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EDITED BY
WILLIAM JAY YOUMANS

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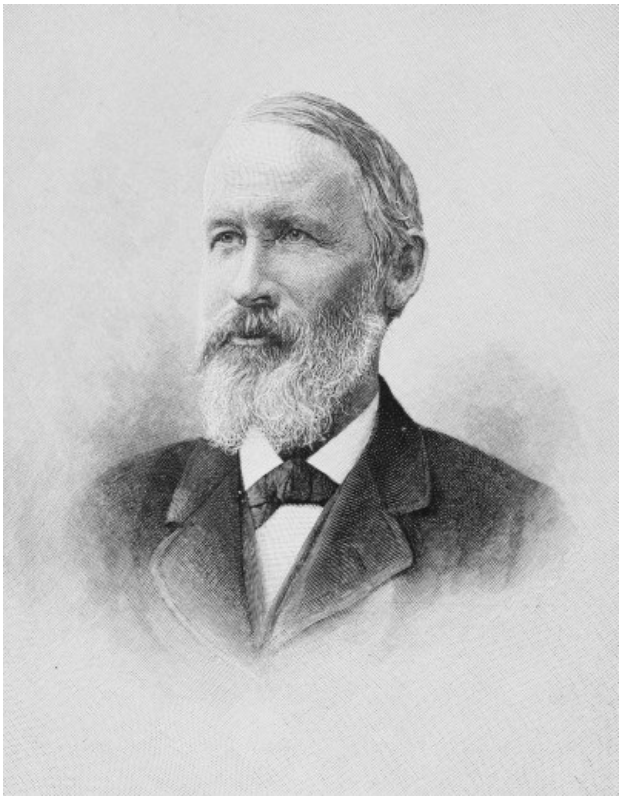

MANLY MILES.

FEBRUARY, 1899.

THE STUFF THAT DREAMS ARE MADE OF.

By HAVELOCK ELLIS.

In our dreams we are taken back into an earlier world. It is a world much more like that of the savage, the child, the criminal, the madman, than is the world of our respectable civilized waking life. That is, in large part, it must be confessed, the charm of dreams. It is also the reason of their scientific value. Through our dreams we may realize our relation to stages of evolution we have long left behind, and by the self-vivisection of our sleeping life we may learn to know something regarding the mind of primitive man and the source of some of his beliefs, thus throwing light on the facts we obtain by ethnographic research.

This aspect of dreams has not always been kept steadily in sight, though it can no longer be said that the study of dreams is neglected. From one point of view or another—not only by the religious sect which, it appears, constitutes a "Dream Church" in Denmark, but by such carefully inquisitive investigators as those who have been trained under the inspiring influence of Prof. Stanley Hall—dreaming is seriously studied. I need not, therefore, apologize for the fact that I have during many years taken note from time to time and recorded the details and circumstances of vivid dreams when I could study their mechanism immediately on awakening, and that I have occupied myself, not with the singularities and marvels of dreaming—of which, indeed, I know little or nothing—but with their simplest and most general laws and tendencies. A few of these laws and tendencies I wish to set forth and illustrate. The interest of such a task is twofold. It not only reveals to us an archaic world of vast emotions and imperfect thoughts, but by helping us to attain a clear knowledge of the ordinary dream processes, it enables us in advance to deal with [Pg 722] many of the extraordinary phenomena of dreaming, sometimes presented to us by wonder-loving people as awesomely mysterious, if not indeed supernatural. The careful analysis of mere ordinary dreams frequently gives us the key to these abnormal dreams.

Perhaps the chief and most frequent tendency in the mechanism of dreaming is that by which isolated impressions from waking life flow together in dreams to be welded into a whole. There is then produced, in the strictest sense, a confusion. For instance, a lady, who in the course of the day has admired a fine baby and bought a big fish for dinner, dreams with horror and surprise of finding a fully developed baby in a large codfish. The confusion may be more remote, embodying abstract ideas and without reference to recent impressions. Thus I dreamed that my wife was expounding to me a theory by which the substitution of slates for tiles in roofing had been accompanied by, and intimately associated with, the growing diminution of crime in England. Amid my wife's rather contemptuous opposition, I opposed this theory, pointing out the picturesqueness of tiles, their cheapness, greater comfort both in winter and summer, but at the same time it occurred to me as a peculiar coincidence that tiles should have a sanguinary tinge suggestive of criminal bloodthirstiness. I need scarcely say that this bizarre theory had never suggested itself to my waking thoughts. There was, however, a real connecting link in the confusion—the redness—and it is a noteworthy point, of great significance in the interpretation of dreams, that that link, although clearly active from the first, remained subconscious until the end of the dream, when it presented itself as an entirely novel coincidence.

The best simile for the mechanism of the most usual type of dream phenomena is the magic lantern. Our dreams are like dissolving views in which the dissolving process is carried on swiftly or slowly, but always uninterruptedly, so that, at any moment, two (often indeed more) incongruous pictures are presented to consciousness which strives to make one whole of them, and sometimes succeeds and is sometimes baffled. Or we may say that the problem presented to dreaming consciousness resembles that experiment in which psychologists pronounce three wholly unconnected words, and require the subject to combine them at once in a connected sentence. It is unnecessary to add that such analogies fail to indicate the subtle complexity of the apparatus which is at work in the manufacture of dreams.

It is the presence of the strife I have just referred to between apparently irreconcilable groups of images, in the effort of overcoming the critical skepticism of sleeping consciousness—a feeble skepticism, it may be, but, as many people do not seem to recognize, a real skepticism—that the [Pg 723] impressive emotional effects of dreams are often displayed. It sometimes happens that two irreconcilable groups of impressions reach sleeping consciousness, one flowing from a recent stratum of memories, the other from an older stratum. A typical form of this phenomenon often occurs in our dreams of dead friends. Professor Sully remarks that in dreams of the dead "awareness of the fact of death wholly disappears, or reduces itself to a vague feeling of something delightfully wonderful in the restored presence." That, however, as I have elsewhere shown,[1] is not the typical process in dreaming of the dead; although in the later dreams of those who often see their dead friends during sleep, the process is abbreviated, and the friend's presence is accepted without a struggle—a very interesting point, for it tends to show that in dreams, as in the hypnotic state, the recollection of previous similar states of consciousness persists, and the illusion is strengthened by repetition.

In typical dreams of a dead friend there is a struggle between that stream of recent memories which represents him as dead and that older stream which represents him as living. These two streams are inevitably caused by the fact of death, which sets up a barrier between them and renders one set of memories incongruous with the other set. In dreams we are not able to

arrange our memories chronologically, but we are perpetually reasoning and striving to be logical. Consequently the two conflicting streams of memories break against each other in restless conflict, and sleeping consciousness endeavors to propound some theory which will reconcile them. The most frequent theories are, as I have found, either that the news of the friend's death was altogether false, or that he had been buried alive by mistake, or else that having really died his soul has returned to earth for a brief space. The mental and emotional conflict which such dreams involve renders them very vivid. They make a profound impression even after awakening, and for some sensitive persons are too sacred to speak of. Even so cautious and skeptical a thinker as Renan, when, after the death of his beloved sister Henriette, he dreamed more than once that she had been buried alive, and that he heard her voice calling to him from her grave, had to still his horrible suspicions by the consideration that she had been tended by experienced doctors. On less well-balanced minds, and more especially in primitive stages of civilization, we can scarcely doubt that such dreams, resting as they do on the [Pg 724] foundation of consciousness, have had a powerful influence in persuading man that death is but a transient fact, and that the soul is independent of the body. I do not wish to assert that they suffice to originate the belief.[2]

While dreams are thus often formed by the molding together of more or less congruous images by a feeble but still intelligent sleeping activity, another factor is to be found in the involuntary wavering and perpetually mere meaningless change of dream imagery. Such concentration as is possible during sleep always reveals a shifting, oscillating, uncertain movement of the vision before us. We are, as it were, reading a sign-post in the dusk, or making guesses at the names of the stations as our express train flashes by the painted letters. Any one who has ever been subject to the hypnagogic imagery sometimes seen in the half-waking state, or who has ever taken mescal, knows that it is absolutely impossible to fix an image. It is this factor in dreams which causes them so often to baffle our analysis. In addition to the mere, as it were, mechanical flowing together of images and ideas, and the more or less intelligent molding of them into a whole, there is thus a failure of sleeping attention to fix definitely the final result—a failure which itself may evidently serve to carry on the dream process by suggesting new images and combinations. I dreamed once that I was with a doctor in his surgery, and saw in his hand a note from a patient saying that doctors were fools and did him no good, but he had lately taken some *selvdrolla*, recommended by a friend, and it had done him more good than anything, so please send him some more. I saw the note clearly, not, indeed, being conscious of reading it word by word, but only of its meaning as I looked at it; the one word I actually seemed to see, letter by letter, was the name of the drug, and that changed and fluctuated beneath my vision as I gazed at it, the final impression being *selvdrolla*. The doctor took from a shelf a bottle containing a bright yellow oleaginous fluid, and poured a little out, remarking that it had lately come into favor, especially in uric-acid disorders, but was extremely expensive. I expressed my surprise, [Pg 725] having never before heard of it. Then, again to my surprise, he poured rather copiously from the bottle on to a plate of food, saying, in explanation, that it was pleasant to take and not dangerous. This was a vivid morning dream, and on awakening I had no difficulty in detecting the source of its various minor details, especially a note received on the previous evening and containing a dubious figure, the precise nature of which I had used my pocket lens to determine. But what was *selvdrolla*, the most vivid element of the dream? I sought vainly among my recent memories, and had almost renounced the search when I recalled a large bottle of salad oil seen on the supper table the previous evening; not, indeed, resembling the dream bottle, but containing a precisely similar fluid. *Selvdrolla* was evidently a corruption of "salad oil." I select this dream to illustrate the uncertainty of dream consciousness, because it also illustrates at the same time the element of certainty in dream *subconsciousness*. Throughout my dream I remained, consciously, in entire ignorance as to the real nature of *selvdrolla*, yet a latent element in consciousness was all the time presenting it to me in ever-clearer imagery.

While the confusions of dreaming are usually the union of unconnected streams of imagery which have, as it were, come from widely remote parts of the memory system to strike together at the narrow focus of shaping consciousness, in some rarer cases the fused images are really suggested by analogy and are not accidental. Maury records successions of dream imagery strung together by verbal resemblances; I have found such dreams rare, but other forms of association fairly common. Thus I once dreamed that I was with a dentist who was about to extract a tooth from a patient. Before applying the forceps he remarked to me (at the same time setting fire to a perfumed cloth at the end of something like a broomstick in order to dissipate the unpleasant odor) that it was the largest tooth he had ever seen. When extracted I found that it was indeed enormous, in the shape of a caldron, with walls an inch thick. Taking from my pocket a tape measure (such as I always carry in waking life) I founds the diameter to be not less than twenty-five inches; the interior was like roughly hewn rock, and there were sea-weeds and lichenlike growths within. The size of the tooth seemed to me large, but not extraordinarily so. It is well known that pain in the teeth, or the dentist's manipulations, cause those organs to seem of extravagant extent; in dreams this tendency rules unchecked; thus a friend once dreamed that mice were playing about in a cavity in her tooth. But for the dream first quoted there was no known dental origin; it arose solely or chiefly from a walk during the previous afternoon among the rocks of the Cornish coast at low tide, and the fantastic analogy, which had not occurred to [Pg 726] waking consciousness, suggested itself during sleep.

The following dream illustrates an association of quite a different order: I imagined I was sitting at a window, at the top of a house, writing. As I looked up from my table I saw, with all the emotions naturally accompanying such a sight, a woman in her night dress appear at a lofty

window some distance off and throw herself down. I went on writing, however, and found that in the course of my literary employment—I am not clear as to its precise nature—the very next thing I had to do was to describe exactly such a scene as I had just witnessed. I was extremely puzzled at such an extraordinary coincidence: it seemed to me wholly inexplicable. Such dreams, reduplicating the imagery in a new sensory medium, are fairly common, with me at all events, though I can not easily explain them. The association is not so much of analogy as of sensory media, in this case the visual image becoming a verbal motor image. In other cases a scene is first seen as in reality, and then in a picture. It is interesting to observe the profound astonishment with which sleeping consciousness apperceives such simple reduplication.

It sometimes happens that the confused imagery of dreams includes elements drawn from forgotten memories—that is to say, that sleeping consciousness can draw on faint impressions of the past which waking consciousness is unable to reach. This is a very important type of dream because of its bearing on the explanation of certain dream phenomena which we are sometimes asked to bow down before as supernatural. I may illustrate what I mean by the following very instructive case. I woke up recalling the chief items of a rather vivid dream: I had imagined myself in a large old house, where the furniture, though of good quality, was ancient, and the chairs threatened to give way as one sat on them. The place belonged to one Sir Peter Bryan, a hale old gentleman who was accompanied by his son and grandson. There was a question of my buying the place from him, and I was very complimentary to the old gentleman's appearance of youthfulness, absurdly affecting not to know which was the grandfather and which the grandson. On awaking I said to myself that here was a purely imaginative dream, quite unsuggested by any definite experiences. But when I began to recall the trifling incidents of the previous day I realized that that was far from being the case. So far from the dream having been a pure effort of imagination I found that every minute item could be traced to some separate source. The name of Sir Peter Bryan alone completely baffled me; I could not even recall that I had at that time ever heard of any one called Bryan. I abandoned the search and made my notes of the dream and its sources. I had scarcely done so when I chanced to take up a volume of biographies which I had [Pg 727] glanced through carelessly the day before. I found that it contained, among others, the lives of Lord *Peter*borough and George *Bryan* Brummel. I had certainly seen those names the day before; yet before I took up the book once again it would have been impossible for me to recall the exact name of Beau Brummel, and I should have been inclined to say that I had never even heard the name of Bryan. I repeat that I regard this as, psychologically, a most instructive dream. It rarely happens (though I could give one or two more examples from the experience of friends) that we can so clearly and definitely demonstrate the presence of a forgotten memory in a dream; in the case of old memories it is usually impossible. It so happened that the forgotten memory which in this case re-emerged to sleeping consciousness was a fact of no consequence to myself or any one else. But if it had been the whereabouts of a lost deed or a large sum of money, and I had been able to declare, as in this case, that the impression received in my dream had never to my knowledge existed in waking consciousness, and yet were to declare my faith that the dream probably had a simple and natural explanation, on every hand I should be sarcastically told that there is no credulity to match the credulity of the skeptic.

The profound emotions of waking life, the questions and problems on which we spread our chief voluntary mental energy, are not those which usually present themselves at once to dream consciousness. It is, so far as the immediate past is concerned, mostly the trifling, the incidental, the "forgotten" impressions of daily life which reappear in our dreams. The psychic activities that are awake most intensely are those that sleep most profoundly. If we preserve the common image of the "stream of consciousness," we might say that the grave facts of life sink too deeply into the flood to reappear at once in the calm of repose, while the mere light and buoyant trifles of life, flung carelessly in during the day, at once rise to the surface, to dance and mingle and evolve in ways that this familiar image of "the stream of consciousness" will not further help us to picture.

So far I have been discussing only one of the great groups into which dreams may be divided. Most investigators of dreams agree that there are two such groups, the one having its basis in memories, the other founded on actual physical sensations experienced at the moment of dreaming and interpreted by sleeping consciousness. Various names have been given to these two groups; Sully, for instance, terms them central and peripheral. Perhaps the best names, however, are those adopted by Miss Calkins, who calls the first group representative, the second group presentative.

All writers on dreaming have brought forward presentative dreams, and there can be no doubt [Pg 728] that impressions received during sleep from any of the external senses may serve as a basis for dreams. I need only record one example to illustrate this main and most obvious group of presentative dreams. I dreamed that I was listening to a performance of Haydn's Creation, the chief orchestral part of the performance seeming to consist chiefly of the very realistic representation of the song of birds, though I could not identify the note of any particular bird. Then followed solos by male singers, whom I saw, especially one who attracted my attention by singing at the close in a scarcely audible voice. On awakening the source of the dream was not immediately obvious, but I soon realized that it was the song of a canary in another room. I had never heard Haydn's Creation, except in fragments, nor thought of it at any recent period; its reputation as regards the realistic representation of natural sounds had evidently caused it to be put forward by sleeping consciousness as a plausible explanation of the sounds heard, and the visual centers had accepted the theory.

It is a familiar fact that internal sensations also form a frequent basis of dreams. All the internal

organs, when disturbed or distended or excited, may induce dreams, and especially that aggravated kind of dreaming which we call nightmare. This fact is so well known that such dreams are usually dismissed without further analysis. It is a mistake, however, so to dismiss them, for it seems probable that it is precisely here that we may find the most instructive field of dream psychology. On account of the profoundly emotional effect of such dreams they are very interesting to study, but this very element of emotion renders them somewhat obscure objects of study. I do not venture to offer with absolute certainty one or two novel suggestions which dream experiences have led me to regard as probable.

Dreams of flying have so often been recorded—from the time of St. Jerome, who mentions that he was subject to them—that they may fairly be considered to constitute one of the commonest forms of dreaming. All my life, it seems to me, I have at intervals had such dreams in which I imagined myself rhythmically bounding into the air and supported on the air. These dreams, in my case at all events, are not generally remembered immediately on awakening (seeming to indicate that they depend on a cause which does not usually come into action at the end of sleep), but they leave behind them a vague but profound sense of belief in their reality and reasonableness.[3] Several writers have attempted to explain this familiar phenomenon. Gowers [Pg 729] considers that a spontaneous contraction of the stapedius muscle of the ear during sleep causes a sensation of falling. Stanley Hall, who has himself from childhood had dreams of flying, boldly argues that we have here "some faint reminiscent atavistic echo from the primeval sea"; and that such dreams are really survivals—psychic vestigial remains—taking us back to the far past, in which man's ancestors needed no feet to swim or float. Such a theory may accord with the profound conviction of reality that accompanies such dreams, though this may be more simply accounted for, even by mere repetition, as with dreams of the dead; but it is rather a hazardous theory, and it seems to me infinitely more probable that such dreams are a misinterpretation of actual internal sensations.

My own explanation was immediately suggested by the following dream. I dreamed that I was watching a girl acrobat, in appropriate costume, who was rhythmically rising to a great height in the air and then falling, without touching the floor, though each time she approached quite close to it. At last she ceased, exhausted and perspiring, and had to be led away. Her movements were not controlled by mechanism, and apparently I did not regard mechanism as necessary. It was a vivid dream, and I awoke with a distinct sensation of oppression in the chest. In trying to account for this dream, which was not founded on any memory, it occurred to me that probably I had here the key to a great group of dreams. The rhythmic rising and falling of the acrobat was simply the objectivation of the rhythmic rising and falling of my own respiratory muscles under the influence of some slight and unknown physical oppression, and this oppression was further translated into a condition of perspiring exhaustion in the girl, just as it is recorded that a man with heart disease dreamed habitually of sweating and panting horses climbing up hill. We may recall also the curious sensation as of the body being transformed into a vast bellows which is often the last sensation felt before the unconsciousness produced by nitrous oxide gas. When we are lying down there is a real rhythmic rising and falling of the chest and abdomen, centering in the diaphragm, a series of oscillations which at both extremes are only limited by the air. Moreover, in this position we have to recognize that the whole internal organism—the circulatory, nervous, and other systems—are differently balanced from what they are in the upright position, and that a disturbance of internal equilibrium always accompanies falling. Further, it is possible that the misinterpretation is confirmed to sleeping consciousness by sensations from without, by the absence of the tactile pressure produced by boots on the foot, or the contact of the ground with [Pg 730] the soles; we are at once conscious of movement and conscious that the soles of the feet are in contact only with the air. Thus in normal sleep the conditions may be said to be always favorable for producing dreams of flying or of floating in the air, and any slight thoracic disturbance, even in healthy persons, arising from lungs, heart, or stomach, and serving to bring these conditions to sleeping consciousness, may determine such a dream.

There is another common class of dreams which, it seems fairly evident to me, must also find their psychological explanation chiefly in the visceral sensations—I mean dreams of murder. Many psychologists have referred with profound concern to the facility and prevalence of murder in dreams, sometimes as a proof of the innate wickedness of human nature made manifest in the unconstraint of sleep, sometimes as evidence of an atavistic return to the modes of feeling of our ancestors, the thin veneer of civilization being removed during sleep. Maudsley and Mme. de Manacéïne, for example, find evidence in such dreams of a return to primitive modes of feeling. It may well be that there is some element of truth in this view, but even if so we still have to account for the production of such dreams. For this we must, in part at least, fall back upon the logical outcome of dream confusions, owing to which, for instance, a lady who has carved a duck at dinner may a few hours later wake up exhausted by the imaginary effort of cutting off her husband's head. But I think we may find evidence that the dream of murder is often a falsely logical deduction from abnormal visceral and especially digestive sensations.

I may illustrate such dreams by the following example: A lady dreamed that her husband called her aside and said: "Now, do not scream or make a fuss; I am going to tell you something. I have to kill a man. It is necessary, to put him out of his agony." He then took her into his study and showed her a young man lying on the floor with a wound in his breast, and covered with blood. "But how will you do it?" she asked. "Never mind," he replied, "leave that to me." He took something up and leaned over the man. She turned aside and heard a horrible gurgling sound. Then all was over. "Now," he said, "we must get rid of the body. I want you to send for So-and-so's cart, and tell him I wish to drive it." The cart came. "You must help me to make the body into

a parcel," he said to his wife; "give me plenty of brown paper." They made it into a parcel, and with terrible difficulty and effort the wife assisted her husband to get the body down stairs and lift it into the cart. At every stage, however, she presented to him the difficulties of the situation. But he carelessly answered all objections, said he would take the body up to the moor, among the [Pg 731] stones, remove the brown paper, and people would think the murdered man had killed himself. He drove off and soon returned with the empty cart. "What's this blood in my cart?" asked the man to whom it belonged, looking inside. "Oh, that's only paint," replied the husband. But the dreamer had all along been full of apprehension lest the deed should be discovered, and the last thing she could recall, before waking in terror, was looking out of the window at a large crowd which surrounded the house with shouts of "Murder!" and threats.

This tragedy, with its almost Elizabethan air, was built up out of a few commonplace impressions received during the previous day, none of which impressions contained any suggestion of murder. The tragic element appears to have been altogether due to the psychic influences of indigestion arising from a supper of pheasant. To account for our oppression during sleep, sleeping consciousness assumes moral causes which alone appear to it of sufficient gravity to be the adequate cause of the immense emotions we are experiencing. Even in our waking and fully conscious states we are inclined to give the preference to moral over physical causes, quite irrespective of the justice of our preferences; in our sleeping states this tendency is exaggerated, and the reign of purely moral causes is not disturbed by even a suggestion of mere physical causation.

