lent to the *de novo* origin of cases of disease which afterward are chiefly communicated by the first and succeeding cases.

Having settled that such origins do take place, we shall then pry into the secret of the laws of combinations and the conditions which favor the evil evolution or the facts of hybridism, and seek to combat these by starting similar processes in opposite directions, or by sterilization, neutralization, disinfection, and all the details of radical sanitation.

Such a view of the occurrence of old or new diseases, and of the reasons for fixity in some and changing forms and types in others, leads to several practical results.

1. The study of parasites, or germs, as they are called, is only one of the methods of informing ourselves as to the phenomena of disease, and in itself is not likely to be the key to rational and successful treament.

2. Our attention should be directed, far more than now, to the study of conditions and circumstances under which new forms appear; to the influence of persons and surroundings, instead of to the mere finding of a specific form. The latter would, of course, be most valuable as one of the facts in the chain of evidence, but we should not, as now, seek so much to look to it as the cause of disease as to inquire what conditions have caused this or that particular microphyte to be present.

3. We should be able to account for the occasional occurrence of a disease independent of any previous case, and for changing types of disease and new diseases, and would come to treat diseases less by their names and more in view of their type and the effect of surroundings upon them.

4. The tendency of all this is to magnify the importance of close observation, and to lead us to feel that success in warding off disease, and in treating it when it appears, depends mostly upon close observation and that experience which is derived from actual practice.

If we are looking to the biological laboratory for the natural history of disease, or to the chemical laboratory for the application of remedies, we shall surely fail. It is not so much that we need to find the specific germ or the specific methods. The world is always looking after specifics. But the science and art of sanitation has far more to expect from a study of the conditions of persons and surroundings under which diseases, or types and modifications of disease, manifest themselves, as also from a study of the prevention or obliteration of such conditions, than it has to expect from the finding of microphytes as the source of disease, and seeking to cure disease by expelling micro-organisms or attenuating them.

Our only design in this paper is to awaken inquiry as to modes of accounting for the localized origin of disease, without any antecedent case, on the proposition that the laws of evolution, environment, hybridism, or modification by culture, give rise to diseases so different from their prototypes as to have individuality and permanency of their own.

Because such inquiry is relevant to prevention, there is good reason to believe that by ascertaining the laws of these transformations and modifications of type and of the origination of special varieties, we shall ere long find new means for the prevention or limitation of many diseases.

'The Malarial Germ of Laveran' was the title of a paper read by Dr. William T. Councilman of Baltimore. He considers that this organism probably belongs to the *Protozoa*, a group of unicellular organisms noted for the varied changes of form which the individual examples undergo in the course of development. Of the malarial germ there are ten more or less distinct forms, of which five are always found in intermittent-fever. During the chill of the fever a definite form is seen, in which multiplication takes place by segmentation. One form has actively moving filaments. This was found in blood taken from the spleen in ten cases of malarial cachexia, and in five cases of intermittent-fever. Dr. Councilman says that too much importance cannot be assigned to this organism as a means of making a differential diagnosis between malarial-fever and typhoid-fever. In outbreaks of fever which occur in small country-towns, where it is of the greatest importance that the character of the disease should be recognized promptly, the advantage of this mode of diagnosis is most evident. There is too much reason for believing that in localities where malarial-fevers prevail, epidemics of typhoid-fever are frequently mistaken for fevers of a malarial type.

Mr. H. Lomb of Rochester offered prizes of $500 and $200 for the best essays on practical sanitary and economic cooking adapted for persons of moderate and small means. Dr. LaBerge, health-officer of Montreal, described the system employed in that city for the collection of garbage, and for its destruction by the Mann furnace. Committees were appointed on State boards of health, pollution of water-supply, disposal of garbage, animal diseases and animal food, forms of statistics, incorporation, protective inoculation, Lomb prize essays, national health legislation, and improvement of the sanitary and medical service on emigrant ships. It was decided to hold the next meeting of the association at Milwaukee. The following officers were elected for the ensuing year: president, Dr. Charles N. Hewitt, Red Wing, Minn.; vice-presidents, Drs. G. B. Thornton, Memphis, and Joseph Holt, New Orleans; executive committee, Drs. Henry B. Baker, Michigan, S. H. Durgin, Massachusetts, and J. N. McCormack, Kentucky. The secretary, Irving A. Watson, M.D., of Concord, N.H., holds over.

