temperature off the west coasts of California and South America. A number of profiles showing the temperatures of the Pacific Ocean off the coast of California, which were published by Dr. C. M. Richter in the *Bulletin of the California Academy of Sciences*, show very plainly the rising of cold water near the shore; and although the author tries to prove, by means of these charts and profiles, the existence of a cold current, they seem to be far more in favor of the theory advanced above.

It will be seen that in the equatorial parts of the Atlantic Ocean two regions of remarkably cold water occur. One of these is on the coast of Guinea; the other, east of St. Paul. Krümmel believes that they are also due to a submarine source, the cold water of the depth taking the place of the warm dense water which is driven westward by the wind. He points out that it is situated between the equatorial current and the counter equatorial current, and that thus the cold water supplies a deficiency caused by two currents flowing in opposite directions. Therefore this area of cold water does not exist in February, when both currents are less strong. The Guinea current he considers entirely caused by the southern equatorial current, and as supplying the Gulf of Guinea with water instead of that which is drawn from it by the southern equatorial current. We ought to point out here the fact shown by Buchanan, that all counter equatorial currents are very superficial, that their velocity is the greater the less the density of this water, and that the isothermal gradients are very great below these currents, as the light water of the surface prevents the heat from penetrating into the ocean.

The problems of the equatorial circulation of the oceans is extremely complicated, and the observations mentioned above show that the vertical as well as the horizontal circulation of the waters must be studied. The dynamics of the counter equatorial current are particularly obscure, and a careful investigation of its density, temperature, and strength is very desirable.

MENTAL SCIENCE.

The Mechanism of Attention.[1]

VOLUNTARY attention is an artificial act: it grafts itself upon spontaneous attention, and takes its nourishment from this. In spontaneous attention the object acts by its intrinsic power; in voluntary attention the subject brings an alien power to bear upon the process. Spontaneous attention represents the maximum of attraction between subject and object; voluntary attention, the maximum of resistance. It is the voluntary form of attention that is here to be considered.

In the first place, how is so artificial a process as voluntary attention brought about? The method, says M. Ribot, is to make attractive artificially what is not so naturally; to arouse an artificial interest in things naturally uninteresting. The process by which this is done is infinitely varied, but consists always of arousing an interest by playing upon some emotional state.

The infant, according to Preyer, at first is under the sway of spontaneous attention alone: it looks only at bright objects, at sustenance-giving objects. At about the end of the third month it explores the field of vision, and glances at less and less (selfishly) interesting objects; and it is the same with the other senses. The path is from the most intense, most impressive sensations to the finer, more delicate ones. The child naturally flits from one sensation to another: to fixate and hold one sensation is an art that must be learned. A child, for example, refuses to learn to read, but is vastly interested in the pictures in the book. The father says that reading will show the meaning of the pictures. This acts as an artificial inducement, and the child goes to work, substituting an artificial attention to arbitrary signs for the natural attractiveness of pictures. M. Ribot distinguishes three periods in this substitution process. In the first we can appeal to bodily feelings alone. The child can be taught voluntary attention only by playing upon its fear, its egoistic tendencies, by rewards, sympathetic emotions, natural curiosity. In the second period the emotional nature is still the most powerful motive, but the kind of emotion is higher. One can here appeal to ambition, to emulation, to duty. In the final period the attention is maintained by habit. The student at his desk, the workman at his shop, often wish they were elsewhere; but the habit as formed by past appeals to pride, ambition, etc., chains them to their tasks. Art has done its work, and attention has become second nature. Granted a certain environment, and the work goes on almost of itself. Many persons never reach this third organized stage of voluntary attention: there is a vast body of unsteady, Bohemian, vagabond types of character in whom voluntary attention is sporadic only, and not habitual.

The training of animals proceeds by the same steps. An ape is taught to do things meaningless to it by connecting such acts with rewards and punishments. The factor of attention in the process is well shown, in that such animals are selected for training as most readily attend amid distractions.

The genesis of voluntary attention is to be found in its utility. When the conditions of life become at all hard, and especially if they become so by more or less sudden changes, the power of adaption to them is dependent upon voluntary attention to details; upon consideration of something besides the immediately attractive and useful. The savage is lazy, is inspired only by chase, by war, by play; his interest is in the unknown, the unforeseen, the chance. He is not capable of continuous labor. In half-civilized communities work is repugnant. Voluntary attention is a factor of civilization, and is maintained with effort. The most constant characteristic of criminals is lack of power to pursue a steady calling; and the Italian anthropologists regard this as a reversion to primitive habits. Voluntary attention thus came in, and is maintained as a sociological power.