There is certainly no profounder emotional excitement during sleep than that which arises from a disturbed or distended stomach, and is reflected by the pneumogastric to the accelerated heart and the impeded respiration.[4] We are thereby thrown into a state of uninhibited emotional agitation, a state of agony and terror such as we rarely or never attain during waking life. Sleeping consciousness, blindfolded and blundering, a prey to these massive waves from below, and fumbling about desperately for some explanation, jumps at the idea that only the attempt to escape some terrible danger or the guilty consciousness of some awful crime can account for this immense emotional uproar. Thus the dream is suffused by a conviction which the continued emotion serves to support. We do not—it seems most simple and reasonable to conclude—experience terror because we think we have committed a crime, but we think we have committed a crime because we experience terror. And the fact that in such dreams we are far more concerned with escape from the results of crime than with any agony of remorse is not, as some have thought, due to our innate indifference to crime, but simply to the fact that our emotional state suggests to us active escape from danger rather than the more passive grief of remorse. Thus our dreams bear witness to the fact that our intelligence is often but a tool in the hands of [Pg 732] our emotions.[5]

I have had frequent occasion to refer to the objectivation of subjective sensations as a phenomenon of dreaming. It is, indeed, so frequent and so important a phenomenon that it needs some further reference. In hysteria (which by some of the most recent authorities, like Sollier, is regarded as a species of somnambulism), in "demon-possession," and many other abnormal phenomena it is well known that there is, as it were, a doubling of personality; the *ego* is split up into two or more parts, each of which may act as a separate personality. The literature of morbid psychology is full of extraordinary and varied cases exhibiting this splitting up of personality. But it is usually forgotten that in dreams the doubling of personality is a normal and constant phenomenon in all healthy people. In dreaming we can divide our body between ourselves and another person. Thus a medical friend dreamed that in conversation with a lady patient he found his hand resting on her knee and was unable to remove it; awakening in horror from this unprofessional situation he found his own hand firmly clasped between his knees; the hand had remained his own, the knee had become another person's, the hand being claimed, rather than the knee, on account of its greater tactile sensibility. Again, we sometimes objectify our own physical discomforts felt during sleep in the emotions of some other person, or even in some external situations. And, possibly, every dream in which there is any dramatic element is an instance of the same splitting up of personality; in our dreams we may experience shame or confusion from the rebuke or the arguments of other persons, but the persons who administer the rebuke or apply the argument are still ourselves.

When we consider that this dream process, with its perpetual dramatization of our own personality, has been going on as long as man has been man—and probably much longer, for it is evident that animals dream—it is impossible to overestimate its immense influence on human belief. Men's primitive conceptions of religion, of morals, of many of the mightiest phenomena of life, especially the more exceptional phenomena, have certainly been influenced by this constant dream experience. It is the universal primitive explanation of abnormal psychic and even physical phenomena that some other person or spirit is working within the subject of the abnormal experience. Certainly dreaming is not the sole source of such conceptions, but they could [Pg 733] scarcely have been found convincing, and possibly could not ever have arisen, among races who were wholly devoid of dream experiences. A large part of all progress in psychological knowledge, and, indeed, a large part of civilization itself, lies in realizing that the apparently objective is really subjective, that the angels and demons and geniuses of all sorts that seemed at first to take possession of the feeble and vacant individuality are themselves but modes of action of marvelously rich and varied personalities. But in our dreams we are brought back into the magic circle of early culture, and we shrink and shudder in the presence of imaginative phantoms that are built up of our own thoughts and emotions, and are really our own flesh.

There is one other general characteristic of dreams that is worth noting, because its significance is not usually recognized. In dreams we are always reasoning. It is sometimes imagined that reason is in abeyance during sleep. So far from this being the case, we may almost be said to reason much more during sleep than when we are awake. That our reasoning is bad, even preposterous, that it constantly ignores the most elementary facts of waking life, scarcely affects the question. All dreaming is a process of reasoning. That artful confusion of ideas and images which at the outset I referred to as the most constant feature of dream mechanism is nothing but a process of reasoning, a perpetual effort to argue out harmoniously the absurdly limited and incongruous data present to sleeping consciousness. Binet, grounding his conclusions on hypnotic experiments, has very justly determined that reasoning is the fundamental part of all thinking, the very texture of thought. It is founded on perception itself, which already contains all the elements of the ancient syllogism. For in all perception, as he shows, there is a succession of three images, of which the first fuses with the second, which in its turn suggests the third. Now this establishment of new associations, this construction of images, which, as we may easily convince ourselves, is precisely what takes place in dreaming, is reasoning itself.

Reasoning is a synthesis of images suggested by resemblance and contiguity, indeed a sort of logical vision, more intense even than actual vision, since it produces hallucinations. To reasoning all forms of mental activity may finally be reduced; mind, as Wundt has said, is a thing that reasons. When we apply these general statements to dreaming, we may see that the whole phenomenon of dreaming is really the same process of image-formation, based on resemblance and contiguity, which is at the basis of reasoning. Every dream is the outcome of this strenuous, wide-ranging instinct to reason. The supposed "imaginative faculty," regarded as so highly active during sleep, is simply the inevitable play of this automatic logic. The characteristic of the [Pg 734] reasoning of dreams is that it is unusually bad, and this badness is due chiefly to the absence of memory elements that would be present to waking consciousness, and to the absence of sensory elements to check the false reasoning which without them appears to us conclusive. That is to say —to fall back on the excellent generalization which Parish has elaborately applied to all forms of hallucination—there is a process of dissociation by which ordinary channels of association are temporarily blocked and the conditions prepared for the formation of the hallucination. It is, as Parish has argued, in sleep and in those sleep-resembling states called hypnagogic that a condition of dissociation leading to hallucination is most apt to occur.

The following dream illustrates the part played by dissociation: A lady dreamed that an acquaintance wished to send a small sum of money to a person in Ireland. She rashly offered to take it over to Ireland. On arriving home she began to repent of her promise, as the weather was extremely wild and cold. She began, however, to make preparations for dressing warmly, and went to consult an Irish friend, who said she would have to be floated over to Ireland tightly jammed in a crab basket. On returning home she fully discussed the matter with her husband, who thought it would be folly to undertake such a journey, and she finally relinquished it, with great relief. In this dream—the elements of which could all be accounted for—the association between sending money and postal orders which would at once occur to waking consciousness was closed; consciousness was a prey to such suggestions as reached it, but on the basis of these suggestions it reasoned and concluded quite sagaciously. The phenomena of dreaming furnish a delightful illustration of the fact that reasoning, in its rough form, is only the crudest and most elementary form of intellectual operation, and that the finer forms of thinking only become possible when we hold in check this tendency to reason. "All the thinking in the world," as Goethe puts it, "will not lead us to thought."

It is in such characteristics as these—at once primitive, childlike, and insane—that we may find the charm of dreaming. In our sleeping emotional life we are much more like ourselves than we are in our sleeping intellectual life. It is a mistake to imagine that our moral and æsthetic instincts are abolished in dreams; they are often weakened, but by no means abolished. Such a result is natural when we remember that our emotions and instincts are both more primitive and less under the dominion of the external senses than are our ideas. Yet in both respects we are removed a stage backward in our dreams. The emotional intensity, the absurd logic, the tendency to personification—nearly all the points I have referred to as characterizing our dreams—are the [Pg 735] characteristics of the child, the savage, and the madman. Time and space are annihilated, gravity is suspended, and we are joyfully borne up in the air, as it were, in the arms of angels; we are brought into a deeper communion with Nature, and in his dreams a man will listen to the arguments of his dog with as little surprise as Balaam heard the reproaches of his ass. The unexpected limitations of our dream world, the exclusion of so many elements which are present even unconsciously in waking life, imparts a splendid freedom and ease to the intellectual operations of the sleeping mind, and an extravagant romance, a poignant tragedy, to our emotions. "He has never known happiness," said Lamb, speaking out of his own experience, "who has never been mad." And there are many who taste in dreams a happiness they never know when awake. In the waking moments of our complex civilized life we are ever in a state of suspense which makes all great conclusions impossible; the multiplicity of the facts of life, always present to consciousness, restrains the free play of logic (except for that happy dreamer, the mathematician) and surrounds most of our pains and nearly all our pleasures with infinite qualifications; we are tied down to a sober tameness. In our dreams the fetters of civilization are loosened, and we know the fearful joy of freedom.

At the same time it is these characteristics which make dreams a fit subject of serious study. It was not until the present century that the psychological importance of the study of insanity was recognized. So recent is the study of savage mind that the workers who have laid its foundation

are yet all living. The systematic investigation of children only began yesterday. To-day our dreams begin to seem to us an allied subject of study, inasmuch as they reveal within ourselves a means of entering sympathetically into ideas and emotional attitudes belonging to narrow or ill-adjusted states of consciousness which otherwise we are now unable to experience. And they have this further value, that they show us how many abnormal phenomena—possession, double consciousness, unconscious memory, and so forth—which have often led the ignorant and unwary to many strange conclusions, really have a simple explanation in the healthy normal experience of all of us during sleep. Here, also, it is true that we ourselves and our beliefs are to some extent "such stuff as dreams are made of."

> The harmonious and equitable evolution of man, says President Dabney, of the University of Tennessee, "does not mean that every man must be educated just like his fellow. The harmony is within each individual. That community is most highly educated in which each individual has attained the maximum of his possibilities in the direction of his peculiar talents and opportunities."

THE BEST METHODS OF TAXATION.

[Pg 736]

By the Late Hon. DAVID A. WELLS.

PART I.

This historical survey of tax experience among peoples widely differing in their economic condition and social relations, and this examination of the scope and practice of taxation, with especial reference to the tax systems of the United States as defined and interpreted by judicial authority, prepare the way for a discussion of the best methods of taxation for a country situated as is the United States. General as are the theoretical principles underlying taxation, the application of these principles to existing conditions must be modified to meet the long usage and inherited prejudice of the people, and the form of production or manner of distributing wealth. This holds true in the face of appearances so opposed to it as to defy definition and acceptance. No less promising field for an income tax can be pictured than British India, and few more promising fields than France. Yet India has borne such a tax for years, while France will not permit a true tax on income to be adopted as a part of its revenue system. In the latter country the plea is made that the upper and middle classes already pay under other forms of taxation more than their due proportion of the public burdens, and an additional and necessarily discriminating duty laid upon them will only make this inequality the greater. Class interest may thus oppose its veto to a change that promises to reduce the burdens of one class of taxpayers at the expense of another; or may even oppose a change that offers the chance of collecting a larger revenue with less real difficulty and sacrifice on the part of the taxed. No opposition can set aside even temporarily the great rules that clearly define a tax from tribute, a legal and beneficial taking by the state of a certain part of the public wealth from a demand that involves waste or mischievous expenditure, for which the state or people derive no advantage commensurate with the cost, or from which individuals obtain a gain not defensible in justice, and at the expense of only one part of the community.

After so many centuries of experiment, in which hardly a possible source of state revenue has escaped attention, some knowledge of the great principles of taxation might have been evolved. Unfortunately, the experience of one nation is not accepted as containing lessons applicable to the needs or conditions of another, and one generation rarely appeals to history save to defend its own experiments. Ignorance, half knowledge, which is quite as dangerous, and interest guide or influence legislation, and those who predict failure or danger are regarded as theorists, and [Pg 737] denounced as unpractical. Nowhere is the tendency to move independent of enlightened knowledge more evident than in the United States. At every appearance of the tax question, State and national legislatures are overwhelmed with measures that have been tried in the past, and after a thorough test condemned beyond any hope of defense.

Yet history shows the gradual disappearance of certain forms of taxation which enjoyed great popularity for a time, and accomplished the end of their creation in a crude and often cruel manner. Looking over long periods of time, it is seen that some advances have been made, rather from a change in the economic condition of the people than from a true appreciation of the principles in question. The development of popular liberty has been an essential factor, and the alterations in tax methods require a close analysis of the causes leading to the rise and dominance of political and constitutional principle. While it is true that a popular uprising against fiscal exactions usually marked the limit of endurance of an oppressive system, it is also true that the same uprisings marked the completion of one stage of political development, and the readiness or even the need of entering upon a new stage. In one sense the progress of a people toward civilization in its highest meaning may be illustrated by its fiscal machinery and methods of obtaining its revenue from the people. It will be of interest to glance at some of these passing phases which have generally come down to a late day, and are still to be found in activity in some of the most advanced states of Europe.

The practice of farming out the revenues of a state or any part of it has become nearly obsolete, and where it does exist is the mark of a fiscal machinery as yet not fully developed. The opportunities and temptation which the contract system offered for oppressing the taxpayers were apparent long before the state was in a position to assert its ability to make its own collections. In France the *fermiers généraux* were a political factor, standing between the king and his people, regarded as necessary to the former and as oppressors of the latter. Their unpopularity, in part justified by their conduct, was a not unimportant item in the arraignment of royalty by the people. Wherever introduced, the farming of taxes proved in the long run as unwise politically as it was unprofitable financially; and the only reasonable defense for adopting it was the want of strength in the state to command its own revenue—a want as likely to arise from the dishonesty of its agents as from a political weakness. In early times the most universal manner of supplying the treasury of the state, the farming of taxes has become so rare as to be classed as a curiosity. Italy still employs this machinery to collect her taxes on tobacco, and Spain [Pg 738] from necessity has mortgaged her taxes to the bank, with the task of collecting them.

Of the same general character are the state lotteries, of which some few and quite important instances may still be found in action. Of the immorality of these instruments there can be little doubt, and there is quite as unanimous an opinion as to their inefficiency as fiscal instruments. Yet it is only within very recent years that state lotteries have been discarded even in the most advanced countries. The machinery of lotteries has often been modified, but, no matter how altered in details, they all have appealed to the love of games of chance. Adam Smith asserted that the "absurd presumption" of men in their own good fortune is even more universal than the overweening conceit which the greater part of men have in their own abilities.[6] Yet another assertion of the same writer is as true: "The world neither ever saw, nor ever will see, a perfectly fair lottery, or one in which the whole gain compensated the whole loss." Where the state undertakes it, there is a profit generally assured to the state, but that profit is by no means certain, and can not make good the demoralization introduced among the people. State lotteries are still a part of the revenue system in Italy and Austria (proper), where the receipts are important, but show a decided tendency to diminish; Hungary and Denmark, where they are of little moment; and in Spain, where they are retained because of the general incapacity of the administration to reach other and more profitable sources of revenue. The experience of the State of Louisiana in connection with a State lottery is too recent to require examination. It is not probable that once abandoned such an instrument for obtaining money from the people will be revived, save as a last resort.

The state monopoly in the manufacture and sale of an article for fiscal purposes holds a place in European countries of high importance, and is met elsewhere under conditions not so favorable to its maintenance. As an example of the latter may be cited the colonial policy of the Dutch in their possessions in the East. After the termination of the trading companies, the Government undertook the entire control of the colonies, and sought to make them a source of revenue. The natives were to be taxed, but, having little of their own to be taxed, and practicing no occupation that could of its own volition become a profitable source of revenue, the state undertook to organize industry, and, by creating an opportunity for employing the labor of the natives, to receive the profits of production for its own uses. The native chiefs were made "masters of industry" and collectors of the revenue; and a certain part of the labor of the natives, one day in every five, was decreed to the state. In order to derive a profit, this labor must be bestowed in [Pg 739] cultivating some product as find a market in international trade. Hence arose the importance of the sugar, coffee, tobacco, and spice crops of these Dutch islands, and for many years a handsome profit to the treasury was obtained from the management and sales of product. With the great fall in prices of sugar and coffee throughout the world, and the narrowing of the market for cane sugar, the Government obtained a less income each year, and has found it of advantage to relax the conditions surrounding cultivation, and to throw the management of the plantations more and more into private hands. To such an extent has this transition been effected that the state can no longer be considered as controlling a monopoly in product or sales, and is content with a revenue from other sources, one that does not even cover the expenses incurred in the colonial system. This experiment differs widely from those industries undertaken with the aid or encouragement of the state to be found in India. It was not with a fiscal object that they were established, and not infrequently the state sacrifices revenue by releasing them from tax burdens they would ordinarily endure. As one of the few remaining instances of the direct participation of a state in the production of products intended for foreign markets, yet undertaken and maintained for fiscal reasons, the history of the Dutch colonies in the East is instructive.

In Prussia the working of certain mines is in the hands of the state, and was originally looked upon as an important contribution to the income of the state. As in the Dutch experience, the changes in production throughout the world have greatly reduced the returns and made the income variable; yet there is little disposition to dispose of these possessions. "The danger of mineral supplies being worked in a reckless and extravagant manner without regard to the welfare of future generations, and the dread of combinations by the producers of such commodities as tin, copper, and salt, with the aim of raising prices, have both tended to hinder the alienation of state mines."[7]

The more common form of state monopoly is that which occupies a middle position, established for reasons of public safety or utility as well as of revenue. The salt monopoly enforced in Prussia was only abolished in 1867, and is still maintained in every canton of Switzerland. The strongest plea in its defense has been the guarantee by the state of the purity of the article sold, and this phase of the question has superseded the revenue aspect. Few articles of prime necessity, like

salt, are subject to monopolies imposed by the state, and by a process of elimination it is only articles of luxury or voluntary consumption that are regarded as fit objects of monopoly for the benefit of the state.

A tax imposed upon an article at a certain stage of its production or manufacture may enforce the [Pg 740] expediency or necessity of a state monopoly. Where the supervision of the state agents must be so close as to interfere with the conduct of the industry, the state intervenes and itself controls the manufacture and sale. Tobacco has long been subject to this fiscal *régime*, and, proving so productive of revenue, there is little to be said against a monopoly by the state of its manufacture and sale.

In Italy the tobacco monopoly is conceded to a company, but its return of net revenue to the state is nearly as large as the revenue derived from the taxes on real property (about thirty-eight million dollars a year). Prussia imposes a charge on the home-grown tobacco by a tax on the land devoted to its culture, but the return is very small, and Bismarck wished to introduce a true tobacco monopoly, modeled on that of France. But the conditions were opposed to his scheme, for the use of tobacco is general throughout the empire, and a proposition to increase its price by taxation or modify its free manufacture and distribution excited a widespread opposition. France maintains a full monopoly, and finds it too profitable to be lightly set aside unless some equally profitable source of revenue is discovered to make good the loss its abolition would involve.

While historical support is given to the maintenance of a monopoly as in France, it is not probable that the system will find imitators in other states, however tempting the returns obtained might seem. Great Britain has by her insular position solved the problem in another way. By interdicting the domestic cultivation of tobacco, all that is consumed must be imported, and a customs duty offers a ready instrument for making the plant, in whatever form it enters, contribute its dues to the exchequer. In Russia, as in the United States, where tobacco is a domestic product, the tax is imposed upon its manufacture, and this method requires supervision but no monopoly of the state.

The tobacco *régime* is defended almost entirely on fiscal grounds, and as a monopoly, an extreme measure, has proved its value as an instrument of taxation. Other reasons, of a moral character, are urged to induce the state to monopolize the manufacture and sale of distilled spirits. Both France and Germany have considered this question, and, in spite of confident predictions of a large profit, have decided not to undertake it. Russia, on the other hand, has taken it up quite as much on social as on revenue grounds, and is gradually securing a monopoly of the trade in spirits. The initial cost of the undertaking is large, and, as the system has not yet been perfected, it is too early to give a judgment on its availability as a financial instrument.

The transit dues, once commonly used by different countries, have been generally abandoned, [Pg 741] and in China must they be sought for in their original forms of vexatious and unprofitable force. They arose from a desire to derive some benefit from a commerce permitted grudgingly, and rarely attaining any high results. The same end was sought by duties on exports, much employed when the country was supposed to be drained of its wealth by what was sent out of it. The conditions necessary for a successful duty on exports are not often found, and only in a few countries are they now existent. In Italy, South America, and Asia, exports of certain natural products are taxed, and, as in the case of Brazil, yield a notable revenue. In view of the rapid advancement of production in new countries and of inventions in the old, whereby many natural monopolies have been destroyed and competition made more general, such duties prove to be more obstructive to trade than productive of revenue, and are rapidly being abandoned. In spite of a formal prohibition of export duties in the Constitution of the United States, they are sometimes suggested in all seriousness.

In thus clearing the path of what may be called dead or dying methods of recent tax systems, the advantages enjoyed by the United States in their freedom from such survivals become more evident. The practice of farming taxes never gained a foothold in any part of the country. Lotteries have been occasional, and with two exceptions have been conducted on a limited scale —that of Louisiana is well known; an earlier instance is less known. During the Revolution one of the means resorted to by the Continental Congress for income was a lottery, but the attempt proved disastrous to all concerned, and was finally abandoned even more thoroughly than was the continental currency. State monopolies of production and sale of any commodity have never met with favor, and stand condemned in the desire for individual initiative. As sources of revenue, the public lands, state control of the post office, and of such municipal undertakings as the water and, in a very few cases, the gas supply, has been employed, and in place of profit the mere cost of management is sought. More than any country of continental Europe, the United States has depended upon taxes, pure and simple, unsupported or modified by state domains, state mines, state manufactures, or state monopolies. Even Great Britain in her local taxation is bound and hampered by precedent, and pursues a system that is notoriously confused, costly, and vexatious. Long usage and the erection of independent and conflicting authorities on principles other than fiscal have imposed upon the local agents the duty of assessing and collecting county and borough taxes which are as indefensible in theory as they are difficult in practice.

