemispheres are cut out there is extremely little change in the behavior of the animal; it acts in almost a normal manner. In the frog there is so little associative memory that the animal moves in nearly the normal manner after the removal. The frog without a cerebrum is purely a reflex animal, while the normal frog is a little capricious; it does not always respond to the stimulus as a frog without a cerebrum does; so there is a certain amount of nerve impulse—stimulus—in the frog which may serve to inhibit an act, apparently; but still it is in the main a reflex animal, and it has relatively little associative memory, and gets along very well without both cerebral hemispheres; they may be cut away and the frog will live for years and catch flies and be apparently almost a normal frog. In the adder there is no appearance of fear in an animal from which the cerebral hemispheres were removed; otherwise it was nearly normal. In birds complete removal of the cerebral hemispheres causes at first a sleep-like condition lasting for several days, and it was originally believed that the animal never recovered from this—that it remained in a sleeping condition all the remainder of its life, never being able to take food unless forced down its throat; but it is now known that this was a shock effect, due, of course, to the great roughness and coarseness of treatment in cutting away the cerebral hemispheres; and that after the animal has recovered from the shock effect it then behaves in a manner remarkably like that of the normal bird. The animal wanders about untiringly; it sleeps and wakes; it perches at night in order to sleep; its movements are coördinate; it will see; for example, when sitting on one perch, it will estimate the distance and fly successfully onto another perch; so that it has perfect space perception of this sort; it avoids obstacles and all this. These are characters which you might at once suppose, especially the space perception, associated with memory. It is a case of associative memory; the bird must have remembered something about distances in the past; but it is a remarkable thing that when little chickens are first hatched they have this space perception well developed. They didn't learn it; they inherited it; it is a part of their nervous system, their organization, and they are but a moment, they step out of the egg to walk around; they don't learn how to walk; they know how to walk, and it is quite possible that human children do not learn to walk, but hold back because the muscles and the nerves are not ready, and as soon as the muscles and the nerves are ready they walk. As is true of the chick, so the guinea pig walks within a minute after it is born, and walks around perfectly—has no difficulty in coördinating its movements, does not learn these things at all, and has good space perceptions—don't jump off a ledge—will walk to the edge of a high shelf and look over, but does not jump; it has inherited space perception; so that in this case the ability of the bird to fly to its perch does not indicate that it has associative memory and it does indicate that it had inherited—we might call it—past experience, but something which had become a part of its organism, not lodged, however, in the cerebrum, but in the rest of its nervous system.

With regard to what a bird without its cerebrum cannot do, it shows no discrimination of objects; it recognizes neither names of friends nor mate, and takes no interest in its young. Schroeder, who performed the experiment, said that the young might cry for its food, but it paid no attention to its young. All that it had acquired by the activity of memory is lost forever with the loss of the cerebral hemispheres.

It is a very difficult thing to perform such an operation as this on the mammals; yet it has been performed, and successfully. It is one of the triumphs of physiology in this line. Goeltz has succeeded in removing the cerebrum from the dog and keeping the animal alive for years. After the shock effect passed away, in a few days the dog sleeps and walks, moves spontaneously and almost unceasingly while it is awake. That is one of the things wherein it resembles the pigeon, which moves about very rapidly and unceasingly while it is awake. It eats meat and milk when placed to its nose, growls and snaps when pinched, withdraws its feet from cold water, can walk on three feet, closes its eyes when strong light was flashed in them, didn't turn out for obstacles (ran against things); was not able to seek food, and would not eat excepting food was put against its nose; could hear, but did not distinguish between scolding and petting; in short, simple reactions depending on inherited associations were preserved. All these experiments prove that the cerebral hemispheres are the organs for associative memory.

If the brain of the dog be opened and be stimulated certain movements of the leg of the opposite side will

occur; that is, if you stimulate the right hemisphere, there will be movements of the left leg; if you stimulate the left hemisphere, there will be movements of the right leg. In the case of the arm you have a little lower area, and in the case of the voice and muscles connected with speech, the tongue and muscles connected with phonation in general, you have a still lower area down here on the side of the brain; and so certain are we of these locations that physicians who deal with nervous troubles are able to predict by the behavior of a patient just where a tumor or a blood-clot is on the brain. I was told by a skilled neurologist of Philadelphia that he had predicted more than one hundred tumors or blood-clots, and they would simply open a space about the size of a half-dollar and find there the tumor. You see how perfect must be such knowledge in order to locate in that way these phenomena; but while these phenomena lead one to believe that the leg, arm, voice and muscles of speech may be controlled from those areas, you must not for a moment suppose that they are controlled only by these areas, because these animals of which I have spoken where the cerebral hemispheres were entirely removed could perform inherited acts very readily. There is a sensory area known as the area of vision; when this is destroyed, or when there are diseases—physiological disturbances—of this area, there appear certain disturbances of vision; and here is an area which when injured will give rise to disturbances of hearing; and of course disturbances of speech would appear in this region here, and of smell in this region which is on the mesial side. There are, then, certain areas which can be located on the cortex of the cerebrum which are concerned with motion (certain organs like the arm, leg, face and the like), and also with sensations; but after we have all these areas plotted and located there remains about two-thirds of the human cortex still unassigned.