While we all have quite a definite notion of the feeling of effort in fixing the attention, the nature of the process escapes our observation. We feel that the struggle is to focus the thought upon one topic to the exclusion of others, all knocking for admittance into consciousness. The question is not, 'How does a concept come to be attended to?' but 'How is it maintained in the focus of attention? How do we inhibit other concepts?' The answer is very incomplete. The physiology of inhibition is in its infancy. The fact itself simply states that the excitation of a nerve may not only produce motion, but may cause a motion to cease. Stimulating the pneumogastric nerve arrests the heart-beat. The highest form of this power of inhibition is attention: this Ferrier locates in the frontal lobes of the brain. The intelligence would thus be proportionate to the development of these lobes; stimulation of them would never produce movements; and their disease would cause no paralysis, but a lowering of the mental life. All this is found to be true. Inhibition is likewise late in appearing, coming long after impulsive will in child-development. We know only the initial and final steps of the process, the will not to do an action, the fact that it is not done; but we have good reason to believe that the muscles play an active *rôle* in the process.

Attention may be fixed upon three kinds of mental objects, — perceptions, images, ideas. In perception the dominance of the motor element is evident. In seeing, touching, etc., there is always a motion; and the law that the more mobile the part the more sensitive it is, is quite a general one. To fixate an object steadily without moving the eye soon reduces the field of vision to a blank; a weight constantly pressing upon the skin is soon not felt. Consciousness is always of change, and change is based upon movement. Attention is the repression of foreign, irrelevant movements and the concentration upon pertinent ones. Distraction is a diffusion of movements. Next with regard to images. Here the attention is turned inwards, and becomes reflection; but the motor element has not been lost. The motor element of the perception is only weakened (not lost) in its recollection. The two processes are the same in kind, and differ only in degree. As the vividness of the recollection increases, it approaches the perception in the prominence of the motor element. The intense thought of falling down an abyss has led some persons to throw themselves down. Mind-reading is really muscle-reading. When we pass to ideas (and especially abstract ideas), the problem is more difficult. M. Ribot confines his attention to three types of ideas. The first are such as are formed by the fusion of like images without the aid of a word. Their type is the idea of a class, a species. This is within the grasp of animals, children, and deaf-mutes. It is a generic image, like a composite portrait. Here the question as to the motor

[1] A *résumé* of an article by Prof. Th. Ribot (v. *Science*, No. 252).

element is unnecessary, because there is no voluntary reflection involved in attaining this idea. The second class includes the fusion of images in different objects, still without the aid of words, and is represented in the common abstraction. This is a much higher process, and many peoples have stood still at the early stages of it. The Fuegians have no abstract terms; the Indians have words for 'red oak,' for 'white oak,' but not for 'oak' in general; the Tasmanians have words for different kinds of trees, but not for 'tree.' In all these processes there is a motor element in the word, and perhaps in the image too. Finally, as the image becomes more and more abstract, the word becomes more and more fundamental. That the word contains a prominent motor element (varying, however, in its strength in different persons) is generally accepted, and is shown by the fact that this element in language can be lost while the rest remains unlost.

We are thus led to the conclusion that thought without motion is impossible; and, though we cannot have the opportunity of demonstrating this absolutely, we can make it extremely probable. Severe activity is incompatible with intense thought. To direct one's attention is work, and the less natural interest in the topic the more fatiguing the strain. It is not a purely mental process, but is connected with nerve-activity and such movements. Monoideism is work, destruction is rest.

Finally the hints as to the action of attention to be derived from experimental study should be noted. In re-acting to a stimulus, the time is shortened when the attention is fixed, and is lengthened when the attention is wandering. So, too, the more cultured classes can re-act more quickly than the ignorant, because their power of voluntary attention is drilled. If the physical state prevents sharp attention, the time is lengthened. A headache lengthened a re-action-time from .133 to .171 of a second, and severe fatigue to .183 of a second. In various stages of paralysis the time lengthened to .166, .281, and .755 of a second; while in hypnotism, when there is an extraordinary concentration on one perception, the time was shortened from .328 to .193 of a second. Again: the most influential factor in the re-action-time is the expectedness of the impression. If the sensation is preceded by a signal announcing its approach, the time is much shortened. According as the nature, intensity, and time of the stimulus is known, the time is more and more shortened. The unexpected delays the re-action. Again: Wundt has shown that when two impressions — say, the ring of a bell and the movement of an indicator — are simultaneous, the one that is attended to gets first perceived. The adjustment accommodation of the attention in all these cases is again a motor act.