From this weight of tradition and precedent the United States has been almost entirely free, and [Pg 742] it was possible to construct out of small beginnings systems of Federal and State taxation at least reasonable and consistent, producing an increasing revenue with the rapid development of wealth and the larger number of taxable objects; and so elastic as to adapt themselves to such

changes as are inevitable in any progressive movement of commerce or industry. That no such system has resulted after a century of national life, and an even longer term of local (colonial and State) activities, these papers have tended to show. That the time is at hand when the problem of a thorough reform of both State and Federal taxation must be met, current facts prove beyond any doubt. If I have aided in a proper comprehension of these problems, and, by collecting certain experiences in taxation among other peoples and in different stages of civilization, contributed toward a proper solution, the end of this work will have been attained. It is not possible to introduce a complete change of policy at once; it is not only feasible but necessary to indicate the direction this change should take, and the ends to be secured in making them. And first as to Federal taxation:

In a democracy like that of the United States, the continuance of a mixed system of direct and indirect taxes is a foregone conclusion. Not that there is an absence of change or modification in the details of this double system, or in the application or distribution of a particular impost or duty. To deny such modification is to deny any movement in the body politic, or any progress in the industrial and commercial economy of the people. There is a steady and continuous movement in every direction, and the mere effort to escape taxation results in a new adjustment of related facts. This development has, partly through necessity and partly through a rising consciousness of what a tax implies, been tending from indirect to direct taxes. Ever restive under a rigid supervision by the state of private concerns, there has been a wholesome opposition to inquisitorial taxes. But this opposition has been carried too far, and is due more to the ignorant and at times brutal disregard by the agents selected for enforcing the law than to an appreciation of the injustice of the tax. Whether in customs or excise, the same blunders of management have been committed, and created a spirit in the people that is injurious to their best interests. On the one hand, private enterprises have been unduly favored by the removal of foreign competition, a favor that is now disappearing through the remarkable development of domestic competition. Thus taxes have been extensively used for other purposes than to obtain revenue, and for private ends. On the other hand, there has been created the feeling that taxation is a proper instrument for effecting a more equal distribution of wealth among the people, and [Pg 743] readily becomes an instrument of oppression.

The almost absolute dependence of the Federal Government upon the customs duties for revenue through a great part of its existence was a striking fact. The simplicity of collection and the comparatively moderate scale of duties, although considered high at the time of imposition, gave this branch of the possible sources of revenue a magnified importance. The development of the country was slow, and at times greatly hampered by the tariff policy; but until about 1857 no other source of income was needed to meet the expenditures of the Government in a time of peace.

In recent years this has all changed, and not for the better. The immense development in manufactures and financial ability accomplished since 1860 has made a tariff for protection an anachronism. The political features of customs legislation have been pushed so far as almost to overshadow the fiscal qualities. The wave of protectionism that followed the abrogation of the commercial treaties of Europe about 1880 has resulted in tariffs framed with the desire to injure the commerce of other states rather than to meet the needs of a treasury. In the United States this policy has been carried beyond that of Europe, and the tariff now in existence is more protective than any hitherto enforced, short of absolute prohibition of imports.

In more respects than one the tariff law of 1897 was an extreme application of the protective policy. Each year the United States has demonstrated its ability not only to meet the industrial competition of the world on an equal footing, but to engage with it aggressively and with complete success. It is not necessary to give the figures of exports of manufactures to establish this fact; it is now beyond question. To frame a measure of extreme protection was, therefore, to overlook the most striking phase of the industrial situation existing in the United States. With an ability to manufacture cheaply and on a grand scale, and with a capacity to supply the demands of a market larger than any home market, there was no foreign competition to encounter, and the higher rates of duties meant nothing, either for protection or for revenue. In carrying further into action a tariff framed more for protection than for revenue, a twofold error was committed. The provisions were so complicated as to make the application difficult, and in applying these provisions inquisitorial and vexatious regulations were necessary to assure even a reasonable fulfillment of the requirements. In former tariff laws a general description carried a large class of articles, and a uniform duty, usually *ad valorem*, was collected. But under the demand for a more scientific tariff, these general classes were broken up into a number of enumerated articles, each one carrying a specific or mixed duty, and an omnium or basket clause at the end to catch any [Pg 744] article that could not be included in any enumeration. This desire to fix specific rates upon each imported commodity has been applied more generally in the law of 1897 than in any previous tariff act. An examination of the imports of manufactures of textile fibers will illustrate this increase of complexity without any increase of revenue. Indeed, these classifications and rates, being suggested by interested parties, have for their object a reduction of imports, and as a rule a reduction in revenue from them follows.

The second objection to the increasing complexity of the tariff laws is to be found in the petty annoyances imposed upon importers and others in enforcing the not always consistent provisions of the law. These vexations are made all the more telling by the fact that the administration of the law is apt to be in the hands of those who are openly hostile to foreign importations, and therefore regard the importer in an unfriendly spirit. The power given to the customs agents is

enormous, and it is not remarkable that it is abused. The demand for samples, the appraisement of articles, the classification of new or compound commodities, all offer room for controversy, which is not always decided by an appeal to the courts of justice. In special instances, where a section of the law has been framed in behalf of a special interest, the attempt to enforce it becomes petty tyranny of the most intolerable kind.

In operation the law soon exhibited its failure as a revenue measure. Although duties were generally increased, the more important articles taxed yielded a smaller revenue than under lower rates. The aggregate collections under the bill did not meet the expectations of its sponsors, and for two reasons: first, because the higher duties discouraged imports; and secondly, the demand for imported articles was steadily decreasing under the expanding ability of home manufactures to meet the needs of the market. No measure short of a direct encouragement to importations can change this situation, or prevent the further shrinkage in the use of foreign manufactures. It follows that the tariff, unless radically altered, can no longer be depended on for a return sufficient to defray one half of the rapidly increasing expenditures of the national Government. By refusing to impose moderate duties on articles of general consumption, revenue is sacrificed; by insisting upon imposing protective duties where little revenue can be had, the tariff is converted into a political weapon. Its dangerous qualities are strengthened by turning these duties against the products of certain countries, a policy specially fit to invite reprisals.

Even the framers of this latest tariff entertained the belief that some provision should be made for breaking its full effect. The familiar scheme for reciprocity treaties, under which moderate [Pg 745] concessions in some of the duties could be made, was retained; but France was the only power that could have an object in seriously entertaining the proposition to enter into a negotiation. No real reduction in duties could be given to Germany or any other country, and it has become a recognized fact that Germany does not hesitate to seize an opportunity to exclude the products of the United States, and on the same grounds as support the high duties in the American tariff. The system of drawbacks has ceased to be of much moment in our customs policy, and in the export interest in canned goods finds its chief exercise. Nor does a privilege to manufacture in bond affect more than one article of importance—ores of lead containing silver. No matter how it is regarded, the tariff of 1897 was not framed for revenue, and in experience has not proved sufficiently productive to meet its share of the expenditures of Government. The animus of its sponsors in attaining the immediate political object sacrificed the more important and permanent object of revenue.

Were the true object of customs duties—revenue—to be kept in view in tariff legislation, it would be a simple matter to devise a measure that would be satisfactory and highly productive of revenue. In the fifteen hundred or more articles enumerated in the tariff schedules, more than fourteen hundred are nonproductive, or yield so small a return as to have in the aggregate no appreciable effect on the total receipts. The number left after so large an exclusion can be still further reduced without reducing the revenue one tenth; and it is from a small number of articles, hardly twenty-five, that the great part of the customs revenue is obtained. By reducing the rates of duties on these to a point of highest revenue efficiency, at which the import is not interfered with and yet not encouraged, a higher return could be had than from the existing complicated, overloaded, and political compilation of duties, usually imposed for any reason other than what they will bring into the treasury.

When, therefore, the best methods of Federal taxation are broached, the reform of the tariff stands first in importance. It is necessary to bring it more into line with the industrial conditions of to-day, which call for foreign markets rather than a domestic or closed market; and for a liberal commercial policy in place of one that regards the products of other countries, whether imported in the crude or manufactured forms, as constituting a menace to American labor and American interests. It calls for a systematic and intelligent revision, which shall throw out such duties as are no longer of service even for protection, and to reduce those that are hostile to the products of other countries and bear in themselves the seeds of reprisals in the future. Now that the United States is going into the great markets with its manufactures, and obtaining a foothold [Pg 746] against all competitors, the invitation to retaliation holds a danger far greater to its own interests than any that can be inflicted on other peoples. The greater the advances made the more readily will recourse be had to reprisals and hostile legislation; and in support of every act appeal may be had to examples set by the United States.[8]

MENTAL DEFECTIVES AND THE SOCIAL WELFARE.

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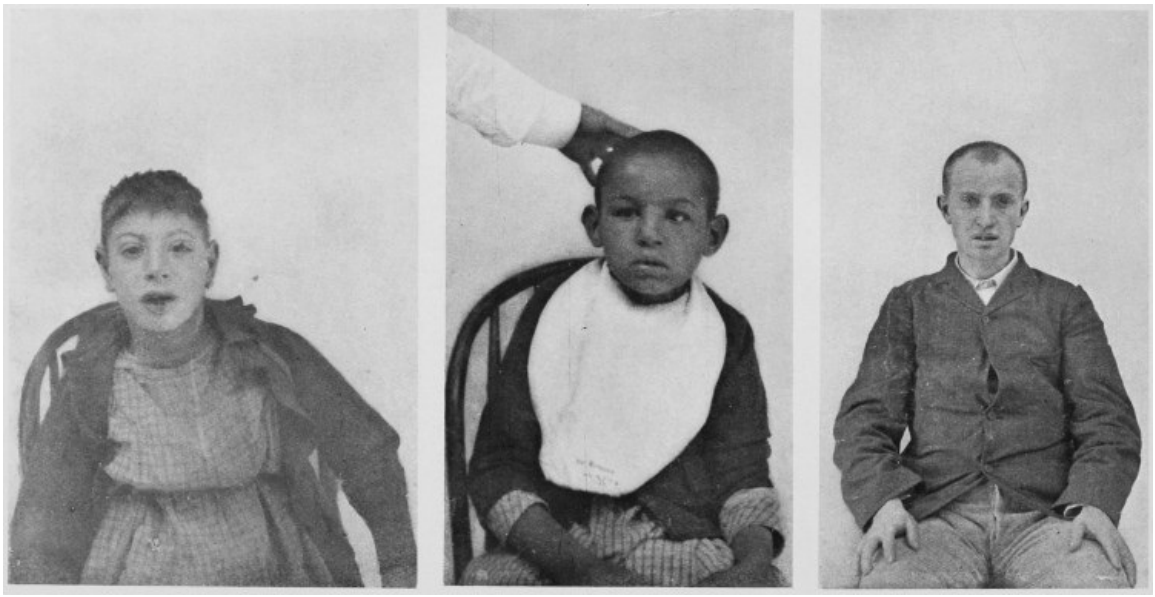
Periods of extraordinary efflorescence or fruitage are followed by exhaustion and sterility not infrequently demanding the free use of the pruning knife; and, just as we remark how frequent is idiocy the offspring of genius, so do we find the same seeming paradox, of mental defect in rank and increasing growth the product of this most wonderful nineteenth century.

True, science has contributed to numbers by revealing as mental defectives the many

"misunderstood," "the backward," "the feebly gifted," as well as by showing what was once esteemed moral perversion to be moral imbecility; but a truth to which science also attests is, that unstable nerve centers uniting and reacting through successive generations, producing various forms of neuroses, evidenced in insanity, moral and mental imbecility, idiocy and epilepsy, do show the influence of a highly nervous age. [Pg 747]

Our last census reports, although necessarily uncertain and unreliable, yet show ninety thousand mental defectives, not including the insane. Unrecognized and unacknowledged cases swell the number easily to one hundred thousand within our present borders—how many we are going to annex remains to be seen; but this is an enemy that attacks not our frontiers but our hearthstones. We have reached that point when we must conquer it, lest it should conquer us, and the means to this end may be summed up in three words—separation, asexualization, and permanent sequestration. "Diseases desperate grown by desperate appliances are relieved, or not at all," and we must recognize that heroic measures now are as essential to the welfare of the unfortunate as to society, which will then naturally adjust itself to new conditions. Viewing the separation and massing of these irresponsibles—innocent victims of ignorance, debauchery, or selfish lust—men will come to realize that a greater crime than taking is the giving of such life; and so a greater reverence for the sacredness of marriage, a deeper sense of the great responsibilities of parenthood, will do more to avert this evil than the most stringent marriage laws. That the present demands some restraint upon the ignorant and the indifferent there can be no doubt, and laws preventing the marriage of defectives and of their immediate descendants would go far to stem the tide of harmful heredity.

But what to do with those now in our midst is the vital question! They must be provided for in a way that shall insure safety to society, economy to the State, and protection and happiness to the individual. The answer found in the experience of half a century is, briefly, asylums for the helpless—training schools and colonies for those capable of becoming helpful. These in very name and nature being widely separate, just as separate as titles and names indicate, should be their working systems. Work among the feeble-minded, a philanthropic movement directed first toward the idiot, soon found a limit in dealing with a subject not trainable and but slightly if at all improvable. Thence, diverging and broadening as idiocy became better understood and imbecility in various phases became recognized, it found its true province in strengthening and encouraging feeble intellects, arousing and stimulating indolent and weak wills, and in training and directing into healthful channels the abnormal energy of those destitute of the moral sense. How wide the divergence can readily be seen, as also how entirely incompatible with union must be work further apart in reality than is the training of an imbecile and a normal child. [Pg 748] [Pg 749]



Excitable Idiot. Practically unimprovable.

Apathetic Idiot. Practically unimprovable.

Idio-Imbecile. But slight hope of improvement.

For the idiot, who not only can not be trained, but who in many cases is unimprovable even in the simplest matters of self-help, nothing is needed but that care and attention found in every well-regulated nursery of delicate children, the *sine qua non* being regular hours, simple nourishing food, frequent baths, and tender mothering. As many are paralyzed, blind, lame, or epileptic, it is desirable that the dormitories, well ventilated, be on the same floor with the living rooms and of easy access to bathrooms and playgrounds. Covered and carefully guarded porches should afford the much-needed fresh air and outdoor life in all weathers. These, with cheerful, sunny playrooms, provided with simple toys and furnished with bright decorations varying with the season, will contribute the maximum of pleasure for this life of perpetual infancy. Low vitality, general poverty of the whole physical make-up, the prevalence of phthisis and epilepsy and kindred diseases require the daily inspection of a physician, while the comfort and well-being of the whole, both workers and children, are insured by a capable and sympathetic house mother.

The character of attendants is of the first importance, as these are they who live with the children; it should combine that firmness, tenderness, and balance that constitute an even temperament, capable of recognizing and meeting an occasion without loss of self-control. The

duties involve not only the care of the idiots, but the training and direction of idio-imbeciles as aids, and this dealing with natures often wholly animal, requires a certain refinement and dignity of character—at least an entire absence of coarseness—while a knowledge of the simpler manual arts, and if possible of drawing and music, will do much to soften and brighten these darkened natures. As these qualities are valuable as well as rare, the remuneration should be in proportion; certainly sufficient to induce permanency and to compensate for such isolation. A life of constant wear and tear demands also regular periods of rest, and the corps therefore should be sufficiently large to give relief hours daily as well as vacations.

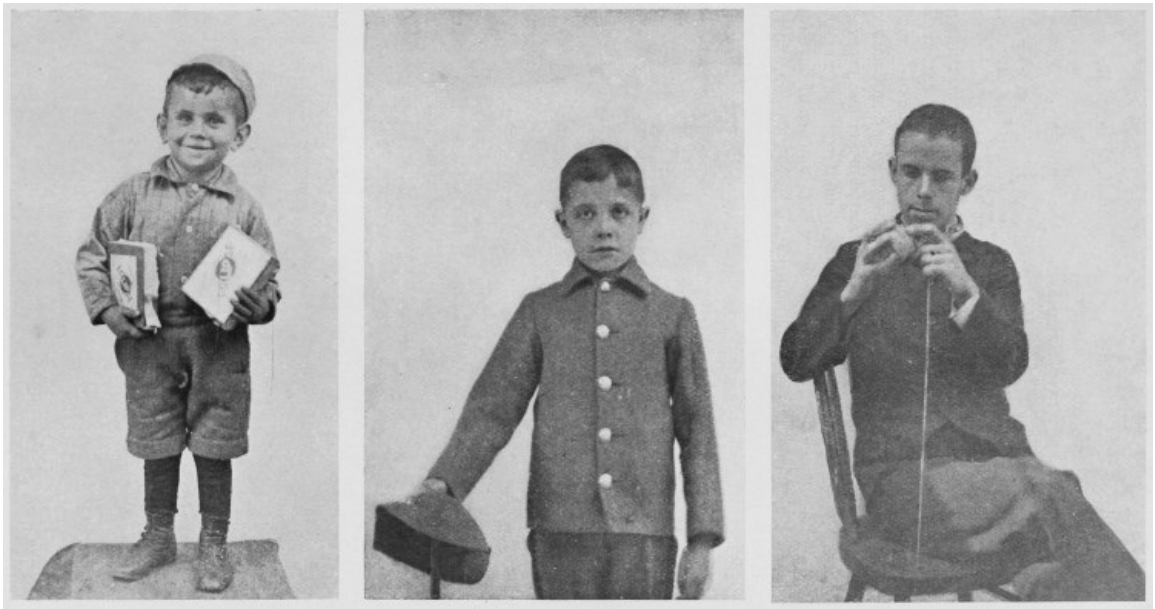
The idio-imbecile, but one remove from his weaker brother, to whose wants he may be trained to minister, finds here his fitting place, and the domestic service of these asylums may be largely drawn from this class and also from that of the low-grade imbecile. Working as an aid, never alone, always under direction, he finds in a monotonous round of the simplest daily avocations his life happiness, his only safety from lapsing into idiocy, and therefore his true home.

The relief to the home, the actual benefit to the State in this housing and care of the idiot and idio-imbecile can never be fully estimated. It is reckoned, however, in a general way that for every idiot sequestrated the energies of two if not four normal persons are returned to society. [Pg 750]

Imbecility, mental or moral, congenital or accidental, is either an inherent defect or an irrecoverable loss, an incurable disease for which hospitals can do nothing, nor can reformatories form again that which never has been formed. Could language be made clear enough to enable the public mind to grasp this fact, the work of training schools, the only hope of the imbecile, would then be simplified, and people might be willing to accept what they can give, in the only way in which it can be given, to be of any permanent value. As it is, the few charlatans who profess to train and in a few years send out an imbecile ready to take a high-school or college course not only deceive those from whom they may gather a few thousands, but their representations, coupled with that of a sensational press, effectually impede the progress of a work which must eventually find its true place in the system of public education.

Influenced by these misrepresentations, parents come with profound idiots and high hopes of a course of training (here is one of the misfortunes of an idiot asylum within a training school), and simply refuse to accept a negative to their expectations. Again—to waifs and strays, high-grade imbeciles, developing after years of labored training proficiency in music, drawing, or some one of the industrial arts, friends will suddenly crop up and, dazzled by what seems phenomenal genius, seek to withdraw them just as they become useful to the community. Little do they know of the weak will, indolent nature, and utter lack of "go," that forbid competition with normal labor and must forever be subject to the will of another; still less of the weak physical build that is kept intact only by watchful care, and which would succumb to any undue hardship. So much for the difficulties that beset the work. Now as to the work itself.

As this must vary according to the status of the individual, a careful study and a correct diagnosis are of primary importance in order that the work may be fitted to the child, not the child to the work. The plan pursued is as follows: A thorough examination—physical, mental, and moral—is first made by the chief physician in connection with papers properly filled out giving personal and family history. He is then sent to the hospital for a fortnight to insure immunity from disease. There, while perfectly free and unrestrained among his fellows, he is under constant observation of the nurses; these observations, carefully noted, are returned to the chief physician, who turns both over to the principal of schools, designating the grade in which he is to enter for probation. Here under different environment he is again tested for some weeks and finally placed. [Pg 751]



High-grade Imbecile. **High-grade Imbecile.** **Low-grade Imbecile.**
Very improvable—can read, write, draw, etc. Only slightly improvable.

It is hard for the uninitiated to understand that the grade, be it high, middle, or low, is not associated with promotion and advancement as in schools for normal children. On the contrary, it [Pg 752]

signifies the quality and status of the individual, his limitations, his possibilities, and consequently determines almost unfailingly the training for his life work; not by any hard-and-fast lines, but by a general mapping out of means which experience has proved will best insure his development, because best suited to his needs. Every latitude is allowed and, as the comfort of both the teacher and the entire class depends upon each going to his own place, there is easy and natural transference according to the necessity indicated by either progress or retrogression; but the varied occupations in each grade give ample scope for indulgence of individual proclivity in the means of development, and it is found that the original diagnosis, based upon experience, rarely errs.

The motto of the schools—"We learn by doing; the working hand makes strong the working brain"—shows manual training to be the basis of the scheme of development, varied for each grade to suit the intelligence. Thus classified, various occupations are arranged and presented with the double intent of securing all-round development, and of giving at the same time opportunity for choice according to individual bent, the child being gradually permitted to devote himself more exclusively to that in which he shows a tendency to excel, and to gain a certain automatic ease in what shall prove the initial of a life employment. A knowledge of writing and of numbers is acquired incidentally as a necessary part of these occupations in daily practice, and arithmetic, taught with objects, is chiefly counting, separating into fractional parts, and practical measurements. Books are used rather as a convenient means of attracting and holding attention while inducing habits of consecutive thinking than for a knowledge of facts to be memorized. Those who can learn to read gain naturally a means of self-entertainment, of self-instruction, hence a certain amount of culture, so long as protected in an institution from indiscriminate and pernicious literature.

The low-grade imbecile, but a slight degree removed from the idio-imbecile, is, like him, totally incapable of grasping artificial signs or symbols. He can therefore never learn to read or write; figures have no meaning for him, nor numbers, beyond the very simplest counting acquired in the daily repetition of some simple task such as knitting, netting, braiding rope, straw, or knotting twine. The excitation of interest in these, which will also give hand and arm power, the arousing of the sluggish, indolent will, through the stimulus of pleasurable emotions, the physical development by means of the various drills and the moral influence of refined, orderly surroundings—these, together with some practical work of house, garden, or farm, which forms part of the daily routine, are all that school life can do for him. [Pg 753] [Pg 754]

Moral Imbecile of High Grade.

Moral Imbecile of Middle Grade.

Moral Imbecile, Low Grade.

From this preparation he passes to the industrial department, where he receives training in that occupation which the school has indicated for him, becoming in his limited way a useful and contented member of a community which should be his life home. As both of these types develop either extreme docility or perversity—the one quiet, gentle, obedient, following any suggestion even of a comrade's stronger will; the other obstinate, indolent, often brutal and cruel—the necessity for constant guardianship is therefore self-evident.

When we consider that the training of a high-grade imbecile takes four times the period commonly allotted to a normal child, some idea of the vital energy expended on the training of the lower grades may be found in the following example:

I find in our museum of educational work a little ball which I am inclined to regard the most valuable thing in the whole collection. The boy who made it was a low-grade imbecile. His hand against every man, he fancied every man's against him. Always under strict custodial care, that he might harm neither himself nor others, he would vent his spleen in tearing his clothing. His teacher, a woman of rare patience and devotedness, sat beside him one day, tearing strips of old

linen and laying them in order. "See, Willie, let us make some pretty strips and lay them so." His wonder grew apace at seeing her doing what he had been reproved for doing; at once he responded, and a new bond of sympathy was established between them. She was playing his game—the only one, poor little lad, that he was capable of—and he joined in.