THE SURFACE-TEMPERATURES OF THE OCEANS.

A NUMBER of researches on the surface-temperatures of the oceans, which have recently been published, throw a new light on this complicated phenomenon. The maps accompanying the present number of *Science* have been constructed according to Dr. O. Krümmel's maps, showing the surface-temperatures of the oceans. As the Arctic Ocean must be considered part of the Atlantic, of which it forms the most northern extremity, it was desirable to include it in the map. Besides this, the Antarctic Ocean exerts a great influence upon the southern part of the Atlantic Ocean, and therefore the latter has also been included in the map, which shows two-thirds of the earth's surface in a perspective projection. The lateral parts, however, have been left off, as they do not belong to the system of the Atlantic Ocean. The Pacific Ocean has been constructed in the same way, the map extending from its northern limits to the entrance of the Atlantic Ocean. The latter map makes it very clear that the Pacific Ocean forms a comparatively well-defined basin connected by narrow straits with the basin of the Atlantic and Indian Oceans. Its southern limit is indicated by the east coast of Australia, Wilkes Land, Graham Land, and the southern portion of America.

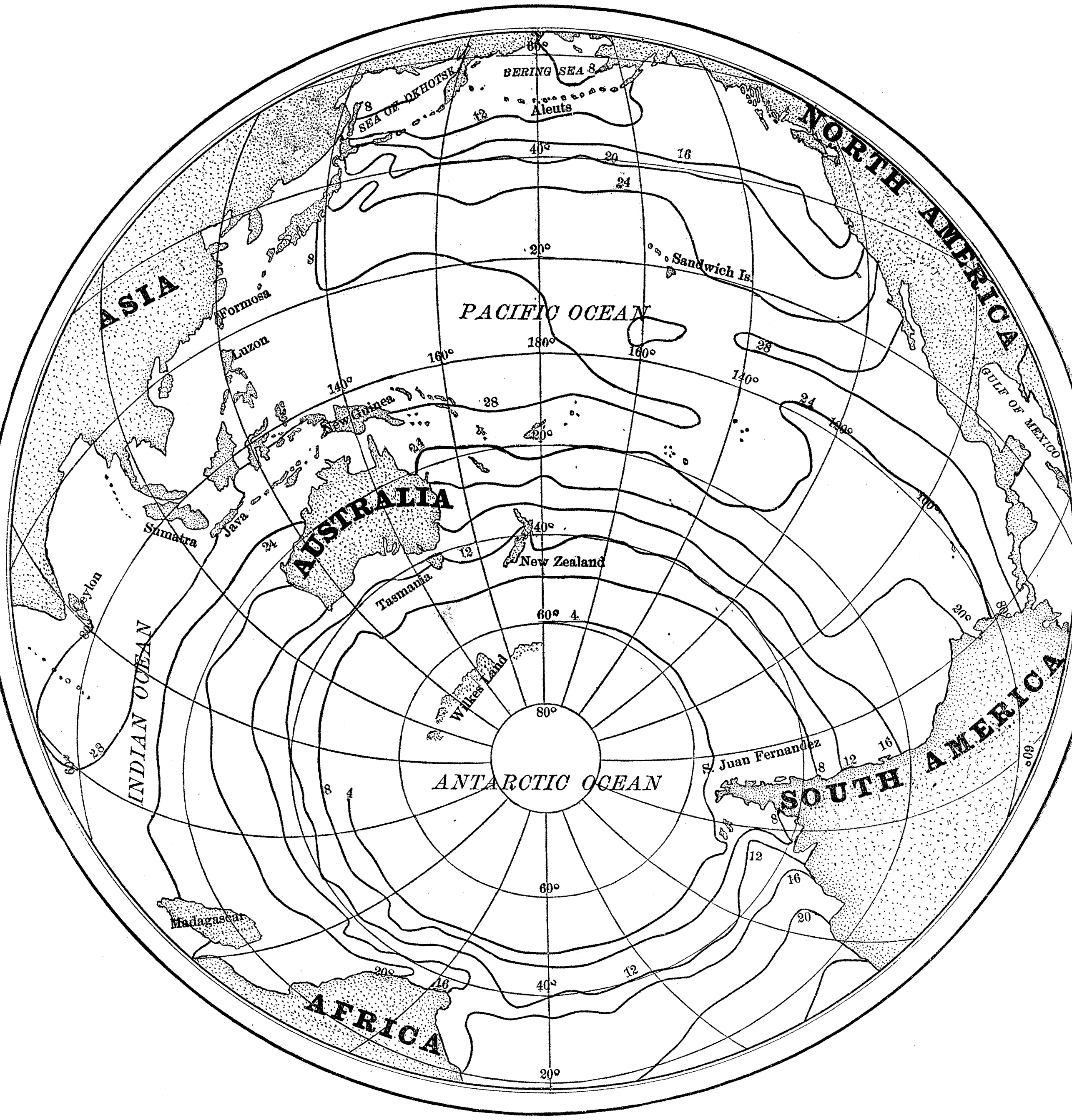
A glance at the lines showing the surface-temperatures of the oceans reveals the remarkable fact that the warm water is accumulated in the western parts of the oceans. Krümmel designates water of more than 24° C. (75° F.) as 'tropical water.' In August the belt of such water is 21 degrees of latitude wide in the eastern part of the Atlantic, while it occupies 61 on its western side. In February it is 22 degrees wide in the eastern part, while it is 56 degrees wide in the western. In the Pacific Ocean it does not occupy more than 17 degrees in August and 25 degrees in February, while in the western parts its width is 57 degrees and 49 degrees respectively. In comparing the amount of tropical and extratropical water, Krümmel finds that twenty-nine per cent of the whole surface of the oceans has always a temperature of more than 25° C., while almost one-half of it temporarily attains this temperature.