SCARLET-FEVER REPORT. — I.

THE success which has followed from the collective investigation into the subject of distillery-milk and its effects on the lower animals and man when used as food, which was made by *Science* in June, has induced this journal to undertake other inquiries into similar matters which affect the public health. Correspondence has been opened with a number of prominent sanitarians of the United States, and as a result scarlet-fever has been selected as the next subject for inquiry. The following letter has been prepared, and forwarded to leading sanitarians and physicians, and others: —

The prevalence of scarlet-fever in all parts of the civilized world, and the great mortality therefrom, amounting in England alone during five years to 88,273 deaths, have induced *Science* to institute an inquiry into the reasons for such a condition of things, — whether it is a fact that this disease is not amenable to control by sanitation; or whether sanitarians have not suggested any practical method by which it may be controlled; or whether parents, teachers, health authorities, and others neglect to carry out the recommendations which sanitary science has made. With the object of helping to determine these questions, will you kindly answer the following inquiries:

1. Do you believe that scarlet-fever ever arises, at the present time, *de novo*, as distinct from a pre-existing case? If so, on what grounds do you base that belief?

2. Is there any doubt in your mind that scarlet-fever is a communicable disease, and, if so, what reasons have you for that doubt?

3. If you believe it to be communicable, can you give any instances which have come under your own *personal* observation, tending to prove its communicability? If so, please give them in detail.

4. Have you any information touching the communication of bovine scarlet-fever to man, either by contagion or the milk of the affected animal?

5. When does a patient who has had scarlet-fever cease to communicate it to others?

6. Can you give any instances which have come under your own *personal* observation in which clothing, toys, books, or other articles have communicated the disease? If so, please give them in detail.

7. How long have you *personally* known such articles to retain the infection?

8. Should boards of health require reports of cases of scarlet-fever to be made to them, and, if so, by whom and why?

9. What is the duty of boards of health if such reports are received?

10. Is there any plan which, if put into execution, would, in your judgment, prevent the spread of scarlet-fever?

11. If so, can you give instances in which it has practically done so?

12. Do you believe that any thing can be done, by the use of remedies or otherwise, to prevent well persons from contracting scarlet-fever when they are exposed to it?

13. Can you give any *evidence* not under your own personal observation, but sufficiently authenticated by competent authorities, printed or otherwise, touching any of the questions propounded in this circular?

To these inquiries a large number of answers have been received, which we now propose to lay before our readers: —

[WILLIAM K. NEWTON, M.D., Paterson, N.J., State dairy commissioner.]

Below please find answers to your circular relating to scarlet-fever:

1. I have often seen isolated cases of this disease beginning at a time when no other case existed in the city. Many times I have seen a single case begin without any probability of an exposure to another case, but I do not think that we are justified in accepting the theory that the disease may arise *de novo* because of our inability to find the original case. But there is much to lead us to study this side of the question, for filth may be a possible cause.

2. It is no doubt communicable.

3. It is communicable, and scores of instances might be mentioned to substantiate this statement. Cases where children have been exposed at school for a few minutes to one sick with the disease have come under my notice, and, where they have not had the disease before, they have taken the disease in due time. It is a common occurrence for children exposed to the sick to contract this disease.

4. No personal information. The London *Lancet* during the past two years has contained many articles on this subject.

5. As long as there is any roughness of the skin.

6. Have known of many instances where woollen clothing has been the means of carrying the disease.

7. Three weeks.

8. Yes, if the proper officers are prepared and authorized to enforce strict separation and quarantine. If reports are required, and on receipt by the authorities are filed, or only tabulated, and no repressive measures employed, no good is done; and the reports should not be required, for they only go to swell the statistics without benefit. The attending physician is the proper person to notify the authorities, and for this work he should be compensated. Reports from the householder or the family are not reliable, and are not promptly made. As was said, these reports are for the purpose of enabling the health authorities to restrict the spread of the disease, and, if notification is required, restrictive measures should be followed up.

9. The reports should first be recorded, and the location of the case marked on a map of the city kept for that purpose, the latter entry being a record of location to enable us to ascertain if locality