"Now, we will draw out the pretty threads and lay them in rows." For weeks the boy found quiet pastime in this occupation, and the violent nature grew quieter in proportion. One day the teacher said, "Let us tie these threads together and make a long string." It took him months and months to learn to tie those knots, but meanwhile his attendants were having breathing space. "Now we will wind this into a pretty ball, and I will cover all you make for the boys to play with"; and a new occupation was added to his meager list.

The next link in this chain of development was a lesson in knitting. Again, through months of patient teaching, it was at last accomplished, and the boy to the day of his death found his life happiness in knitting caps for the children, in place of tearing both them and their clothing. You see the teacher was wise enough to utilize the natural activities of the child and divert evil propensities into healthful channels. Had she brought knitting and bright yarn or anything foreign to him first, it would in truth have been fitting new cloth to old garments and the rent would have been widened: his obstinacy would have been aroused, and he would have continued to tear to the end of the chapter. [Pg 755]

High-grade Imbeciles (Feebly Gifted) at Sloyd Work.

The imbecile of middle grade receives that fuller presentation of work suited to fuller capacity. Some time is devoted to the three "Rs," as it is found that attention may be aroused and concentrated in the phonetic drills, more especially if associated with pictures, and the drawing of the objects named free-hand; thus eye, ear, and hand are encouraged to work simultaneously. Those who accomplish finally the reading of short simple stories not only enjoy evenings in the library, but may be enabled to glean suggestions for the various handicrafts for which they are being trained. This effort at quick observation and original thinking is further carried forward in the ambidextrous movements of free-hand drawing, designing, and sketching from life—finding ready and practical application in the daily use of tools. The value of the rule and the try-square is tested in the manufacture of the various useful articles in both paper and wood included under the head of sloyd, and "a boy can not learn to take a straight shaving off a plank," says Ruskin, "or to drive a fine curve without faltering, or to lay a brick level in the mortar, without learning a multitude of other matters which life of man could never teach him."

Equally useful to the girl in the workroom as to the boy in the shop is this training of a ready eye, this quick intuition of balance and proportion, this practice of obedience of hand and arm to brain, until it becomes automatic. To both, therefore, the value of such preparation will be incalculable. It is noticeable that boys of this grade turn out as good workers in the ordinary crafts of shoemaking, carpentering, and house painting as those of higher grade who, although capable of grasping more intelligently the details of work, yet do not bring to it that energy and perseverance of one who finds in it "this one thing I do." With the imbecile of high grade, able to accomplish studies equal to about the first intermediate of the public schools, there is a diffusion of interest; the intelligence broadens rather than deepens during the school period in natural response to environment. With greater grasp of numerical values and of letters he attains proficiency impossible to the lower grades in drawing, in music, in printing, and in cabinet work. Other industries will probably be provided for him as the demand increases, for it must be remembered that this is a class whose needs have been the last to be recognized in a work begun, as I have before said, for the idiot. Regarded as queer, unlike other children—unable to keep up—he has, after an unsuccessful trial at school, been kept at home, in some cases an aid, [Pg 756]

in others a tyrant, to those relatives charged with his care.

Changed conditions of both family and school, fortunately for him, combine to render this no longer possible, as absence of proper training is always certain to result in deterioration. The pressure upon the primary schools in the struggle for higher education leaves no time to contend with dull, backward children. In the family the care-takers grow fewer in proportion as the home-makers become home-winners, and so these feeble ones are a burden instead of an aid in the ordinary household offices.

The next hope is a training school where, with false hopes fostered by ignorance and sensationalism, they are entered, and after a few years, a time all too short for any lasting benefit, a sentimentality equally stupid withdraws them from that guardianship absolutely essential, with just that little knowledge which will render them more dangerous to society, because less recognizable—an evil element perpetuating an evil growth. Under both conditions these unfortunates have suffered from that lack of constant care and supervision which should be theirs from the cradle to the grave.

The separation of backward children in the schools and the placing of them in special classes for special training is the first step in the right direction. Here, after sufficient time for observation and diagnosing by teacher and physician, the defectives so adjudged will naturally drift to the training schools for the feeble-minded; these, if relieved of the odium as well as the care of their [Pg 757] helpless population, will then be encouraged to arrange for this brighter class of defectives industries which will provide not only for development and happiness, but will largely aid in maintenance. The recognition of the necessity for this weeding out of the schools, having place first on the Continent, next in England, and later in our own country, marks an era in the national as well as in the special schools. Both will be benefited largely, and formal expression of this, found in the addition to our National Educational Association of a department representing the training of all classes of defectives, is one of the most encouraging signs of the times.

Middle-grade Imbeciles.

The same experience which dictates the separation of the idiot from the imbecile, the backward from the normal child, urges also that a permanent sequestration would tend alike to the safety and happiness of the normal and abnormal classes. The experiment made of preparing and sending out into the world these irresponsibles has proved, to say the least, not encouraging, and the advisability of their permanent detention has become self-evident.

The heads of training schools here are a unit in urging that provision be made for those who have reached the limit of school progress. That experience has reached a similar conclusion in England is testified in the munificent gift lately made to the Royal Albert Asylum, and by the [Pg 758] opinion of its superintendent, Dr. T. Telford-Smith, thus clearly expressed:

"It is yearly more noticeable that the public mind is coming gradually but surely to recognize the threefold value of the work of such institutions as the Royal Albert Asylum. The educational and the custodial aspects early aroused the sympathies of the charitable; but the preventive aspect is another which must force itself upon all who thoughtfully consider the subject. The far-reaching and inexorable law of heredity is written large for those who study the imbecile."

The following paragraph, from a daily paper, shows that, in America at least, public opinion and the acts of the legislature have become ripe for action:

"The State of Connecticut is about to try a curious experiment in social legislation, having passed a law forbidding any man or woman, imbecile or feeble-minded, to marry under forty-five years of

age, the penalty being imprisonment for not less than three years; and persons aiding and abetting are also liable. The hope of the legislature is to keep down dégenerate families."

That this experiment is wise and justifiable who can doubt?

Low-grade Imbeciles.
No. 1, obstinate, perverse, indolent;
No. 2, gentle and obedient.

To glance at another and sadder, but not less real, side of the same question, can any one doubt but that the adolescent and adult female imbecile needs lifelong care and protection? Surely the noble gift to the asylum by Sir Thomas Storey of a home for forty such cases is a wise, far-seeing, and statesmanlike act.

It is greatly to be hoped that this noble example may be speedily emulated on both sides of the sea, and that each State may shortly possess, in addition to its training school, its own colony farm with all the industries of a village, drawing its workers from the well-directed energies of a carefully guarded community. Cottages, each with its house mother, would insure that sense of home, and that affectionate and sympathetic oversight so essential to this society composed of those who are always children, while measures, which science has already pointed out and experience proved as advisable, might, if protected by wise legislation, permit less vigilance on the part of care-takers and consequent happiness because of greater freedom to its members. [Pg 759]

It is a happy coincidence that Massachusetts, the pioneer State in the work among the feeble-minded, should in its fifty-first year celebrate the beginning of its second half century by the inauguration of this most eventful step in the onward progress of the work. The training school at Waltham has lately purchased sixteen hundred and sixty acres of land for the establishment of a colony which is to have natural and healthful growth from the fostering care of the parent institution.

As these colonies increase, drawing from society a pernicious element and transforming it under watchful care into healthful growth, may not in time the national Government, finding these homes of prevention a more excellent way than prison houses of cure for ill, be induced to provide a national colony for this race more to be commiserated because of a childhood more hopeless than that of the two others in our midst on whom so much has been expended?

THE WHEAT PROBLEM AGAIN.

By EDWARD ATKINSON.

In a recent article in the North American Review, Mr. John Hyde, the statistician of the United

States Department of Agriculture, a gentleman of very high authority and repute, presents this problem in such terms as to throw a doubt upon the validity of any forecast of the potential increase in the product of wheat, or, in fact, of any crop in this country. Without referring to myself by name, he yet makes it very plain that he does not attach any value to my recent forecast of wheat production printed in the Popular Science Monthly for December, 1898.

On the other hand, he rightly says that since Tyndall's address to the British Association for the Advancement of Science in 1874 no treatise presented to that association has excited so general an interest or provoked so much unfavorable criticism as Sir William Crookes's recent utterances on the subject of the approaching scarcity in the supply of wheat.

Mr. Hyde disclaims any intention to give his own views, but yet no one can read his treatise [Pg 760] without noting a substantial agreement with Sir William Crookes, perhaps almost unconsciously to himself. In his closing paragraph he says: "To discuss the extent to which under conceivable conditions the United States may, *notwithstanding the somewhat dubious outlook*, still continue to contribute to the food supply of other nations, would be little more than speculation."

The Italics are my own.

I venture to point out that the use of the word "speculation" is an example of many instances. Like a dog, one may give a word a bad name, yet it may be a good dog and a very good word when rightly used. In the true and very innocent meaning of the word "speculation" we find exactly what the public has a right to expect and even to demand from the Department of Agriculture. In Webster's Dictionary I find that, when used in such a connection as this problem of the potential of this country in farm productions, the word "speculation" stands for "a mental view of anything in its various aspects and relations; contemplation; intellectual examination."

If any "mental view" has yet been taken in the Department of Agriculture of the proportion of the land of this country which may be termed "arable," I have yet to find the record. If any "contemplation" has been devoted to the proportions of this arable land which may be devoted to different crops in each section, I have been remiss in not securing the reports. If any "mental view" has been taken of the relative area now devoted to each principal crop, and that which may be so devoted hereafter in order to meet the prospective demand upon the land, either for the supply of our own population or of other nations, where is the record? If there is no such "speculation" now of record, is it not time that a true agricultural survey corresponding to our geologic and geodetic surveys should be entered upon? I have reason to believe that such surveys have been made by many European states in which all the arable land in some kingdoms is classified, listed, and so recorded that any one wishing to know the best place for any special product can get the information by reference to the proper department of the Government.

I have had occasion to make several studies of this kind. In order to inform myself on the potential of the South in the production of cotton, I undertook a study of the physical geography and climatology of the cotton States and of other cotton-producing countries nearly forty years ago. The results of this research were first given in Cheap Cotton by Free Labor, published in 1861. In that pamphlet and in many treatises following, finally in an address in Atlanta, in 1880, a true forecast or "speculation" or "intellectual examination" will be found of the production of the cotton fiber, the potential of the future and of the cotton-seed-oil industry, then almost unheard [Pg 761] of in this country. In 1880 I also entered upon my first "speculation" (not in the market) on the lines of a "contemplation" or forecast of the effect of agricultural machinery applied to our wheat land, coupled with the prospective reduction in the cost of carrying wheat to England, upon the condition of the American farmer and the British landlord. That forecast of prosperity to our farmers in the supply of bread at low cost to our kin beyond the sea has been justified at every point and in every detail. I therefore ventured to review Sir William Crookes's address, and I am well assured that what Mr. Hyde now calls a "somewhat dubious outlook" is subject to no doubt whatever as to our ability to continue our full supply for domestic consumption and export for the next century.

Let me now repeat again what I have often said: statistics are good servants, but very bad masters. I long since ceased to put any great reliance upon averages of crops, wages, or products covering wide areas and varying conditions, unless I could find out, *first*, the personal equation of the man who compiled them; *second*, ascertain what he knew himself about the subject of which his statistics or figures were the symbols; and, *third*, unless I could verify these great averages from one or more typical areas of farm land, or from one or more representative factories or workshops, of the conditions of which I could myself obtain personal information.

General statistics and averages of farm products and earnings I regard with more suspicion than almost any others because of the immense variation in conditions.

I have sometimes almost come to the conclusion that so many of the figures of the United States census are mere statistical rubbish as to throw a doubt on nearly all the schedules. Yet without accurate statistics on many points, many of them yet to be secured, the conduct of our national affairs must become as uncertain as would be the conduct of any great business corporation without a true ledger account and a trial balance. Hence the necessity for a permanent census bureau and for a careful "speculation" or "intellectual" and intelligent examination and "contemplation" or study of the facts about our land by which our future welfare must be governed.

A good beginning has been made by the authorities of many States, yet more by the body of well-

trained men in charge of the Agricultural Experiment Station, in whose support too much can not be said. To them I appealed when trying to get an adequate conception of our potential in wheat.

When we think of the blunders which have been made in very recent years, we may well have some suspicion that we may still be very ignorant on many points about our own country. Who really knows very much about the great middle section of the South, what is called the "Land of the Sky," comprising the upland plateaus and mountain sections of Virginia, North and South Carolina, Georgia, Alabama, eastern Tennessee, and Kentucky? Within this area, as large as France and twice as large as Great Britain, will be found timber and minerals equal to both the countries named, and a potential in agriculture equal to either, as yet very sparsely populated. [Pg 762]

Yet under a craze for centrifugal expansion we are now in danger of trying to develop tropical islands far away, already somewhat densely peopled, where white men can not work and live, to our detriment, danger, and loss, while we fail to see that if we expand centripetally by the occupation and use of the most healthy and productive section of our own country, we may add immensely to our prosperity, our wealth, to our profit without cost and without militarism. This sparsely settled Land of the Sky is greater in area and far greater in its potential than the Philippine Islands, Cuba, and Porto Rico combined. Verily, it seems as if common sense were a latent and sluggish force, often endangered by the noisy and blatant influence of the venal politician and the greed of the unscrupulous advocates of vassal colonies who now attempt to pervert the power of government to their own purposes of private gain.

Witness the blunders of the past:

We nearly gave away Oregon because it was held not to be worth retaining.

When the northern boundary of Wisconsin was being determined, it was put as far north as it was then supposed profitable farming could ever extend, excluding Minnesota, now one of our greatest sources of wheat.

The Great American Desert in my own school atlas covered a large part of the most fertile land now under cultivation.

What blunders are we now making for lack of "speculation" or "intellectual examination" as to the future of American farming and farm lands?

On one point to which Mr. Hyde refers I must cry *peccavi*. He rebukes the editor of the Popular Science Monthly for admitting an article in which a potential of 400,000,000 bushels of wheat is attributed to the State of Idaho. The total depravity of the type-writing machine caused the mechanism to spell Montana in the letters I-d-a-h-o. What I imputed to Idaho is true of Montana, if the Chief of the Agricultural Experiment Stations of Montana is a competent witness, if all its arable land were devoted to wheat. It will be observed that I mentioned Idaho incidentally (meaning Montana), taking no cognizance of the estimate given, because it was at present of no practical importance.

I have expressed my distrust of great averages in respect to agriculture and farm products. [Pg 763]

In illustration of this fallacy, the figures presented by Mr. Hyde will now be dealt with. It is held that in 1930, which is the year when Sir William Crookes predicts starvation among the bread-eating people of the world for lack of wheat (as if good bread could only be made from wheat), the population of this country may be computed at 130,000,000. The requirements of that year for our own consumption Mr. Hyde estimates at 700,000,000 bushels of wheat, 1,250,000,000 bushels of oats, 3,450,000,000 bushels of corn (maize), and 100,000,000 tons of hay; and, although other products are not named by him, we may assume a corresponding increase.

Subsequently Mr. Hyde gives the present delusive average yields per acre of the whole country, and then throws a doubt on the future progress of agricultural science, saying, "Whatever agricultural science may be able to do in the next thirty years, up to the present time it has only succeeded in arresting that decline in the rate of production with which we have been continually threatened." Without dealing at present with this want of and true consideration of or "speculation" upon the progress made in the last decade under the lead of the experiment stations and other beginnings in remedying the wasteful and squalid methods that have been so conspicuous in pioneer farming, let us take Mr. Hyde's averages and see what demand upon land the requirements of 1930 will make, even at the present meager average product per acre.

Mr. Hyde apparently computes this prospective product as one that will be required for the domestic consumption of 130,000,000 people by ratio to our present product. He ignores the fact that our present product suffices for 75,000,000, with an excess of live stock, provisions, and dairy products exported nearly equal in value to all the grain exported, and in excess of the exports of wheat. If we can increase proportionally in one class of products, why not in another? Whichever pays best will be produced and exported.

1897 and 1930 compared.—Data of 1897.

	Products.	Average per acre.	Area required.
Maize	1,902,967,933 bushels.	23.8 bushels.	125,150 square miles.
Wheat	530,149,168 "	13.4 "	61,660 " "
Oats	698,767,809 "	27.2 "	40,200 " "
Hay	60,664,770 tons.	1.43 "	66,290 " "

Total in square miles	293,300 square miles.

All other farm crops carry the total to less than 400,000 square miles now under the plow, probably not exceeding 360,000.

Prospective demand of 1930, at the same meager average product per acre, without progress in agricultural science: [Pg 764]

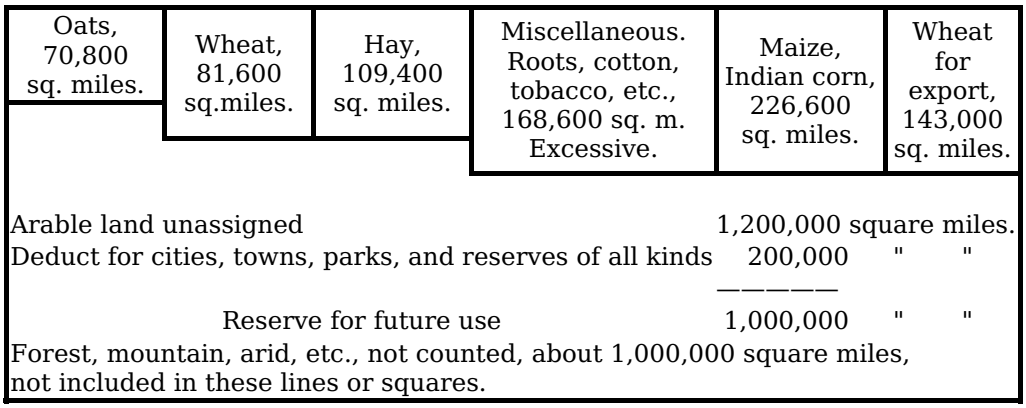
Crop called for.	Per acre.	Area required.
Maize 3,450,000,000 bushels.	23.8 bushels.	226,600 square miles.
Wheat 700,000,000 "	13.4 "	81,600 " "
Oats 1,250,000,000 "	27.2 "	70,800 " "
Hay 100,000,000 tons.	1.43 "	109,400 " "
Total in square miles		488,400 square miles.

Assuming all land under the plow in 1930 in the ratio as above, the area of all now in all crops 400,000 square miles—an excessive estimate—that year (1930) will call for 667,000 square miles of arable land in actual cultivation.

I have been accustomed to consider one half our national domain, exclusive of Alaska, good arable land in the absence of any "speculation" on that point in the records of the Department of Agriculture; but from the returns given by the chiefs of the experiment stations and secretaries of agriculture of the States hereafter cited, that estimate may be increased probably to two thirds, or 2,000,000 square miles of arable land out of a total of 3,000,000 square miles, omitting Alaska.

Assuming that we possess 2,000,000 square miles of arable land, capable at least of producing the present meager average product cited above, the conditions of 1930 will be graphically presented on the following diagram:

Prospective Use of Land in the Year 1930 on Present Crop Average.
(Arable land assumed to be 2,000,000 square miles in the outer lines of the diagram)



No reduction on area cultivated on prospective improvement in the present methods of farming, although it may be assumed that the prospective increase of crop per acre will exert great influence.

If the facts should be in 1930 consistent with Mr. Hyde's "speculation" it would therefore appear that our ability to meet the domestic demand of 1930 with proportionate export of cattle, provisions, and dairy products, and to set apart a little patch of land for the export of 1,226,000,000 bushels of wheat raised at the rate of only 13.4 bushels per acre from 143,000 [Pg 765] square miles of land will be met by the cultivation of not exceeding 700,000 square miles out of 2,000,000 available.

I should not venture to question the conclusions emanating from the Department of Agriculture, or the deductions of so eminent a scientist as Sir William Crookes, had I not taken the usual precaution of a business man in studying a business question. I went to the men who know the subject as well as the figures on which statistics are to be compiled.

Being supplied by the Popular Science Monthly with one hundred proofs of the first nine and a half pages of the December article in which the terms of the problem are stated, I sent those proofs to the chiefs of the experiment stations and to the secretaries of agriculture in all the States from which any considerable product of wheat is now or may be hereafter derived; also to many makers of wheat harvesters; to the secretaries of Chambers of Commerce, and to several economic students in the wheat-growing States. This preliminary study was accompanied by the following circular of inquiry:

BOSTON, MASS., *October 5, 1898*.

To the Chiefs of the Agricultural Experiment Stations and others in Authority:

Calling your attention to the inclosed advance sheets of an article which will by and by appear in the Popular Science Monthly, I beg to put to you certain questions.

If the matter interests you, will you kindly fill up the blanks below and let me have your replies within the present month of October, to the end that I may compile them and give a digest of the results? I shall state in the article that I am indebted to you and others for the information submitted.

Area of the State of..... square miles.

1. What proportion of this area do you believe to be arable land of fair quality, including pasture that might be put under the plow?

Answer ..... square miles.

2. What proportion is now in forest or mountain sections which may not be available for agriculture for a long period?

Answer ..... square miles.

3. What has been done or may be done by irrigation?

....
.....

4. What proportion of the arable land above measured should you consider suitable to the production of wheat under general conditions such as are given in the text, say, a stable price of one dollar per bushel in London? [Pg 766]

Answer ..... square miles.

5. To what extent, in your judgment, is wheat becoming the cash or surplus crop of a varied system of agriculture as distinct from the methods which prevail in the opening of new lands of cropping with wheat for a term of years?

....
.....

What further remarks can you add which will enable me to elucidate this case, to complete the article and to convey a true impression of the facts to English readers?

....
.....

Your assistance in this matter will be gratefully received.

Respectfully submitted,
EDWARD ATKINSON.

To this circular I received twenty-four detailed replies, containing statistics mostly very complete; also many suggestive letters, in every case giving full support to the general views which I had submitted in the proof sheets. It has been impossible for me to give individual credit within the limits of a magazine article to the gentlemen who have so fully supplied the data. Space will only permit me to submit a digest of the more important facts in a table derived from these replies:

FROM RETURNS MADE TO MY INQUIRY.