It will be observed that in certain parts of the oceans the lines of equal temperature are much crowded, and show sharp angles. This is entirely due to currents, which carry warm water to high latitudes, and cold water to warmer regions. Thus the influence of the Agulhas current may be observed in the sharp angles of these lines near the Cape of Good Hope, while the cold Cape Horn current lowers the temperature along the eastern coast of South America. The influence of the Gulf Stream may be seen in the crowding of the lines of equal temperature near Newfoundland.

The accumulation of warm water in the western parts of the oceans is entirely due to the action of the trade-winds, which blow continually from the eastward, and drive the warm water of the ocean westward, where it is accumulated on the coasts of the continent. Buchanan has explained this phenomenon in a paper on similarities in the physical geography of the great oceans, which has been published in the *Proceedings of the Royal Geographical*

Society. The trade-winds, he says, produce not only dry places on the land, but also comparatively dry places on the sea, and therefore the areas of maximum density or salinity of the surface-water are situated in the trade-winds region. In passing over the surface of the ocean, the winds impart motion to the water immediately under their influence. The effect of this is to produce a general motion of the denser intertropical water towards the equator and towards the west. At the same time the surface-water is evaporated, and thus becomes more concentrated than the deeper and colder layers. In consequence of its greater salinity, the warm surface-water sinks to a certain depth, and thus conveys its higher temperature to the deeper layers. Thus the western parts of the ocean are supplied with water of high temperature, which is collected in the Atlantic Ocean in the immense bay formed by the coasts of North and South America.

Another remarkable fact is shown in our map. It is the prevalence of cold water along many coasts. In South Africa we see the line of 16° C. (61° F.) extending far northward, and on the west coast of North Africa the line of 24° C. (75° F.) extends far southward. Similar phenomena occur on the west coast of America. Formerly the reason for the low temperature of these waters was looked for in polar currents, but recent observations show that it is caused by cold water of deeper layers rising to the surface. So far as we are aware, E. Witte was the first to express this opinion, in a paper published in 1878; but recently a considerable amount of material has been contributed by numerous investigators. Among these, I mention Buchanan's researches in the region of the counter equatorial current on board the 'Buccaneer,' Captain Hoffmann's observations off Cape Guardafui, and Dr. G. Stapff's off Angra Pequeña in South Africa. All these observations tend to show, that wherever the prevailing winds are blowing off the shore, and the water is thus removed without a possibility of being replaced by superficial currents, cold water rises to the surface. But it has been pointed out in an essay published in the *Annalen der Hydrographie*, that, wherever a current is deflected from a coast, cold water must rise to the surface. This fact accounts for the low



MAP OF THE PACIFIC OCEAN, SHOWING THE SURFACE-TEMPERATURES IN AUGUST (ACCORDING TO O. KRÜMMEL).

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).