There is a great deal of conflicting testimony with regard to many of these areas and centers, in spite of the definiteness that I have spoken of in predicting certain possibilities. Not all such lesions cause disturbances; a great many persons have had tumors on the brain and did not show evidences of it; and not every lesion of the brain will produce these sensory disturbances. A man had a crowbar shot through his head which tore out the main portion of the frontal lobe; yet the man afterward was a reasonable, intelligent man—possibly not quite so intelligent; they say it changed his disposition a little bit; but otherwise he was quite a reasonable sort of man and lived a good many years. Dr. Loeb says he has cut off the frontal lobe (supposed to be the seat of the soul) in many dogs; he knows no operation in dogs that is more harmless; the dog is really injured less than by almost any other operation. All these things tend to create more or less disturbance—and do—with regard to cerebral localization; but while we may readily assume that there is a localization, that is, an anatomical localization of fibers—there is no doubt about it—yet the whole trouble is that there is such an opportunity for the spread of impulses from one cell to another, like a sort of flashing over the hemisphere, that it is difficult to isolate any one spot and say, "This must be the center of such and such an act."

The dog will very quickly recover from an operation of cutting out certain of these centers. Loeb has cut out all these association centers which Flechsig has described, and the dog remained quite intelligent. Monk holds the removal of the visual sphere (the area of vision) produces psychic blindness, that is, they see, but do not recognize what they see. Loeb says that is a form of color blindness, just as if you had cut a part of the optic nerve. Monk found that dogs, after six weeks, would learn again the objects which they had lost. As he thought, the images were in their brains, that is, if we cut out a certain area of vision, the dogs would not recognize the things they saw, but in about six weeks they would begin again to recognize things, and he thought in the meantime they had trained other cells by their intervening experience; so he took a dog and cut out the visual area; put him in an absolutely dark room for six weeks; then he brought the dog out, and after the shock was over he at once recognized, showing that his vision was all right and that something was wrong in the former conclusion.

If the word "rose" is pronounced, I not only get the sound of the word; it goes to the auditory center, but it also arouses a visual image, and it arouses an odor—an image of certain odors to me, as well as an image of taste and so on; we may have a large number of centers stimulated from a single center. How is it possible to assume that you have a single center for memory when, so far as known, vision is in large part located in this region, hearing in this region, and smell and taste down in this region on the mesial side of the brain? In short, it seems impossible to localize in a hemisphere these phenomena; they are rather phenomena which concern the whole of the hemispheres. That that is true is shown in various ways. You may take out one hemisphere of the brain from a dog, and it still remains an intelligent dog; it perceives objects and remembers and behaves like a normal dog, although it has lost one-half of its brain; but if you cut off one-half of the brain in the other way, that is, if instead of taking this half of the brain you cut the brain in two this way and take half of it, then the dog becomes hopelessly idiotic; he has lost a great many associations that he had, and he is thereafter an idiotic dog. You may cut off the anterior or posterior portion and it does the same thing. The removal of the dog's frontal lobe, destroying the tracts of vision, sensation and emotion, will cause the dog to go about with his head down and be surly; whereas, cutting off portions of the occipital lobes improves the nature of a dog; he is always happier and better-natured.

Protoplasmic sensibility is the germ out of which the sense life grows, as the egg is the germ out of which the adult body grows. We face here the problem of generation, namely, the extent of preformation or new formation, which varies in different cases; but it is certain that elements are present in the egg which under suitable conditions develop into adult structures, and that elements are absent in dead protoplasmic material. Both structurally and functionally the germ is relatively simple, and from its simple

qualities come the complexities of the adult. Consciousness is not present in the egg, nor are vertebrate nor any other adult characteristics. The qualities of water are not present in either hydrogen or oxygen, nor those of ammonia in either nitrogen or hydrogen; by the combination of these elements new qualities arise; and the same is true of the development both of the body and the soul. It is a timeworn argument that you cannot have in the whole what does not exist in any of the parts; but the falsity of this statement is seen at once when applied to chemical compounds in general; for you do have in the water what you do not have either in hydrogen or oxygen.