Name.	Area of State.	Arable.	Suitable to wheat	From United States report in wheat, 1897.
Minnesota	84,287	66,000	50,000	7,189
South Dakota	76,000	42,500	40,000	4,187
North Dakota	74,312	50,000	50,000	4,300
Illinois	56,000	54,000	20,000	2,292
Missouri	68,000	64,000	64,000	2,448
Wisconsin	56,000	35,000	35,000	961
	414,599	311,500	259,000	21,372
Texas	269,694	200,000	100,000	700
California	158,360	54,000	30,000	5,062
Montana	145,310	30,000	25,000	109
Idaho	87,000	30,000	15,000	192
	660,364	314,000	170,000	6,063
Total	1,074,963	625,500	429,000	27,435

I do not give the data of the Eastern and Southern States, and I have selected only the most complete data of the other States, choosing the more conservative where two returns have been made from one State. [Pg 767]

The foregoing States produced a little over one third of the wheat crop of 1897. They comprise a

little over one third the area of the land of the United States, excluding Alaska.

The list covers States like Illinois, Minnesota, and Wisconsin, now very fully occupied relatively to Texas, Montana, and Idaho, as yet but sparsely settled.

Ohio, Michigan, Indiana, Iowa, Kansas, Nebraska, Oregon, and Washington combined far exceed the above list in wheat production; but, as I have no complete data from these States, I can only say that the national or census statistics, as far as they go, develop corresponding conditions to those above given. The very small product of Texas and Montana, even of Idaho, as compared with the claimed potential, will attract notice, and perhaps excite incredulity. But let it be remembered that in 1880 the Territory of Dakota yielded less than 3,000,000 bushels of wheat, while in 1898 the two States of North and South Dakota, formerly in one Territory, claim to have produced 100,000,000 bushels. Perhaps it will then be admitted that the potential of Montana, and even of Idaho, may be attained in some measure corresponding to the reports from those States; but as yet their product is a negligible quantity, as that of Dakota was only twenty years since.[9]

Again, let it be remembered that Texas will produce a cotton crop, marketed in 1898-'99, above [Pg 768] the average of the five ante-war crops of the whole country, and nearly equal to the largest crop ever grown in the United States before the war. Texas could not only produce the present entire cotton crop of the United States but of the world, on but a small part of her land which is well suited to cotton. When these facts are considered, perhaps the potential of that great State in wheat and other grain, in cattle and in sheep, as well as in cotton, may begin to be comprehended.

The writer is well aware that this treatment of a great problem is very incomplete, but it is the best that the leisure hours of a very busy business life would permit. If it discloses the general ignorance of our resources, the total inadequacy of many of our official statistics, the lack of any real agricultural survey, and the necessity for a reorganization and concentration of the scientific departments of the Government as well as of a permanent census bureau, it will have served a useful purpose.

If it also serves to call attention to the meager average crops and the poor quality of our agriculture as a whole down to a very recent period, it may suggest even to those to whose minds the statistics of the past convey but gloomy and "doubtful views" of the future, that the true progress in scientific agriculture could only begin when substantially all the fertile land in the possession of the Government had either been given away or otherwise distributed. So long as "sod crops" and the single-crop system yielded adequate returns to unskilled farmers, no true science of agriculture could be expected, any more than a large product of wool can be hoped for in States where it has been wittily said that "every poor man keeps one cur dog, and every d—d poor man keeps two or more."

Finally, if I shall have drawn attention to the very effective work which is being done in the agricultural experiment stations by men of first-rate ability, I shall have drawn attention to a great fact. This work has already led to a complete revolution from the old practice of [Pg 769] maltreating land, and to the renovation of soils that had been partially exhausted. Governor Henry A. Wise, of Virginia, long since condemned the old methods of Southern agriculture by telling his hearers, "The niggers skinned the land and the white men skinned the niggers." We are changing all that by new and progressive methods. I hope that in this recognition of the work of the experiment stations I shall have made some return for the attention which has been given to my inquiry by so many of my correspondents that the space assigned me forbids a list of my authorities being given by name.

When the suggestion is made from the Department of Agriculture that all that science has yet accomplished has been to stop a tendency to a lessened production from the land now under the plow, and when it is even suggested that in 1930 the present meager average of crops per acre may still exist, it seems to me that little credit is given to the good work already accomplished in the short period in which the separate Department of Agriculture has been represented in the Cabinet, especially in the last five or six years, while the suggestion itself shows very little consideration of the great work of the experiment stations.

Unless it can be proved that my correspondents and myself have entered into a conspiracy to mislead the public in dealing with the potential of this country in wheat production, nearly all the deductions from the figures of the past must be considered mere statistical rubbish. These statistics cover sections and States in which wheat should never be grown or attempted in competition with the true wheat soils and climate. As well might misplaced iron furnaces, built to boom city lots where there are no favorable conditions for the production of iron, be included in an average and held up as a standard of our potential in iron and steel production.

In my efforts to discover the rule of progress in the arts and occupations of the people of this country, it has become plain that in ratio to the application of science and invention to every art the quantity of product is increased, the number of workmen is relatively diminished, the price of the product tends to diminish, while the wages or earnings of those who do the work are augmented. I have investigated many branches of industry, and find evidence conclusive to my own mind that such is the law of industrial development. This rule is subject to temporary variations under the restriction of statutes. In my own judgment, the so-called protective principle or policy of interference with commerce by imposing fines on foreign imports has retarded the progress of the specially protected arts, and has in some measure obstructed the

diversity of manufactures; but the opposite policy of absolutely free trade in our domestic traffic over a greater area and among a much larger number of people than have elsewhere secured their own liberty has been so much more potent in its progressive influence as to have lessened the evils of the restrictions on foreign trade. [Pg 770]

According to my observation, all the efforts to regulate railroad charges by State legislation and under the interstate commerce act have greatly retarded the progress of the railway, and have deprived great States, notably Texas, of any service at all commensurate to the demand which might otherwise have been supplied to the mutual benefit of the owners of the railways and the inhabitants of the State. The most serious retarding influence, especially evil in its effect upon farmers, was the useless panic of 1893, caused by the silver craze—that is to say, by the effort to enact a force bill by which the producers of our great crops would have been compelled to accept money of half the purchasing power of that to which their industry had been long adjusted. This caused a temporary paralysis of industry, in which I think none suffered so much as the farmers of the country.

But admitting these temporary variations, I find the same rule governing the products of the farm that governs the mine, the factory, and the workshop—namely, a lessening of the number occupied in ratio to the product; a great reduction in the cost of labor; an increased return in due proportion of the skill and intelligence of the farmer; a rapid reduction in the farm mortgages, ending at the present date in making the farmers of the grain-growing States the creditors of the world, especially those occupied upon wheat.

But in the development of this progress we find the reverse of the practice in the factory and the workshop. The most important applications of science and invention led first to what might be called the manufacture of wheat on an extensive method of making a single crop on great areas of land. That phase has about spent its force; the great farms are in process of division; the single-crop system has about ended; the intensive system of making a larger product from a lessened area with alternation and variation in crops is rapidly taking the place of former methods.

Therefore, while many branches of manufacturing tend more and more to the collective method, the tendency in agriculture is more and more to individualism in dealing with the land itself, coupled with collective ownership in the more expensive farm machinery, in creameries, cheese factories, and the like. We are apparently at a halfway stage in this revolution of agriculture. The intelligent and intensive methods of breeding cattle and sheep is also rapidly taking the place of the semibarbarous conditions of the ranch.

If these points are well taken, the very suggestion that we must compute the land which should be under the plow in 1890 in order to supply the needs of 130,000,000 people on the basis of the imperfect statistics and inadequate data of the past, becomes almost an impertinence. It is much more probable that the 400,000 square miles which now meet the needs of 75,000,000 people, with an enormous excess for export, will in 1930 still suffice for the domestic supply of 130,000,000 people, with a proportionate export corresponding to the present. [Pg 771]

If the product of the farms of the West now yielding the largest crops, or of the renovated lands of the South now yielding the best crops, be taken as the average standard of the near future, as they should be, then it may be true in 1930, as it is now, that one fifth of the arable land of this country when put under the plow will still suffice for all existing demands, the remainder of our great domain extending the promise of future abundance and welfare to the yet greater numbers who will occupy the land a century hence.

I may add that in the course of a very friendly correspondence with Sir William Crookes, while we are still at variance in our estimates of the area which may be converted to the production of wheat in this country without trenching upon any other product, we are wholly at an agreement on a most material point. I quote from one of his letters: "Under the present wasteful method of cultivation there will be in a limited number of years an insufficient supply of wheat. Apply artificial fertilizers judiciously, and the supply may be increased indefinitely." I would only venture to add to the judgment of so eminent a writer the words "or natural," to the end that the paragraph should read, "Apply artificial or natural fertilizers judiciously, and the supply can be increased indefinitely."

Many years ago I was asked among others, "What would be the next great discovery of science or invention?" To which I replied, "A supply of nitrogen at low cost." Has not that discovery been made in the recent development of the functions of the bacteria which, living and dying upon the leguminous plants, dissociate the nitrogen of the atmosphere and convert it through the plant to the renovation of the soil? Is not the invention of methods of nitrifying the soil by distributing the germs of bacteria one of the most wonderful discoveries of science ever yet attained? Can any one yet measure the potential of any given area of land in any part of this country in the production of any one of its great crops? That there is a limit may be admitted. Can any one venture to say that any of our average crops yet approach beyond a small fractional measure the true limit of production, whatever it may be, either in cotton, maize, wheat, or any other product of the soil?

In this, as in many other developments of the theory of evolution, the factor of mental energy, which is the prime factor in all material production, may have been or is almost wholly ignored. We are ceasing to treat the soil as a mine subject to exhaustion, but we have as yet made only a beginning in treating it as an instrument of production which will for a long period respond in its [Pg 772]

increasing product in exact ratio to the mental energy which is applied to the cultivation of the land.

THE COMING OF THE CATBIRD.

By SPENCER TROTTER.

In southeastern Pennsylvania there comes a day in February that brings with it an indefinable sense of joyousness. A southerly wind wanders up the Delaware with a touch of the spring in its air that quickens, for the first time, the slumbering life. It is then that those mysterious forces in the cells of living things begin their subtle work—hidden in the dark, underground storehouses of plants and the sluggish tissues of animals buried in their winter sleep. On such a day the ground hog ventures from his burrow, some restless bee is lured from the hive to wander disconsolate over bare fields, a snake crawls from its hole to bask awhile in the sunshine, and one looks instinctively for the first breaking of the earth that tells of the early crocus and the peeping forth of daffodils. The southerly wind is more apt than not to be a telltale, for with all its springtime softness it is drawing toward some storm center, near or remote, that will inevitably follow with rough weather in its sweep. The country folk rightly call such a day a "weather breeder," and even the ground hog knows its portent in the very sign of his shadow. Come as it will, the day is really a day borrowed in advance from the spring, as though to hearten one through all the dreary days that will follow and, in starting the growing forces of vegetation, to make ready for the season's coming.

With this forerunner of the year come the harbingers of the bird migration. With the rise of the temperature to sixty or over, a well-marked bird wave from the south spreads over the Delaware Valley. On this balmy, springlike day we hear for the first time since November the croaking of grackles as a loose flock wings overhead or scatters among the tree tops. A few robins may show themselves, and the mellow piping of bluebirds lends its sweet influence to the charm of such a day. There is a sense of uncertain whereabouts in the bluebird's note, a sort of hazy, in-the-air feeling that suggests sky space. It does not seem to have the tangible element by which we can locate the bird as in the voices of the robin and the song sparrow. It is on such a day as this that song sparrows are first heard—cheery ditties from the weather-beaten fences and the bare, [Pg 773] brown tangle of brier patches. The day may close lurid with the frayed streamers of lofty cirrus clouds streaking across the sky—the vaporous overflow of a coming storm—or a week of the same bright weather may continue with the wind all the while blowing softly out of the south, but sooner or later the inevitable winter storm must close this foretaste of the spring.

A decided wave of rising temperature usually reaches the Delaware Valley from the middle to the last of March, maintaining itself longer than the February rise, and ushering in a well-marked bird wave. It is about this time that the vanguard of the robin migration scatters over the country. The grackles or crow blackbirds, which have been more or less in evidence since their first appearance in February, begin renovating the old nests or laying the foundations of new ones in the tops of tall pines. The shrill call of the flicker sounds through the woods, and before the end of the month one is sure to hear the plaintive song of the field sparrow. This is about the time that the spicebush shows its yellow blossoms through the grays and browns of the spring underwoods, and the skunk cabbage unfolds its fresh, green leafage in rank abundance along the boggy course of woodland rills. A week earlier the streaked yellow and purple of its fleshy spathes shows here and there in the oozy ground by the side of the folded leaf spikes. It is just at this time, too, that one must go to the woods for the first spring wild flowers—bloodroot, hepatica, anemones, and the yellow dog-tooth violet—if one would get the real freshness of spring into his soul. The crows, that all through the winter filed away each evening in straggling lines of flight toward the distant roost, have broken ranks, and go rambling in small groups through the woods and over the fields of green winter wheat. Like the grackles, they have thoughts of courtship and the more earnest business of family cares. The liquid notes of meadow larks sound clear and sweet in the greening fields and pastures, and small flocks of vociferous killdeers scatter in wheeling flight over the newly plowed lands. In tangle covers the rustle of dead leaves here and there tells of the whereabouts of a flock of fox sparrows halting in their northward pilgrimage. The pewee is back, inspecting her last year's house under the span of some old bridge, and the melancholy voice of the dove is borne on the air from the fence rows and cedars along the farther side of fields.

After the 1st of April the tide of migration sets in with force, and the earlier waves bring several species of summer birds—those that come to build and breed in our woods—that rarely if ever make their appearance before this time. It is an interesting fact that none of the migrants that make their first appearance in April are ever found in the Delaware Valley during the winter, [Pg 774] though several, if not all, of the species that come on the March waves are occasionally met with in the winter months. It appears, further, that the winter quarters of certain birds which are summer residents with us and some that are transient, passing on to more northern breeding grounds, lie not so very far to the south. If the last of March has been marked by warm weather lapping over into the first days of April, then one may expect soon to hear the familiar notes of the chipping sparrow from the swelling branches of garden shrubbery and the trees about the lawn, and a brown thrasher is sure to be heard volubly proclaiming his arrival from some near-by tree top. Among the budding sprigs of thickets the elusive chewink breaks into occasional

fragments of song, and from the red-blossomed maples and the jungle of pussy willows and alders that fringe the meadow brook the metallic creaking notes of the red-winged blackbirds sound not unpleasingly. This jargon of the red-wing has a true vernal ring about it, suggesting the fresh green of oozy bogs and the loosening up of sap.

From the middle to the last of April there are several big waves of migration that bring many of the summer residents as well as some transient species, forerunning the greater waves that are to follow in May. On certain warm April days the barn and the bank swallows appear, and the chimney swifts are seen scurrying to and fro above the trees and house tops. These are genuine signs of the coming summer, for swallows and swifts feed only on the minute gnats and other ephemera that develop under conditions of warm temperature. Whoever knows of a martin box that year after year is visited by its colony has an unfailing source of delight at this time in watching the lovely birds. The martins are very prompt in their arrival, rarely coming before the 1st of April nor later than the 10th. We are aware for the first time that the house wren has come back by the voluble song that greets us some morning from the branches just beyond our window —a song that only the lover of his own rooftree can fully appreciate, for the wren's chant, more than any other bird song, seems to voice the home instinct in a man. By the last week of April the woods are fast closing up their vistas in a rich profusion of unfolding leafage. The umbrellalike leaves of the May apple are scattered everywhere through the woods and fields, forming conspicuous patches of green. During this last week of the month a few straggling thrushes make their appearance—the hermit thrush with its russet tail, the veery, and the wood thrush. The first two are transients, flitting through the underwoods or rustling among fallen leaves in search of their insect food. To hear the incomparable matins and vespers of the hermit one must follow to the bird's breeding range on the wooded slopes of the Appalachians or farther into the deep recesses of the Canadian forests. The wood thrush breeds with us, and the melody of its notes [Pg 775] adds a peculiar charm to our groves and woodlands that would leave an unfilled blank in the choir if the bird were a transient like the hermit or the veery.

From the 1st to the 10th of May a succession of bird waves comes from the south of such vast proportions as to the number of individuals and variety of species that all the previous migratory waves seem insignificant in comparison. It is the flood tide of the migration, bringing with it the host of warblers, vireos, orioles, tanagers, and thrushes that suddenly make our woods almost tropical in the variety of richly colored species and strange bird notes. It would take a volume to describe the wood warblers, sylvan nymphs of such bizarre color patterns and dainty forms that one is fain to imagine himself in the heart of some wondrous forest of a far-away land. Their curious dry notes, each different in its kind and expression, yet all of the same insectlike quality; their quick, active motions, now twisting head downward around the branches, prying into every nook and cranny in their eager search for food, or fluttering about the clusters of leaves, add to the strange effect. Their names, too, are richly stimulative to the color sense—the black-throated green, the black-throated blue, the chestnut-sided, the bay-breasted, the black and yellow, the cerulean, the Blackburnian, the blue-winged yellow, the golden-winged, the blue-yellow-backed or parula warbler, and the Maryland yellow-throat are each suggestive of a wealth of coloring. Others have names that carry us to southern realms, like the myrtle and the palm warblers; and others again tell of curious habits, as the worm-eating warbler, the hooded fly-catching warbler, and the black and white creeping warbler that scrambles about the tree trunks like a true creeper. There is nothing in all the year quite like the May woods. Then, if never again, you can step from your dooryard into an enchanted forest. The light yellowish effects of new green in the feathery masses of the oak catkins and the fresh, unfolding leafage of the forest trees are a rich feast to the eyes. Against this wealth of green the dogwood spreads its snow-white masses of bloom. In sunlit spaces of greenness the scarlet flash of a tanager, the rich blue coloring of the indigo bird, newly arrived from its winter quarters in South America, and the glimpse of a rose-breasted grosbeak among the high tree tops are strangely suggestive of a tropical forest. The ear, too, is charmed with a multitude of curious notes. The weird cries of the great-crested flycatcher among the topmost branches, and the loud chant of the ovenbird with its rising cadence coming from farther depths of the wood are two of the most characteristic bird voices of the May woodlands. If one would have the famous song of the mocking bird in this sylvan carnival [Pg 776] he has only to loiter in the nearest grove to hear the wonderful performance of the catbird. The catbird is the real harbinger of summer. He is familiar throughout the countryside, liked or disliked according to the dispositions of folks, but when he appears amid the May-day throng every one knows that summer has come. As a countryman once said to me: "You can't place any dependence on the robin—it may snow the very day he comes; but a catbird never makes a mistake—it's summer with him for sure."

The passing on of the great warbler waves to the north and the ending of the migration likewise mean the passing of the spring. It is summer any time after the 15th of May, or, to be more accurate, after the last of the migratory warblers, thrushes, and tanagers have passed beyond our woods. To a New-Englander summer will come a little later, nearer the true almanac date of June 1st. To a dweller in Virginia the last of April is the passing of spring and the advent of summer.

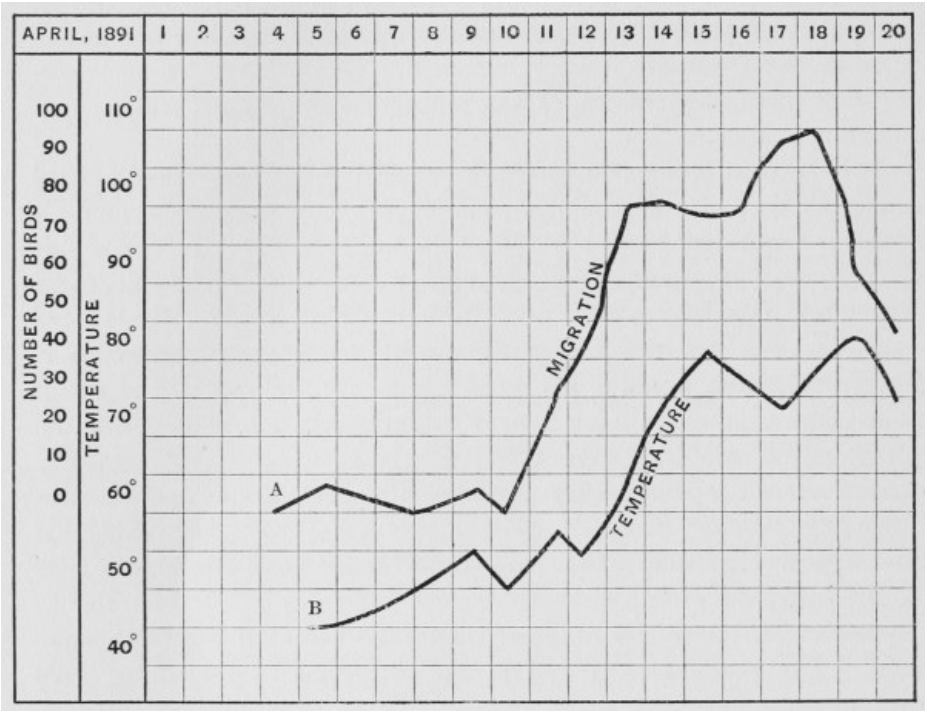
Some ten or more years ago several enthusiastic ornithologists living in the neighborhood of Philadelphia began keeping records of the times of arrival of the different species of birds, and at the same time noted the conditions of temperature in relation to the abundance of individuals. After several years of these observations they were able to see clearly that these bird waves were directly related to the waves of rising temperature marking the advent of warm spells of weather. One of the most significant facts deduced from these observations was the remarkable regularity

in the first appearance of certain species. For example, the Baltimore oriole in eight years of observation never arrived before the 1st of May, and only twice later than the 4th—viz., once on the fifth and once on the 7th. The list on the opposite page shows the date of first arrivals extending over a period of eight years, from 1885 to 1892.[10]

	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.
Flicker	April 10	Mar. 24	Mar. 26	Mar. 30	Mar. 28	Mar. 26	Mar. 30	April 2
Chimney swift	April 22	April 23	April 22	April 20	April 15	April 22	April 16	April 27
Hummingbird	April 29	May 12	May 12	May 14	.....	May 7	May 11	.....
Kingbird	May 6	May 11	May 7	May 6	May 6	May 14	May 1	May 4
Crested flycatcher	May 2	May 12	May 3	May 1	May 8	May 1	April 30	May 3
Pewee	April 3	Mar. 20	Mar. 21	Mar. 22	Mar. 27	Mar. 27	Mar. 31	April 3
Wood pewee	May 6	May 15	April 30	May 13	May 12	May 14	May 6	May 17
Red-winged blackbird	Mar. 4	Feb. 19	Feb. 19	Feb. 21	Mar. 13	Mar. 12	Feb. 25	Mar. 9
Meadow lark	.....	Feb. 10	Mar. 19	Mar. 21	Mar. 14	Mar. 12	Feb. 23	Mar. 17
Baltimore oriole	May 5	May 4	May 2	May 2	May 7	May 1	May 1	May 3
Purple grackle	Mar. 16	Mar. 7	Feb. 19	Feb. 21	Mar. 2	Feb. 13	Feb. 18	Mar. 6
Chipping sparrow	April 8	April 9	April 8	Mar. 31	Mar. 29	April 8	April 13	April 4
Field sparrow	April 11	April 7	April 9	April 2	Mar. 29	Mar. 13	Mar. 15	Mar. 26
Chewink	April 22	April 23	April 27	April 18	April 11	May 1	April 18	April 24
Indigo bird	May 16	May 11	May 7	May 12	May 12	May 10	May 8	May 10
Scarlet tanager	May 9	May 12	May 5	May 8	May 9	May 4	April 28	May 3
Barn swallow	April 22	April 19	April 21	April 12	April 22	April 19	April 19	April 24
Red-eyed vireo	May 7	May 11	May 4	April 29	May 5	April 30	May 2	May 3
Black-and-white warbler	April 30	May 4	April 27	April 21	April 20	April 30	April 24	May 1
Yellow warbler	May 6	May 4	May 2	May 5	May 11	May 1	May 8	May 4
Myrtle warbler	May 2	April 10	May 2	April 25	April 20	April 27	April 18	April 7
Black-throated green warbler	May 2	May 11	May 5	April 26	May 5	May 2	April 19	April 30
Ovenbird	April 30	May 3	April 29	April 30	May 3	May 3	April 29	April 30
Maryland yellow-throat	April 29	April 24	April 28	April 30	May 6	April 30	May 1	May 3
Chat	May 2	May 12	May 5	May 5	May 11	May 5	May 1	May 3
Redstart	May 2	May 4	May 3	May 1	May 4	May 3	April 29	April 30
Catbird	May 2	May 4	May 3	May 5	May 5	May 5	May 4	April 30
Brown thrasher	April 24	April 25	April 28	April 15	April 22	April 30	April 19	April 30
House wren	May 3	April 27	April 24	April 28	April 14	April 30	April 19	May 5
Wood thrush	May 2	May 1	May 1	May 1	May 3	April 30	April 23	May 2
Veery	.....	May 11	April 25	May 3	May 6	May 2	April 28	May 4
Hermit thrush	April 13	April 7	April 9	April 3	April 10	April 13	April 12	April 3
Robin	Mar. 7	Mar. 10	Feb. 28	Feb. 19	Mar. 7	Feb. 26	Feb. 24	Mar. 9
Bluebird	Mar. 18	.....	Feb. 17	Feb. 21	Mar. 8	Feb. 23	Feb. 17	Mar. 9

Another fact of great interest which bears on the south-to-north movement of migrating birds, and which these observations very clearly brought out, was the earlier appearance of individuals of various species at points nearer the river, the first arrival of the same species at points back from the river being, in many instances, several days later. The first report of the arrival of a given species usually came from a low, marshy tract of land immediately bordering the western shore of the Delaware. The second report came from a locality several miles back of the eastern shore of the river, but situated in the low plain of the river valley and within tide-water limits. The third report came from a place some miles back from the river on the uplands, but near the head of a stream emptying into the Delaware from the west. The last two places to report arrivals were situated farther up the river and some distance back from it. All this confirms the general idea that in migrating most, if not all, of the various land birds follow river valleys and invade the upland districts, lying back from either side, by way of the smaller tributaries. [Pg 777]

The fact of greatest importance resulting from these observations was that relating to temperature. It was found that there was always a marked increase in the number of individuals of a given species following a warm wave of temperature as marked by a decided rise of the thermometer. The following graphic representation, based on the abundance from day to day of three common and easily observed species—the brown thrasher, chipping sparrow, and flicker—affords an interesting illustration of the relative movements of the two waves. It will be understood that the numbers in the extreme left-hand column refer to the relative abundance of individuals of the three species collectively. The inside column refers to temperature. The period of observation was twenty days, as shown by the line across the top of the figure.[11] [Pg 778]



A, migration; B, temperature.

The advent of spring is marked by the northward progression of the isotherm of 42.8° F., which is the initial temperature required to awaken the dormant reproductive and germinating activities in animals and plants. With the gradual invasion of the United States, from the south northward, by temperatures above this, there passes over the different regions the ever-old but ever-new panorama of the spring with its opening blossoms, its unfolding green, and its waves of migrating birds. The restlessness produced by the periodic development of the reproductive function under the stimulus of increased temperature causes the highly organized bird life to spread out from its winter quarters, wherever those may be, and follow the zone of new green that steadily widens northward with its increase of food supply in the form of myriads of insects. The comparative regularity in the recurrence of this phenomenon year after year is attested by the observations just noted. Each species has a certain, definite physiological relation to temperature, and its migratory movement toward the breeding ground is determined by the movement of the isotherm [Pg 779] of this temperature. Just as warm a spell of weather may occur in early April as in the first week of May, but it does not represent the permanent summer rise; and the majority of the warblers, the catbird, the tanager, the rose-breasted grosbeak, the two species of oriole, the vireos, and the kingbird, are rarely if ever seen in abundance in the Delaware Valley before the 1st of May. The migratory movement of such species is as regular as any other periodic phenomenon in Nature.

It is hard to realize the enormous multitude of birds that form a so-called "wave." During the whole period of migration there is a general northward movement of all the migratory species, but under the influence of warm spells of weather this more or less uniform movement rises into a vast wavelike sweep of birds. These bird waves, as already noted, *follow* the rise of temperature appearing at any given locality about a day or two after the first day of the warm spell. Many species of land birds migrate at night—such, for example, as the orioles, tanagers, warblers, vireos, wrens, the majority of the finches, the woodpeckers, and the thrushes, excepting the robin. During the passing of one of the May waves the darkness overhead is alive with flying birds. One may stand for hours at a time and hear the incessant chirping and twittering of hundreds of birds calling to one another through the night as though to keep from getting separated. The great mass of individuals are probably guided by these call notes.

The usually accepted notion that birds migrate from south to north in traveling to their breeding grounds is largely true of shore birds and waterfowl, but among many of the species of land birds conditions of topography tend to deflect a direct northward movement. The Atlantic coast plain, reaching up into southern New Jersey, and the Mississippi basin, each offers a broad south-to-north highway for birds leaving the Gulf shores of the United States on their northward journey in the spring. A great majority of species find in the wilderness of the Appalachian highland, from the Catskills to Georgia, breeding grounds quite as well adapted to their needs as the forests of Maine and Canada. Large numbers of birds, according to their regional relations, will constantly turn from the Atlantic coast plain up the numerous rivers, which become great highways of migration, leading to the highlands. The northward movement has thus a large westerly deflection on the Atlantic slope of the middle United States. It is also quite certain that many birds winter in favorable localities on the Atlantic coast plain much farther north than is generally supposed. This is especially true of the holly thickets among the coastwise sand dunes of southern New Jersey and the cedar swamps and pine barrens in the vicinity of Cape May. Many of the finches, the marsh wrens, red-winged blackbirds, meadow larks, thrashers, and [Pg 780] myrtle warblers are frequently seen in these localities through the winter. I spent one first day of February some years ago among the dunes below Atlantic City, N. J. At Philadelphia that morning it was bleak winter weather, but two hours later we found ourselves in a warm expanse of sunlight on the seaward beaches. The balmy air was filled with bird notes, and the holly thickets

and bay bushes fairly swarmed with myrtle warblers. It seems to be a fact that many birds thus make comparatively short migratory movements between the seacoast plain and the mountains, up and down the river valleys.

The phenomenon of the migrating bird has always appealed in a wonderful manner to the human mind. The guiding geographical sense that all animals, and wild animals and birds in particular, possess is peculiarly attractive to men of civilized society, because they have largely lost this same natural instinct of direction, and now look upon it in wonderment. Birds have very sure landmarks; their senses are keen for noting features of topography. They undoubtedly know the Potomac, the Susquehanna, the Delaware, the Hudson, and the Connecticut, and never confuse one with another. They know to which side the sea lies and that the rivers flow down from a wild, wooded region where there are plenty of food and the best possible places to raise their young. All these facts get fixed in their brains. The bird's brain-cell structure is built on these lines and is only waiting to get the impressions of the first migratory experience. They keep in with one another, follow their chirpings in the night, learn to tell the Hudson from the Delaware, or where this or that stretch of woodland lies, just as they learned when first out of the nest how to tell good from bad sorts of food, or how to find their way about the home woods, and that an owl or a fox was an undesirable acquaintance. In the fall migration the young birds follow the older ones in the general movement southward, and are often belated, showing that the impulse to leave their birthplaces is forced upon them, rather from necessity than choice, and is not the well-developed instinct impressed by former experience which their elders seem to possess. The old birds who have bred and reared these young ones set the example of early departure which the birds of the year through inexperience are tardy in appreciating. The habit waits upon experience.

Each year, from midwinter, when the first warmth of advancing sunlight calls to the sleeping life, on to the first fervid heat of the reproductive summer, we have the joyous pageant of the spring. This steady waxing of the new light appealed to the pagan mind of western Europe with a far deeper sense than the modern mind can appreciate. To our rude ancestors it was the goddess Eástre, bountiful in her gift of warmth and the magic of reproductive life, that each year came [Pg 781] with the light to drive away the frost giants. And with the goddess, whom we still love to picture as a maiden tripping lightly through the budding groves in her wind-blown garments, came the birds. It was the cuckoo that brought the summer with "daisies pied and violets blue," and to-day, when its voice is heard for the first time in the year, every one knows that summer has come again to the hedgerows of England and the lands of the Rhine. So with us across the Atlantic, summer comes when the catbird first pours out its babel of sweet notes in green woodland ways and the tangled nooks of old gardens.

GUESSING, AS INFLUENCED BY NUMBER PREFERENCES.

By F. B. DRESSLAR.

About two years ago a certain progressive clothing company of Los Angeles, California, procured a very large squash—so large, indeed, as to attract much attention. This they placed uncut in a window of their place of business, and advertised that they would give one hundred dollars in gold to the one guessing the number of seeds it contained. In case two or more persons guessed the correct number, the money was to be divided equally among them. The only prerequisite for an opportunity to guess was that the one wishing to guess should walk inside and register his name, address, and his guess in the notebook kept for that purpose.

The result of this offer was that 7,700 people registered guesses, and but three of these guessed 811, the number of seeds which the squash contained.

It occurred to me that a study of these guesses would reveal some interesting number preferences, if any existed, for the conditions were unusually favorable for calling forth naïve and spontaneous results, there being no way of approximating the number of seeds by calculation, and very little or no definite experience upon which to rely for guidance. It seemed probable, therefore, that the guesses would cover a wide range, and by reason of this furnish evidence of whatever number preference might exist. It is undoubtedly safe to assume, too, that the guesses made were honest attempts to state as nearly as possible best judgments under conditions given; but even if some of the guesses were more or less facetiously made, the data would be equally valuable for the main purpose in hand.

According to the theory of probability, had there been no preference at all for certain digits or certain combinations of digits within the limits of the guesses, one figure would occur about as [Pg 782] often as another in units' or tens' place. It was argued, therefore, that any marked or persistent variation from such regularity in such a great number of cases would reveal what might be termed an unconscious preference for such numbers or digits for these places.

The purpose of this study, then, was to determine whether or not there existed in the popular mind, under the conditions offered, any such preferences.

After the very arduous and tedious task of collating and classifying all the guesses for men and

women separately had been done, the following facts appeared:

In the first place, marked preference is shown for certain digits both for units' and tens' places. This statement is based on a study of the 6,863 guesses falling below one thousand. Of these, 4,238 were made by men and 2,625 were made by women. By tabulations of the digits used in units' place by both men and women, the following facts have been determined: 800 used 9, while but 374 used 8; 1,070 used 7, and 443 preferred 6; 881 used 5, and only 295 preferred 4; 862 chose 3, while 331 used 2; 577 ended with 1, while 1,230 preferred 0 as the last figure.

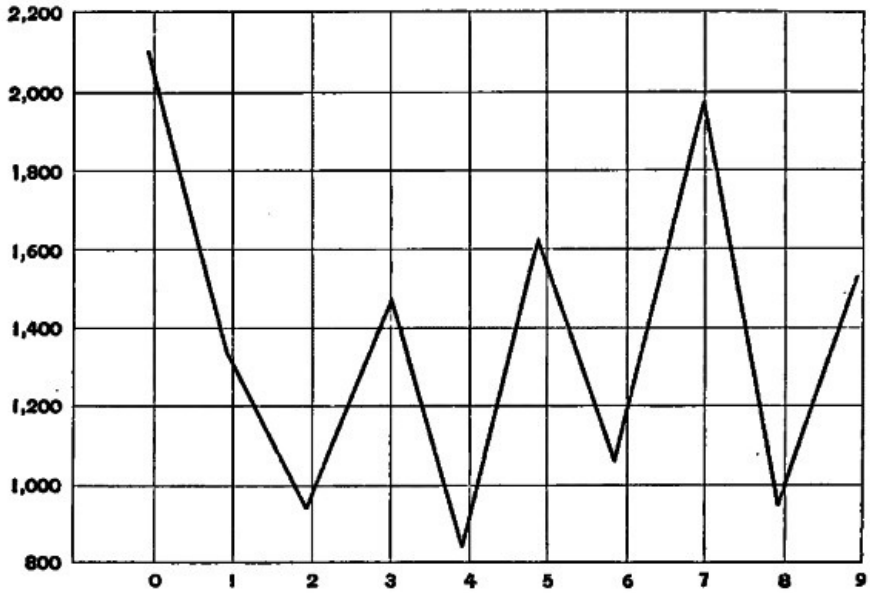
A tabulation of the figures used in tens' place shows, save in the case of 2 and 3, where 2 is used oftener than 3, the same curious preferences, but in a much less marked degree. To go into detail, 850 chose 9 for tens' place, while 559 took 8; 907 used 7, while only 637 selected 6; 748 took 5, while only 536 used 4; 601 used 3, and 634 chose 2; 728 used 1, as against 872 who used 0.

Were it not that the selections here in the main correspond with the preferences shown in units' place, the significance of these figures would be much less important; but the evidence here can not wholly be ignored when taken in connection with the facts obtained in the preferences shown in the case of the figures occupying units' place.

We are enabled, then, as a result of the study of these guesses, to say that under the conditions offered, aside from a preference of 0 over 1 to end the numbers selected, digits representing odd numbers are conspicuously preferred to those representing even numbers. How far this will hold under other conditions can not now be stated, but the facts here observed are of such a nature as to suggest the possibility of an habitual tendency in this direction. However, further investigations can alone determine whether or not this bias for certain numbers is potent in a general way.

The curve on the next page, exhibiting the results noted above, shows at a glance the marked and persistent preference for the odd numbers.

It will be noticed that of the digits preferred, 7 surpasses any of the others. Not only, then, do we [Pg 783] tend to select an odd number for units' place when the guess ranges between one and a thousand, but of these digits 7 is much preferred. In connection with this fact one immediately recalls all he has heard about 7 as a sacred number, and its professed significance in the so-called "occult sciences." I think one is warranted in saying from an introspective point of view that there is a shadow of superstition present in all attempts at pure guessing. There appears to be some unexpressed feeling of lucky numbers or some mental easement when one unreasoned position is taken rather than any other.



Choice of Digits in Tens' and Units' Places (Men and Women).

Vertical distance shows the number of times the figure on the horizontal line immediately below was used.

It is impossible on the evidence furnished by this study to give more than hints at the probable reason for the preference here indicated. But it is worth while to glance backward to earlier conditions, when the scientific attitude toward all the facts of life and mind was far more subordinated to supernatural interpretations than it is to-day. In this way we may catch a thread which still binds us to habits formed in the indefinite past.

The Greeks considered the even numbers as representative of the feminine principle, and as belonging and applying to things terrestrial. To them the odd numbers were endowed with a masculine virtue, which in time was strengthened into supernatural and celestial qualities. The same belief was prevalent among the Chinese. With them even numbers were connected with [Pg 784] earthly things, partaking of the feminine principle of Yang. Odd numbers were looked upon as

proceeding out of the divine and endued with the masculine principle. Thirty was called the number of earth, because it was made up by the addition of the even numbers 2, 4, 6, 8, and 10. On the other hand, 25, the sum of the five odd numbers 1, 3, 5, 7, and 9, was called the number of heaven.

It is generally true that, as lower peoples developed the need of numbers and the power to use them, certain of these numbers came to be surrounded with a superstitious importance and endued with certain qualities which led at once to numerical preferences more or less dominant in all their thinking connected with numbers.

It would certainly be unjustifiable to conclude from the evidence at hand that the preferences shown in the guesses under consideration are directly traceable to some such superstition; and yet one can scarcely prevent himself from linking them vaguely together. Especially is this true when some consideration is given to a probable connecting link as shown in our modern superstitious notions. I have found through a recent study of these superstitions that where numbers are introduced, the odd are used to the almost complete exclusion of the even. For example, I have collected and tabulated a series of more than sixty different superstitions using odd numbers, and have found but four making use of the even. Besides these specific examples there are many more which in some form or another express the belief that odd numbers have some vital relation with luck both good and bad.

It would be impossible to define precisely or even approximately just what sort of a mental state the word "luck" stands for, but one element in its composition is a more or less naïve belief in supernatural and occult influences which at one time work for and at another time against the believer. In its more pronounced forms, the belief in luck lifts itself into a sort of a blind dependence upon some ministering spirit which interposes between rational causes and their effects. In a way one may say that the more or less vague and shadowy notions of luck which float in the minds of people to-day are but the emaciated and famishing forms of a once all-embracing superstition, and that these shadows possess a potency over life and action oftentimes beyond our willingness to believe.

There is another interesting and somewhat curious thing to be noticed in connection with these guesses. There is a persistent tendency to the duplication of digits, or, if one thinks of the numbers as at first conceived in terms of language, a tendency to alliteration. For example, the numbers 111, 222, 333, 444, 555, 666, 777, 888, and 999 occur oftener by sixty-seven per cent than any other combination possible in the tens thus represented. That is to say, other things [Pg 785] equal, one would have a right to expect 334 or 332 to occur as often as 333. But the fact is, in this particular case, 333 occurred forty-eight times, while the other two put together occurred only three times. Here, however, we have the combined influence of the preference for the odd over the even and the digital sequence. Still, if we select 444, we find that this number, made up though it is of three digits in general least selected of all, the preference for alliterative effect is strong enough to make the number occur 28 times to 14 times for both 443 and 445. If we take 777, we find that it was used more times than all the other combinations from 770 to 779 inclusive, put together.

Therefore, under conditions similar to those presented for these guesses, one would be safe to expect these duplicative or alliterative numbers to occur much oftener than any other single number in the series.

It would evidently be unsafe to generalize upon the basis of this study, notwithstanding the large number of guesses considered. However, it seems to me that the results here obtained at least suggest a field of inquiry which promises interesting returns. If it be true, as here suggested, that odd numbers are preferred by guessers, advantage could be taken of this preference in many ways. Furthermore, as I suspect, it may be that this probable preference points to a habit of mind which more or less influences results not depending strictly on guessing. It has been shown, for example, that the length of criminal sentences has been largely affected by preferences for 5 or multiples of 5—that is to say, where judges have power to fix the length of sentence within certain limits, there is a strong probability that they will be influenced in their judgments by the habitual use of 5 or its multiples. Here it would seem that unconscious preference overrides what one has a right to consider the most careful and impartial judgments possible, based upon actual and well-digested data.[12]

Another thing is noticeable in these guesses. The consciousness of number beyond 1,000 falls off very rapidly. The difference in the values of 1,000 and 1,500 seems to have had less weight with the guessers than a difference of 50 had at any place below 1,000. And so, in a way, 1,000 seems to mark the limit of any sort of definite mental measurement. This fact is more and more emphasized as the numbers representing the guesses increase until one can see there exists absolutely no conception of the value of numbers. For example, many guessed 1,000,000, while several guessed more than 10,000,000. Guessing means, with many people, no attempt at any [Pg 786] sort of reasonable measurement, but rather an attempt to express their guess in such a way as to afford them the greatest amount of mental relief. And this relief can not be wholly accomplished without satisfying number preferences. Therefore, guessing is likely to exhibit, in a greater or less degree, some habitual lines of preference subject to predetermination. It may be that much practical advantage has been taken of these facts in games of chance where number selections play an important part.

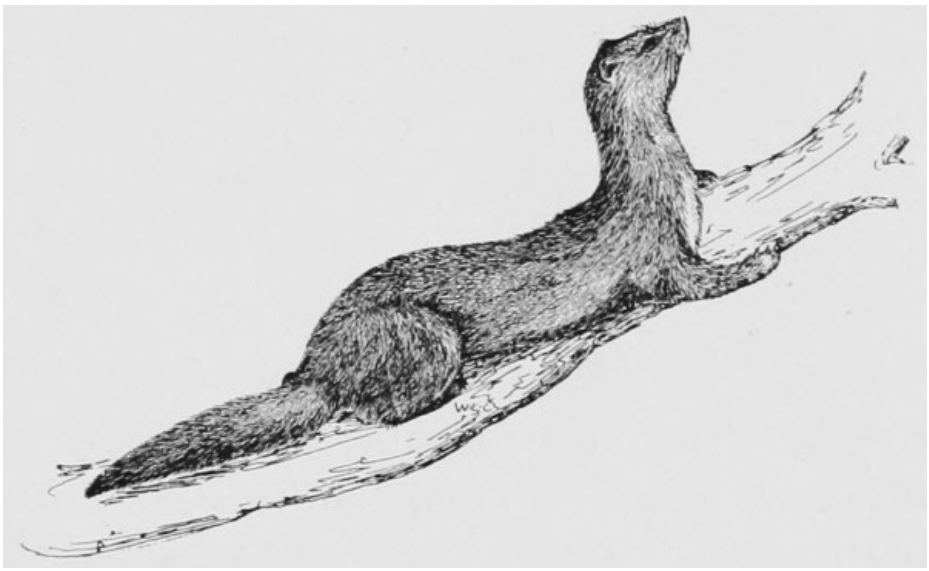
CONCERNING WEASELS.

By WILLIAM E. CRAM.