You are asking, "What is the ultimate relation between the psychic life and the nervous system—between mind and matter? Let us hear your conclusion of the whole matter." I almost fear to tell you that upon the ultimate relations of mind and matter I have no conclusions to which I am absolutely committed. I know not why it is; but in this world of uncertainty and doubt almost the first requirement in an investigator is that he shall commit himself to some hypothesis or other. To regard all hypotheses in an equally impartial way—most of all, not to form a new hypothesis of his own, for which he is willing, if necessary, to stake all—is generally considered to be an element of weakness; but in this case I frankly confess to that condition of indecision.

The relation of mind to body is best represented by the connection of function and structure. There can be no sensibility without protoplasm; no normal protoplasm without sensibility; no intellect without brain; no normal brain without intellect; I do not know how protoplasmic structure conditions sensibility, nor how brain structure conditions mind; yet to me it seems probable that they do condition each the other. Sensibility is not the cause of organization, nor is organization the cause of sensibility, but they are different aspects of the same thing—life. Dubois-Reymond said that the first appearance of life would offer only a mechanical problem were it not for the fact that the germs of psychic processes which we are not able to record are found in the most primitive and simplest organisms. Others believe that even these psychic processes are explicable in terms of chemistry and physics; but when I consider that according to this view, chemical and physical processes in nerve cells must produce that which is neither chemical nor physical, namely, sensation, consciousness and will; when I reflect that if consciousness is the result of molecular movement, a particular mode of development must enable molecules to recognize themselves as distinct from others; and, most of all, when I consider that molecules and atoms are themselves but the creatures of the mind—I realize the absurdity of trying to explain the soul—the creator of such symbols—by the symbols created. Although philosophers and scientists may well perhaps speak of it that things are not what they seem, and that the will cannot be wholly free, yet the universal recognition both by individuals and society of personal responsibility is a phenomenon which, so far as I know, has not been—cannot be—explained on mechanical grounds, and which we dare not assert to be a child of evolution. As Prof. Harper says, it is clearly impossible for those who teach that consciousness is a by-product and never a cause of physical energy to dispute that actions arise; and just as every individual of the human race would have been exactly what they have been in the absence of mind—if mind, of course, has no influence on these things—had mind been wanting the same empires would have risen and fallen, the same battles would have been fought and won, the same literature, the same masterpieces of painting and music would have been produced, the same religious rites would have been performed, and the same actions of friendship and affection given—to this absurdity realistic materialism stands committed; with these things in mind we cannot but agree with Prof. Huxley when he calls materialism a shallow philosophy. On the other hand, assuming the position which I have taken that the mind is related to the body as structure is to function—as function is to structure—we do not know how function is related to structure, how mind is related to matter; we do not know, and it is useless for us to dogmatize about it. In the presence of this mystery of mysteries we can only say—*ignoramus*.

SOFT COAL AS AN EMERGENCY FUEL.

THE question so often asked, What will the people of New York do if the anthracite strike lasts until cold weather? may be answered without difficulty. They will burn soft coal.

The furnaces and ranges designed for anthracite will burn any grade of bituminous coal which reaches this market. If intended for that fuel they would have been made somewhat different as to their draught openings, firepot linings, and smoke exits, but the difference is not so great that as an emergency fuel for two or three months, or longer if necessary, the New York householder cannot do very well with soft coal as a domestic fuel in both cooking and heating. There are reasons, perhaps, why the coal dealers have not made this fact more generally known; but fact it is, and the prudent householder may find specific information on this point useful.

Soft coal in a range or cook stove will meet all the requirements of domestic use if ordinary intelligence is displayed in the management of the fire. The same is true of hot-air furnaces. With the low-pressure boilers used for steam heating somewhat more trouble may be expected, but this is largely a question of the type. Even in such devices soft coal can be burned without an amount of inconvenience comparable to that of an uncomfortably low house temperature. Probably the greatest difficulty will be that experienced in changing the habits of servants who have never known any fuel except anthracite. Filling the firepot of a range to the lids with soft coal will not give good results, and attempts to broil over fresh fuel will be disappointing, though for this purpose a bed of glowing coke is vastly better than one of incandescent anthracite. Care must also be taken in keeping oven temperatures uniform. Soft coal ignites very quickly, dies down with equal facility, and needs constant watching and frequent

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