Why is it that while popular fancy has attributed all sorts of uncanny and supernatural qualities to owls and cats, and that no ghost story or tale of horrid murder has been considered quite complete without its rat peering from some dark corner, or spider with expanded legs suddenly spinning down from among the rafters, no such grewsome association has ever attached itself to the weasels, creatures whose every habit and characteristic would seem to suggest something of the sort? Now, fond as I am of cats, I should never think of denying that they are uncanny creatures, to say the least. But, suppose it was the custom of our domestic tabbies to vanish abruptly or even gradually on occasion, like the Cheshire cat after its interview with Alice, that would at least furnish some excuse for the general prejudice against them, but would really be no more than some of our commonest weasels do whenever it serves their purpose. I remember one summer afternoon I was trout-fishing along a little brook that ran between pine-covered hills. As I lay stretched on the bank at the foot of a great maple I saw a weasel run along in the brush fence some distance away. A few seconds later he was standing on the exposed root of the tree hardly a yard from my eyes. I lay motionless and examined the beautiful creature minutely, till suddenly I found myself staring at the smooth greenish-gray root of the maple with no weasel in sight. Judging from my own experience, I should say that this is the usual termination of any chance observations of either weasels or minks.

[Pg 787]

Occasionally they may be seen to dart into the bushes or behind some log or projecting bank, but much more frequently they vanish with a suddenness that defies the keenest eyesight.



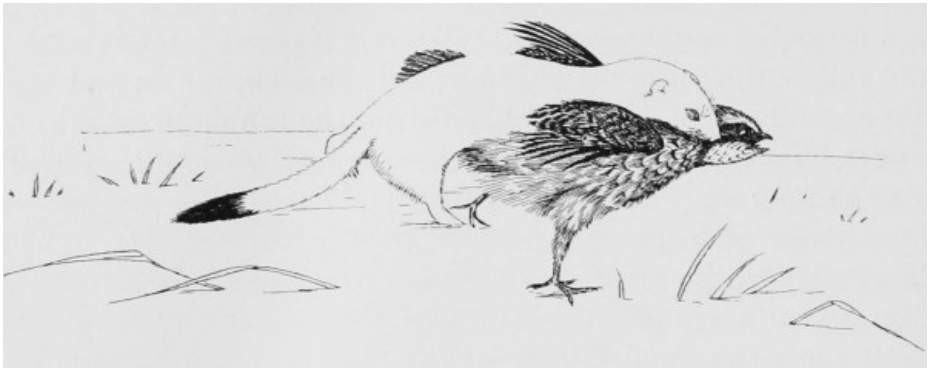
In all probability this vanishing is accomplished by extreme rapidity of motion, but if this is the case then the creature succeeds in doing something utterly impossible to any other warm-blooded animal of its size. Mice, squirrels, and some of the smaller birds are all of them swift enough at times, but except in the case of the humming bird none of them, I believe, succeed in accomplishing the result achieved by the weasels. The humming bird, in spite of its small size, leaves us a pretty definite impression of the direction it has taken when it darts away; but when a

mink, half a yard in length and weighing several pounds, stands motionless before one with his dark coat conspicuous against almost any background, and the next instant is gone without a rustle or the tremor of a blade of grassA weasel, it leaves one with an impression of witchcraft difficult to dispel; and best appreciated when one sees it for one's self. Nor is the everyday life of the weasel quiet or commonplace; his one object in life apparently is to kill, first to appease his hunger, then to satisfy his thirst for warm blood, and after that for the mere joy of killing.

The few opportunities I have had for observing these animals have never shown them occupied in any other way, nor can any hint of anything different be gained from the various writers on the subject, while accounts of their attacking and even killing human beings in a kind of blind fury are too numerous and apparently well authenticated to be entirely ignored. These attacks are said usually to be made by a number of weasels acting in concert, and the motive would appear to be revenge for some injury done to one of their number. There seems to be something peculiar about the entire family of weasels. The American sable or pine marten is said to have strange ways that have puzzled naturalists and hunters for years. In the wilderness no amount of trapping has any effect on their numbers, nor do they show any especial fear of man or his works, occasionally even coming into lumber camps at night and being especially fond of old logging [Pg 788] roads and woods that have been swept by fire; but at the slightest hint of approaching civilization they disappear, not gradually, but at once and forever, and the woods know them no more. If there is anything in the theory of the survival of the fittest, why is it that not one marten has discovered that, like other animals of its size, it could manage to live comfortably enough in the vicinity of man? The mink and otter still follow the course of every brook and river and manage to avoid the keen eyes of the duck hunter, while for six months in the year their paths are sprinkled with steel traps set either especially for them or for the more plebeian muskrat. If a pair of sables could be persuaded to take up their quarters in some parts of New England they could travel for dozens of miles through dark evergreen woods with hollow and decaying trees in abundance, while at present there are almost no traps set in a manner that need disturb creatures of their habits. Partridges, rabbits, and squirrels, which form their principal food, are nearly if not quite as abundant as before the country was settled, so that it would certainly not require any very decided change of habits to enable them to exist, but evidently the root of the matter goes deeper than that, and, like some tribes of Indians, it is impossible for them to multiply or flourish except in the primeval forest.

The common weasel or ermine, which is the only kind I have seen hereabouts, would seem to have everything on its side in the struggle for existence, and when one happens to be killed by some larger inhabitant of the woods it must be due entirely to its own carelessness. Nevertheless, they do occasionally fall victims to owls and foxes, and I once shot a red-tailed hawk that was in the act of devouring one. Still, these casualties among weasels are probably few and far between.

Fortunately, however, they never increase to any great extent. Occasionally in the winter the snow for miles will be covered with their tracks all made in a single night, and then for weeks not a track is to be seen; but usually they prefer to hunt alone, each having its beat a mile or more in length, over which it travels back and forth throughout the season, passing any given point at intervals of two or three days. This habit of keeping to the same route instead of wandering at [Pg 789] random about the woods is characteristic of the family, the length of the route depending to a certain extent on the size of the animal. The mink is usually about a week in going his rounds, and may cover a dozen miles in that time, while the otter is generally gone a fortnight or three weeks. When it is possible the ermine prefers to follow the course of old tumble-down stone walls, and lays its course accordingly. In favorable districts he is able to keep to these for miles together, squeezing into the smallest crevices in pursuit of mice or chipmunks. All the weasels travel in a similar manner—that is, by a series of leaps or bounds in such a way that the hind feet strike exactly in the prints made by the fore paws, so that the tracks left in the snow are peculiar and bear a strong family resemblance. On soft snow the slender body of the ermine leaves its imprint extending from one pair of footprints to the next, and as these are from four to six feet apart, or even more, the impression left in the snow is like the track of some extremely long and slender serpent with pairs of short legs at intervals along its body. I have said that the ermine is the only true weasel I have found in this vicinity, but this is not strictly true, at least I hope not. One winter I repeatedly noticed the tracks of an exceedingly large weasel—so very large, in fact, that I was almost forced to believe them to be those of a mink. The impression of its body in the snow was quite as large as that made by a small mink, but the footprints themselves were smaller, and the creature appeared to avoid the water in a manner quite at variance with the well-known habits of its more amphibious cousin, while, unlike the common weasel, it never followed stone walls or fences. I put my entire mind to the capture of the little beast, and set dozens of traps, but it was well along in the month of March before I succeeded. It proved to be a typical specimen of the Western long-tailed weasel, though I can find no account of any other having been taken east of the Mississippi. Its entire length was about eighteen inches; the tail, which was a little over six, gave the effect at first glance of being tipped with gray instead of black, but a closer inspection showed that the black hairs were confined to the very extremity and were partly concealed by the overlying white ones; the rest of the fur was white, with a slight reddish tinge, and much longer and coarser than that of an ermine. Since then I have occasionally seen similar tracks, but have not succeeded in capturing a second specimen. In all probability the least weasel is also to be found here if one has the patience to search carefully enough; none, however, have come under my observation as yet. All the small weasels that I have [Pg 790] seen have proved on close inspection to be young ermines with thickly furred black-tipped tails; in the least weasel the tail is thinly covered with short hair and without any black whatever. Late in the autumn or early in the winter the ermine changes from reddish-brown to white, sometimes slightly washed with greenish-yellow or cream color, and again as brilliantly white as anything in Nature or art; the end of the tail, however, remains intensely black, and at first thought might be supposed to make the animal conspicuous on the white background of snow, but in reality has just the opposite effect. Place an ermine on new-fallen snow in such a way that it casts no shadow, and you will find that the black point holds your eye in spite of yourself, and that at a little distance it is quite impossible to follow the outline of the weasel itself. Cover the tail with snow, and you can begin to make out the position of the rest of the animal, but as long as the tip of the tail is in sight you see that and that only. The ptarmigan and northern hare also retain some spot or point of dark color when they take on their winter dress, and these dark points undoubtedly serve the same purpose as in the case of the ermine.



An old hunter, one of the closest observers of Nature I have ever known, once told me that female minks hibernated in winter in the same manner as bears, though it was his belief that, unlike the bears, they never brought forth their young at that season. At first I refused to take the slightest stock in what he said; the whole thing appeared so absurd and so utterly at variance with the teachings of those naturalists who have made the closest possible study of the habits of [Pg 791] minks. Since then, however, I have kept my eyes open for any hint that might have the slightest bearing on the subject, and to my surprise have found many things that would seem to point to the correctness of the old hunter's theory. To begin with, he said that late in the winter he had repeatedly known female minks to make their appearance from beneath snow that had lain undisturbed for days or even weeks, the tracks apparently beginning where he first observed them, the difference in size between the two sexes being sufficient to make it easy to distinguish between their tracks at a glance; and, moreover, since he first began trapping he had noticed that while the sexes were about equally abundant in the autumn, the females always became very scarce at the approach of winter and remained so until spring, when they suddenly increased in

numbers and became much the more abundant of the two.

This is also the experience of trappers in general, and may be verified by any one who cares to take the trouble to look into the matter. Evidently no one has ever discovered a mink in a state of hibernation; at any rate, no such case appears ever to have been reported; but this does not necessarily prove that it is not a regular habit among them.

The cry of the mink is seldom heard, even in places where they are fairly abundant, as they have evidently learned that the greatest safety lies in silence. It is a peculiarly shrill, rattling, whistlelike scream, that can be heard at a considerable distance.

CARE OF THE THROAT AND EAR.

By W. SCHEPPEGRELL, A. M., M. D.,

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Hygiene is that branch of medical science which relates to the preservation and improvement of the health. As the prevention of disease is more important than its cure—in fact, superior to all methods for its cure—this is a subject which demands our most earnest attention. Hygiene is not limited to the preservation and improvement of the health of the individual, but includes that of whole communities. As, however, the health of a community depends upon the state of the health of the various families composing it, and this again of its members, the proper understanding of the hygienic laws by each individual is of the utmost importance.

For some reason, however, the subject of hygiene or the prevention of disease does not create the enthusiasm caused by methods advocated for its cure. A Koch, who publishes to the world a supposed means of curing tuberculosis, or a Behring, who introduces the serum therapy of [Pg 792] diphtheria, arouses an interest which is limited only by the four corners of the world. The modest worker in sanitation, however, who explains the means of the development of these diseases, and the conditions and laws by means of which they may be prevented, is looked upon without interest and frequently with disfavor. But in spite of these conditions, the laws of hygiene are gradually becoming more farspread, and their influence is felt more with each advancing year.

The nose, throat, and ear are so intimately connected with the other parts of the body that their health depends to a large extent upon the condition of the system in general. The laws of hygiene and their application which refer to the body in general are also applicable to these parts, and whatever condition benefits the former will have a useful influence on the upper respiratory passages, and, inversely, any injurious effect will injure the health of these organs.

The physiology of this region is of much importance. Formerly the nose was considered principally in its relation to the organ of smell. This is a most important function, as it is a constant sentinel over the air we breathe and the food we eat. It is a curious circumstance that many of the functions that are referred to the organ of taste really belong to that of smell. In eating ice cream, for instance, the sense of taste simply informs us that it is sweet or otherwise, but the flavor is perceived only by the sense of smell. A proof of this is that where this function is destroyed, all ability in this direction disappears, and the patient thus affected will frequently complain that his sense of taste is defective, not realizing that it is the sense of smell which

performs this act.

The nose, however, has a much more important function to perform—viz., in respiration. Strange to say, however, this has only recently been realized, and it is even yet not well understood. You have all observed that, when you had a severe "cold" which prevented nasal breathing, the next morning the mouth and throat were dry and parched and frequently inflamed, the voice sometimes hoarse, and there was a general feeling of depression. While the progress of the inflammatory process may be a factor in this, still the mechanical obstruction of the nose from any cause whatsoever will have a similar effect. In patients in whom, for various reasons, an artificial opening has been made in the trachea, the air of the room has to be heated to an almost intolerable point and saturated with moisture, or severe bronchial inflammation will soon develop in the patient, simply because the nose has not taken an active part in the act of respiration. These effects, therefore, clearly demonstrate that the nasal passages have an important function to perform in the breathing process. Summarized in a few words, it is simply to warm, moisten, and clean the air which we inhale. [Pg 793]

The healthy nostrils are anatomically and physiologically so formed that when the current of air passes through them it will have been freed of its mechanical impurities, warmed to within a few degrees of the temperature of the body, and moistened to saturation. This has been experimentally demonstrated.

The opening of the passage of the ear into the throat has several objects, the most important being ventilation and the adjustment of the atmospheric equilibrium. This passage leads outward until it enters the cavity of the middle ear, which is closed by the drum on the outside, thus separating it from the external canal of the ear. We know that atmospheric pressure varies at different times and in different altitudes. It is much less, for instance, at the top of a mountain than at the seaside. The opening into the throat allows the air to enter, and adjusts the atmospheric pressure within the ear to these various external conditions. Those of you who have ascended Lookout Mountain by means of the incline cable car may have noticed the adjustment taking place by a peculiar click when different altitudes were reached.

So intimately are the nose, throat, and ear connected that it is unusual to find one affected to any considerable extent without the others being involved. While the rules of hygiene in general are applicable to the nose, throat, and ear, there are certain special conditions which deserve consideration. One of the most common causes of injurious effects to the nose, throat, and ear is the so-called "cold." The cold in this connection is, of course, understood to be simply the cause, the condition itself being a peculiar inflammation of the parts concerned. As cold is so frequently a cause of diseases of these parts, it would be well to consider under what circumstances it develops and the best mode of prevention.

I have often noticed that persons who suffer most frequently and severely from colds usually insist that they exercise the greatest care to avoid exposure. They have dressed in the warmest clothing, wrapped the neck in the heaviest mufflers, remained in the closest rooms, and avoided every draught, and yet they continually "take cold." The street urchin, on the other hand, with only two or three garments and without shoes, and who lives out of doors, suffers less frequently from this affection.

"Colds" have truly been called a product of modern civilization. The trouble was rare among the aborigines and is more common among the cultured than among the laboring classes. If we make a plant an exotic, we must keep it in the conservatory, and even here it is not free from danger. On the other hand, if we wish to harden it and make it proof against atmospheric and climatic changes, we must prepare it by judicious exposure for these conditions. The warm clothing which is thought to be a protection against cold is frequently the most fertile cause. It relaxes the body, moistens the skin, and the perspiration which is induced especially prepares the unresisting body for its attacks. This applies especially to warm covering around the neck, to which the air has periodic access. Except in unusually severe weather, the throat requires no more covering or protection than the face. [Pg 794]

The method of having only two systems of underclothing, the heavy to be worn until it is quite warm, and *vice versa*, is also a source of danger. There should be three changes: one of the lightest texture for the warm weather of summer, a medium for spring and fall, and the pure wool for winter, which in this climate need not be very heavy. Waterproof shoes, rubbers, furs, etc., are not recommended for customary use, and should be worn only when absolutely indicated.

The best preventive of recurrent colds is the judicious use of the sponge or cold shower bath. The ordinary bath should usually be of a temperature not disagreeable to the body, but after the question of cleanliness has been attended to, an application, either by means of a sponge or shower, of ordinary cold water should be made. This should be of short duration, and friction with a coarse towel follow at once. When properly conducted, a reaction sets in so that there is no danger from this, and the toning effect of the method is of the utmost value in the prevention of colds. This applies, of course, only to persons in ordinarily good health. Even in these cases there are rare occasions in which this method is not advisable, and it may on general principles be stated that it should not be used by persons who do not react promptly. As stated, however, the application of cold water should be only momentary. The daily application of cold water to the throat and chest is also a useful practice for strengthening these parts.

In addition to these means there are certain injurious conditions that it would be well to avoid. One almost universally present in large cities is that of dust. The constant inhalation of the small

particles of sand and of organic impurities of which dust is composed has an irritating effect on the delicate lining of the nose and throat, which may develop a chronic inflammation, resulting in injury to both the throat and ear. This evil, however, can be prevented by the artificial watering of our streets.

Excessive tobacco smoking produces injurious effects in the nose and throat. Of all forms of smoking, the cigarette is the most injurious, and allowing the smoke to pass through the nostrils the most dangerous. Occasionally ladies inhale the smoke of a closed room where the male members of the household are smoking, and this is injurious to a delicate throat. [Pg 795]

Loud and excessive talking is sometimes a factor in throat diseases. The former is more apt to be exercised in transit in our steam or electric cars, and members of the theatrical profession realize this so well that they rarely use their voice while traveling. In excessive talking, in addition to the mechanical wear and tear of the throat, the respiration is usually spasmodic, a combination that is likely to lead to evil results. At puberty, when the voices of boys and girls are changing, the former sometimes almost an octave and the latter usually a note or two, special care should be taken of the voice, and singing or vocal exercises should be discontinued until the change has been finally established.

The effect of singing on the throat is of much interest, but it is one of such an extensive character that it can be only casually referred to here. The exercise required in singing improves the healthy throat in the same manner that exercise benefits the body in general. The diseased throat, however, may be injured by this practice, as no form of vocal culture can remedy a mechanical interference in its action. The method of singing is also of the utmost importance; an erroneous one may not only injure a promising voice, but may also have a bad effect on a normal throat. The subject of register requires careful consideration. The placing of the voice in the wrong register is fruitful of evil; the ambition of the singer to reach a few notes higher or lower than her range may also work severe injury to the throat.

The throat may be improved or strengthened by any of the forms of exercise, especially the out-of-door, which have been advised for the health in general. In addition to this, breathing exercises are of special value. These consist of taking deep inhalations through the nose, holding the breath for a few seconds and then gently expiring it, the body in the meanwhile being free from all restraint from tight clothing. The practice of this exercise for five minutes mornings and evenings will have a remarkable effect in developing the chest and throat.

In order to anticipate serious complications, children should be taught to allow their mothers to examine their throats freely and without resistance. I feel especially the importance of this subject, as I have frequently seen children almost sacrificed on account of the nervous dread of having their throats examined, or by their inability to control themselves. The method is exceedingly simple: the child is placed facing a bright window, and the handle of a spoon placed on the tongue and so depressed that the posterior part of the throat can be distinctly seen. At first this may be difficult, but the child soon becomes accustomed to the manipulation and the throat may then be examined without difficulty. Another advantage of this procedure is that the mother becomes familiar with the normal appearance of the throat, and can easily note any change due to disease. [Pg 796]

In view of the important function of the nose in warming, cleaning, and moistening the inspired air, the greatest care should be taken to teach children to breathe through the nostrils. When only a portion of the air enters through the mouth, the irritation is not as marked as when all the air is inhaled in this manner, but it nevertheless develops a condition of chronic irritation which is easily recognized by one familiar with its appearance, and which may lead to important complications. In many cases, mouth breathing is not due to habit, but to some obstruction in the nostrils or throat. These cases form a proper subject for the consideration of the physician. After the removal of any existing obstruction, children will sometimes, from force of habit, continue to breathe through the mouth, but this can usually be overcome by attention and firmness on the part of the parents.

The prevention of grave throat diseases, such as diphtheria, necessarily forms a subject of much interest to the public in general and to mothers in particular. The causation of this disease has been much cleared up in later years, and we now know that the important factor is a bacillus—a small organism of the vegetable kingdom—which is the cause of this disease and a necessary material for its propagation. Bacteriologic investigations have shown that the so-called "membranous croup" is in by far the largest number of cases identical with diphtheria, and the same precautions which apply to the latter should therefore also be carried out in this disease.

As diphtheria is strictly an infectious disease, and one which must be directly or indirectly contracted from a similar case, there is no sanitary reason why this dreaded malady in the course of time should not be entirely eliminated from the earth. In view of the fact that diphtheria is so frequently present in our larger cities, this may appear at present a Utopian idea. It is not so many years ago, however, when smallpox was almost universal, and yet we now but rarely have it in our midst. Not only is this the case, but the health authorities are severely criticised when a number of these cases exist, as indicating that there has been a lack of watchfulness in carrying out certain well-known means of prevention.

While we have at the present time no means of inoculation that will permanently protect against infection from diphtheria, still it is not of such an infectious character as smallpox, as the cases are usually limited to children, and its spread may therefore be more easily prevented. Not only

should children who have had diphtheria be prevented from returning to school until infection is no longer possible, but other children of the same household should also be kept at home. A few years ago a certain school in this city was rarely without a case of diphtheria among its pupils for many months. I am convinced that had the principal of the school or the parents insisted upon the other children of the infected household remaining at home, the spread in this direction would have been arrested and much suffering avoided. [Pg 797]

When a patient has recovered from diphtheria, thorough disinfection is a most important measure. Unfortunately, however, many persons consider it a hardship if articles which can not be disinfected are destroyed, and many will even use every endeavor to prevent the representatives of the Board of Health from carrying out their regulations. In this way the germ of the disease remains on the premises, and under suitable conditions again finds another victim in the household. To illustrate this, I recall an instance some years ago in which I was called in consultation to see a most malignant case of diphtheria. The little patient fortunately recovered, and the premises were thoroughly disinfected, the parents being anxious to avoid any repetition of the dreaded malady. Five months later, however, a younger child became ill, and was found to have diphtheria. In view of the vigorous efforts which had been made to disinfect the house thoroughly, and of the fact that the child could not have contracted it elsewhere, not having left its home for several weeks, the cause at first appeared a mystery. Careful inquiry, however, soon elicited a fact which clearly explained the case. The first patient had used a mouth-organ just before its illness, and when this was abandoned, the toy was carelessly thrown on the top of a bookcase, the nature of the child's illness at the time not being known. The second child, just before its illness, had accidentally found this toy and used it frequently. This experience explains the necessity of disinfection in all its details, and also illustrates the tenacious character of the germ which produces this disease.

Our knowledge of the specific cause of scarlet fever is not as complete as that of diphtheria, but we have much useful information which is of importance from a hygienic standpoint. As in diphtheria, the specific poison is probably produced in the throat of the patient, and may therefore be spread by the dried secretion from the mouth and throat. The most common means of contagion, however, is the skin, which peels off in the later stage of the disease, infection being produced by the inhalation into the nostrils of some of the diseased particles.

A predisposing factor which applies alike to diphtheria and all other throat affections is the abnormal condition of the nose and throat. When these important parts are in an unhealthy condition, where mouth breathing exists and other conditions inimical to normal health, the patient is more predisposed to all forms of maladies of this region, and the attack when developed is more apt to be of a serious character. The more ordinary forms of sore throat, such as tonsilitis, are frequently due to defects in the sanitary conditions and surroundings of the home. While modern sanitary plumbing, when properly constructed, adds much to the convenience of the household, it is a certain menace to all its members if, through improper construction or defective ventilation, decomposing matter collects in the waste pipes and vitiates the atmosphere of the rooms. Many recurrent cases of tonsilitis are due to this cause. Even the ordinary stationary washstands may be a source of danger, especially in the bedroom, unless thoroughly ventilated and care exercised that the traps are not filled with decomposing matter. A physician of large experience in this city is so imbued with the danger of this form of plumbing that he condemns it *in toto*. When well constructed and well ventilated, however, they can not be the source of danger in the household. [Pg 798]

Tuberculosis, which is responsible for so enormous a mortality, frequently also affects the throat as well as the lungs. Although it usually originates within the chest, it sometimes finds its primary origin in the throat, and in a large percentage of cases the throat affection forms a complication of tuberculosis of the lungs. In spite of the numerous remedies which have been advocated for the cure of this disease, it must be admitted that our chief reliance is in proper nourishment and climatic effects, and that hygiene is the sheet-anchor which will eventually rescue us from this terrible foe of the human race.

Recent investigations tend to prove more and more that tuberculosis is inherited in but rare cases; that inheritance is simply a predisposing factor, and that the real cause is infection. As an illustration of this, all have seen instances in which there had been apparently no cases in a family for ten or fifteen years, when from some cause one case develops, and this is soon followed by other cases in the same family. Whatever rôle heredity may play in these cases, this simply shows that the first case produced the infectious material which found a suitable soil in the other members of the family and developed a similar disease. The inheritance theory has been the source of much injury by causing members of the afflicted family to submit to the apparently inevitable instead of instituting measures for its prevention. The infectious product in tuberculosis is not the breath, as is so frequently believed by the laity, but simply the expectoration which comes from the diseased lungs or throat. When this is allowed to come in contact with clothing or other material in the room, it becomes dry and loads the atmosphere with a dust which contains the infectious bacillus, which may cause a similar disease in a person predisposed by heredity or sickness to this affection. [Pg 799]

The germ of tuberculosis is the seed, and the predisposed person the soil, and it requires a combination of both to develop the disease. To illustrate the necessity of suitable conditions for the development of plants—for it is now almost universally admitted that the germ of tuberculosis is a micro-organism which belongs to the vegetable kingdom—I remember some years ago, while in North Europe, seeing in a hothouse a plant which is here commonly known as the "four

o'clock." The gardener in charge of the conservatory considered it a remarkable plant, but difficult to propagate, and stated that it was absolutely impossible to raise it out of doors. In this part of the world, however, we know that this plant grows so easily that once established in a garden it is difficult to keep it within limits. In both of the cases we have the same seed, the difference being only in the soil and the conditions favorable for its development. The absence of either the seed or the soil will absolutely prevent tuberculosis, and if the laws of hygiene are properly carried out, both in destroying the seed and in preventing the formation of a suitable soil, favorable effects will soon be shown.

Hygiene in regard to patients demands simply that the infectious character of the expectoration be destroyed. The vessels for this purpose should contain some disinfecting solution, should be cleaned regularly, and handkerchiefs, towels, or other material with which the expectoration has come in contact should be sterilized by being placed for at least half an hour in boiling water. This is necessary not only for those in the same room with the patient, but also for the patient, as it is quite possible that a former expectoration may produce reinfection of the patient himself.

Another method of contracting tuberculosis is by means of animals, such as cows, used for food and milking, which are known to be subject to this disease. It has been shown in some localities that one cow out of every twenty-five was affected with tubercular disease. This suggests the importance of having competent veterinarians to examine not only the meat which is sold, but also the cows used for milking purposes. Where there is the slightest doubt as to the nature of the meat or milk, the former should be thoroughly cooked and the latter sterilized before using.

In this connection it would be well to refer to the subject of spitting in street cars and in public places. While this nuisance is the subject of danger to every one in the street cars, especially in winter, when the windows are closed and a large amount of impurities is inhaled, it is more particularly so to ladies, whose skirts, in spite of every care, are soiled by the filthy expectoration, thus making them subject not only to the inhalation in the car, but also to carrying [Pg 800] the infectious material to their homes.

The danger of this condition is not merely speculative. It has been bacteriologically demonstrated that the organisms of various contagious diseases thus find a lodging place in our cars and public places, and experiments on animals, in which the inoculation has developed diseases, have shown that these organisms retain their vitality in these places and may propagate disease under favorable conditions.

A factor in the spread of diseases of the throat and mouth that should not be overlooked is kissing. Unfortunately, this matter has usually been treated with much levity, and where a sanitarian is bold enough to condemn the habit he is frequently made the subject of all forms of ridicule in the public press.

The tender lining of the lips, mouth, and throat, and its large blood supply, make it peculiarly susceptible to contagion, and I have no doubt that the habit of kissing is responsible for many cases of infection. Last year I noticed a lady coming from a house from which a diphtheria flag was flying, who walked to the corner to take the street car, when a nurse with a small child approached. The lady without hesitation stooped down and kissed the little child. As it is well known that a healthy person may transmit a disease without incurring the disease himself, this lady voluntarily risked the danger of inflicting this disease upon the innocent child. It is not an uncommon thing for nurses to kiss the children under their charge, and here in New Orleans even the colored nurses sometimes practice this habit, occasionally with the permission of the parents. In fact, a fashionable lady on one occasion told me, when I remonstrated with her about this, that she feared to hurt the feelings of the old nurse, who had been a valuable servant in the family for many years.

How often this habit is productive of evil results is of course only speculation. I recall, however, an instance in which two small children of one family developed a specific disease which originated in the mouth and affected the whole system. Examination proved this to have been caused by a nurse, a white woman, who had been in the habit of kissing the children. If women will voluntarily incur risks by using kissing as a form of salutation in all stages of acquaintanceship, I would at least request that the innocent children be spared the possible consequences.

The subject of the hygiene of the ear is so intimately connected with conditions influencing the nose and throat, which have already been explained, that but few words are needed to cover this part of my subject. In general, the best care of the ear is to leave it alone. Ear scoops are injurious; the ear should be cleaned simply on the outside, and nothing, as a rule, should be inserted into the external canal. I have seen many cases of abscess and the most severe [Pg 801] inflammation due to endeavors to clean the ear with the omnipresent hairpin and other objects used for this purpose. The use of cotton in the ear in general is to be condemned. It produces an artificial condition in the outer canal of the ear which reduces its physical resistance and makes it more liable to injury from exposure. The ear is sometimes injured by the entrance of cold water. This happens occasionally during ordinary bathing, but more frequently in outdoor bathing and in swimming. In surf bathing, where the water is thrown up with considerable force, it is much more liable to enter the external orifice of the ear, and severe inflammation may originate from this cause.

Salt water has been claimed to be more injurious than fresh, but my personal experience leads me to believe that it is more a question of temperature than of the quality of the water. Some

years ago a large reservoir was built by an educational institute near this city, the water, which was quite cold even in summer, being supplied by an artesian well. The tank was used for bathing purposes, but earache soon became so frequent among the boys that the use of the reservoir for this purpose had to be entirely abandoned. In ordinary bathing, the entrance of water into the ear can easily be avoided. In swimming or surf bathing it is advisable to use a pledget of lamb's wool to close the opening of the ears. Ordinary cotton soon becomes saturated and is of no use in this connection, but the wool, which is slightly oily, forms an excellent protection in these cases.

The "running ear" is a diseased condition which should not be tampered with by the inexperienced, but which should not be neglected. The old idea that the child will outgrow it, or that it is a secretion of the head which if interfered with would prove dangerous, has been fruitful of many cases of deafness and even more serious complications.

Another condition to which I would call your attention is the incipient development of deafness in children. Where the capacity of hearing is quickly lowered from the normal to fifty per cent, it is so striking that the patient is much distressed and even confused. But when this change takes place insidiously from day to day, it is frequently not observed by either the patient or those around him until it has greatly advanced. Children thus affected hear only with difficulty and by straining certain small muscles of the ear, which soon become fatigued, and the child becomes listless and inattentive. I have seen numerous cases in which children have been severely punished for inattention, when this was due to defective hearing. Watchfulness and early attention in these cases will frequently prevent the more serious forms of deafness.

THE PHYSICAL GEOGRAPHY OF THE WEST INDIES.

[Pg 802]

By F. L. OSWALD.

I.—THE FAUNA OF THE ANTILLES: MAMMALS.

The study of the geographical distribution of plants and animals has revealed facts almost as enigmatical as the origin of life itself. Water barriers, as broad as that of the Atlantic, have not prevented the spontaneous spread of some species, while others limit their habitat to narrowly circumscribed though not geographically isolated regions.

Tapirs are found both in the Amazon Valley and on the Malay Peninsula; the brook trout of southern New Zealand are identical with those of the Austrian Alps. Oaks and *Ericacea* (heather plants) cover northern Europe from the mouth of the Seine to the sources of the Ural; then suddenly cease, and are not found anywhere in the vast Siberian territories, with a north-to-south range rivaling that of all British North America.

But still more remarkable is the zoölogical contrast of such close-neighborhood countries as Africa and Madagascar, or Central America and the West Indian archipelago. The Madagascar virgin woods harbor no lions, leopards, hyenas, or baboons, but boast not less than thirty-five species of mammals unknown to the African continent, and twenty-six found nowhere else in the world.

Of a dozen different kinds of deer, abundant in North America as well as in Asia and Europe, not a single species has found its way to the West Indies. The fine mountain meadows of Hayti have originated no antelopes, no wild sheep or wild goats.

In the Cuban sierras, towering to a height of 8,300 feet, there are no hill foxes. There are caverns —subterranean labyrinths with countless ramifications, some of them—but no cave bears or badgers, no marmots or weasels even, nor one of the numerous weasel-like creatures clambering about the rock clefts of Mexico. The magnificent coast forests of the Antilles produce wild-growing nuts enough to freight a thousand schooners every year, but—almost incredible to say—the explorers of sixteen generations have failed to discover a single species of squirrels.

The Old-World tribes of our tree-climbing relatives are so totally different from those of the American tropics that Humboldt's traveling companion, Bonplant, renounced the theory of a unitary center of creation (or evolution), and maintained that South America must have made a separate though unsuccessful attempt to rise from lemurs to manlike apes and men. Of such as they are, Brazil alone has forty-eight species of monkeys, and Venezuela at least thirty. How shall [Pg 803] we account for the fact that not one of the large West Indian islands betrays a vestige of an effort in the same direction?

More monkey-inviting forests than those of southern Hayti can not be found in the tropics, but not even a marmoset or squirrel-monkey accepted the invitation. In an infinite series of centuries not one pair of quadrumana availed itself of the chance to cross a sea gap, though at several points the mainland approaches western Cuba within less than two hundred miles—about half the distance that separates southern Asia from Borneo, where fourhanders of all sizes and colors compete for the products of the wilderness, and, according to Sir Philip Maitland, the "native women avoid the coast jungles for fear of meeting Mr. Darwin's grandfather."

The first Spanish explorers of the Antilles were, in fact, so amazed at the apparently complete absence of quadrupeds that their only explanation was a conjecture that the beasts of the forest

must have been exterminated by order of some native potentate, perhaps the great Kubla Khan, whose possessions they supposed to extend *eastward* from Lake Aral to the Atlantic. The chronicle of Diego Columbus says positively that San Domingo and San Juan Bautista (Porto Rico) were void of mammals, but afterward modifies that statement by mentioning a species of rodent, the *hutia*, or bush rat, that annoyed the colonists of Fort Isabel, and caused them to make an appropriation for importing a cargo of cats.

Bush rats and moles were, up to the end of the sixteenth century, the only known indigenous quadrupeds of the entire West Indian archipelago, for the "Carib dogs," which Valverde saw in Jamaica, were believed to have been brought from the mainland by a horde of man-hunting savages.

But natural history has kept step with the advance of other sciences, and the list of undoubtedly aboriginal mammals on the four main islands of the Antilles is now known to comprise more than twenty species. That at least fifteen of them escaped the attention of the Spanish creoles is as strange as the fact that the Castilian cattle barons of Upper California did not suspect the existence of precious metals, though nearly the whole bonanza region of the San Joaquin Valley had been settled before the beginning of the seventeenth century. But the conquerors of the Philippines even overlooked a variety of elephants that roams the coast jungles of Mindanao.

Eight species of those West Indian *incognito* mammals, it is true, are creatures of a kind which the Spanish zoölogists of Valverde's time would probably have classed with birds—bats, namely, including the curious *Vespertilio molossus*, or mastiff bat, and several varieties of the owl-faced *Chilonycteris*, that takes wing in the gloom preceding a thunderstorm, as well as in the morning and evening twilight, and flits up and down the coast rivers with screams that can be heard as [Pg 804] plainly as the screech of a paroquet. The *Vespertilio scandens* of eastern San Domingo has a peculiar habit of flitting from tree to tree, and clambering about in quest of insects, almost with the agility of a flying squirrel. There are times when the moonlit woods near Cape Rafael seem to be all alive with the restless little creatures; that keep up a clicking chirp, and every now and then gather in swarms to contest a tempting find, or to settle some probate court litigation. San Domingo also harbors one species of those prototypes of the harpies, the fruit-eating bats. It passes the daylight hours in hollow trees, but becomes nervous toward sunset and apt to betray its hiding place by an impatient twitter—probably a collocution of angry comments on the length of time between meals. The moment the twilight deepens into gloom the chatterers flop out to fall on the next mango orchard and eat away like mortgage brokers. They do not get fat—champion gluttons rarely do—but attain a weight of six ounces, and the Haytian darkey would get even with them after a manner of their own if their prerogatives were not protected by the intensity of their musky odor. The above-mentioned *hutia* rat appears to have immigrated from some part of the world where the shortness of the summer justified the accumulation of large reserve stores of food, and under the influence of a hereditary hoarding instinct it now passes its existence constructing and filling a series of subterranean granaries. Besides, the females build nurseries, and all these burrows are connected by tunnels that enable their constructors to pass the rainy season under shelter. They gather nuts, *belotas* (a sort of sweet acorns), and all kinds of cereals, and with their *penchant* for appropriating roundish wooden objects on general principles would probably give a Connecticut nutmeg peddler the benefit of the doubt.

They also pilfer raisins, and a colony of such tithe collectors is a formidable nuisance, for the *hutia* is a giant of its tribe, and attains a length of sixteen inches, exclusive of the tail. It is found in Cuba, Hayti, Jamaica, Porto Rico, Antigua, Trinidad, the Isle of Pines, Martinique, and two or three of the southern Bahama Islands, and there may have been a time when it had the archipelago all to itself. The Lucayans had a tradition that their ancestors found it on their arrival from the mainland, and in some coast regions of eastern Cuba it may still be seen basking in the sunlight—

> "Sole sitting on the shore of old romance,"

and wondering if there are any larger mammals on this planet.

Its next West Indian congener is the Jamaica rice rat, and there are at least ten species of mice, all clearly distinct from any Old-World rodent, though it is barely possible that some of them may [Pg 805] have stolen a ride on Spanish trading vessels from Central America.

Water-moles burrow in the banks of several Cuban rivers, and two genera of aquatic mammals have solved the problem of survival: the bayou porpoise and the manatee, both known to the creoles of the early colonial era, and vaguely even to the first discoverers, since Columbus himself alludes to a "sort of mermaids (*sirenas*) that half rose from the water and scanned the boat's crew with curious eyes."

Naturally the manatee is, indeed, by no means a timid creature, but bitter experience has changed its habits since the time when the down-town sportsmen of Santiago used to start in sailboats for the outer estuary and return before night with a week's supply of manatee meat. The best remaining hunting grounds are the reed shallows of Samana Bay (San Domingo) and the deltas of the Hayti swamp rivers. Old specimens are generally as wary as the Prybilof fur seal that dive out of sight at the first glimpse of a sail; still, their slit-eyed youngsters are taken alive often enough, to be kept as public pets in many town ponds, where they learn to come to a whistle and waddle ashore for a handful of cabbage leaves.

Fish otters have been caught in the lagoons of Puerto Principe (central Cuba) and near Cape

Tiburon, on the south coast of San Domingo, the traveler Gerstaecker saw a kind of "bushy-tailed dormouse, too small to be called a squirrel."

But the last four hundred years have enlarged the list of indigenous mammals in more than one sense, and the Chevalier de Saint-Méry should not have been criticised for describing the bush dog of Hayti as a "*canis Hispaniolanus*." Imported dogs enacted a declaration of independence several centuries before the revolt of the Haytian slaves, and their descendants have become as thoroughly West Indian as the Franks have become French. A continued process of elimination has made the survivors climate-proof and self-supporting, and above all they have ceased to vary; Nature has accepted their modified type as wholly adapted to the exigencies of their present habitat. And if it is true that all runaway animals revert in some degree to the characteristics of their primeval relatives, the ancestor of the domestic dog would appear to have been a bush-tailed, brindle-skinned, and black-muzzled brute, intermittently gregarious, and combining the burrowing propensity of the fox with the co-operative hunting *penchant* of the wolf.

Fourteen years of bushwhacker warfare have almost wholly exterminated the half-wild cattle of the Cuban sierras, but the bush dog has come to stay. The yelping of its whelps can be heard in thousands of jungle woods and mountain ravines, both of Cuba and Hayti, and no variety of thoroughbreds will venture to follow these renegades into the penetralia of their strongholds. [Pg 806] Sergeant Esterman, who shared the potluck of a Cuban insurgent camp in the capacity of a gunsmith, estimates the wild-dog population of the province of Santiago alone at half a million, and predicts that in years to come their raids will almost preclude the possibility of profitable cattle-breeding in eastern Cuba.

Still, the *perro pelon*, or "tramp dog," as the creoles call the wolfish cur, is perhaps a lesser evil, where its activity has tended to check the over-increase of another assisted immigrant. Three hundred years ago West Indian sportsmen began to import several breeds of Spanish rabbits, and with results not always foreseen by the agricultural neighbors of the experimenters. Rabbit meat, at first a luxury, soon became an incumbrance of the provision markets, and finally unsalable at any price. Every family with a dog or a trap-setting boy could have rabbit stew for dinner six times a week, and load their peddlers with bundles of rabbit skins.

The burrowing coneys threatened to undermine the agricultural basis of support, when it was learned that the planters of the Fort Isabel district (Hayti) had checked the evil by forcing their dogs to live on raw coney meat. The inexpensiveness of the expedient recommended its general adoption, and the rapidly multiplying quadrupeds soon found that "there were others." The Spanish hounds, too, could astonish the census reporter where their progeny was permitted to survive, and truck farmers ceased to complain.

In stress of circumstances the persecuted rodents then took refuge in the highlands, where they can still be seen scampering about the grassy dells in all directions, and the curs of the coast plain turned their attention to *hutia* venison and the eggs of the chaparral pheasant and other gallinaceous birds. On the seacoast they also have learned to catch turtles and subdivide them, regardless of antivivisection laws. How they can get a business opening through the armor of the larger varieties seems a puzzle, but the *canis rutilus* of the Sunda Islands overcomes even the dog-resisting ability of the giant tortoise, and in Sumatra the bleaching skeletons of the victims have often been mistaken for the mementos of a savage battle.

Near Bocanso in southeastern Cuba the woods are alive with capuchin monkeys, that seem to have escaped from the wreck of some South American trading vessel and found the climate so congenial that they proceeded to make themselves at home, like the ring-tailed colonists of Fort Sable, in the Florida Everglades. The food supply may not be quite as abundant as in the equatorial birthland of their species, but that disadvantage is probably more than offset by the absence of tree-climbing carnivora.

Millions of runaway hogs roam the coast swamps of all the larger Antilles, and continue to [Pg 807] multiply like our American pension claimants. The hunters of those jungle woods, indeed, must often smile to remember the complaint of the early settlers that the pleasure of the chase in the West Indian wilderness was modified by the scarcity of four-footed game, and in the total number (as distinct from the number of species) of wild or half-wild mammals Cuba and Hayti have begun to rival the island of Java.

[*To be continued.*]

IRON IN THE LIVING BODY.

By M. A. DASTRE.

Iron occurs, in small and almost infinitesimal proportions, in numerous organic structures, in which its presence may usually be detected by the high color it imparts; and in the animal tissues is an important ingredient, though far from being a large one. It is essential, however, that the animal tissues, and particularly the liquids that circulate through them, should be of nearly even weight, else the equilibrium of the body would be too easily disturbed, and disaster arising therefrom would be always imminent. Hence the iron is always found combined and associated with a large accompaniment of other lighter elements which, reducing or neutralizing its superior

specific gravity, hold it up and keep it afloat. Thus the molecule of the red matter of the blood contains, for each atom of iron, 712 atoms of carbon, 1,130 of hydrogen, 214 of nitrogen, 245 of oxygen, and 2 of sulphur, or 2,303 atoms in all. Existing in compounds of so complex composition, iron can be present only in very small proportions to the whole. Though an essential element, there is comparatively but little of it. The whole body of man does not contain more than one part in twenty thousand of it. The blood contains only five ten-thousandths; and an organ is rich in it if, like the liver, it contains one and a half ten-thousandths. When, then, we seek to represent to ourselves the changes undergone by organic iron, we shall have to modify materially the ideas we have formed respecting the largeness and the littleness of units of measure and as to the meaning of the words abundant and rare. We must get rid of the notion that a thousandth or even a ten-thousandth is a proportion that may be neglected. The humble ten-thousandth, which is usually supposed not to be of much consequence, becomes here a matter of value. Chemists working with iron in its ordinary compounds may consider that they are doing fairly well if they do not lose sight of more than a thousandth of it; but such looseness would be fatal in a biological investigation, where accuracy is necessary down to the infinitesimal fraction. The [Pg 808] balances of the biologists must weigh the thousandth of a milligramme, as their microscopes measure the thousandth of a millimetre.

The great part performed by iron in organisms, what we may call its biological function, appertains to the chemical property it possesses of favoring combustion, of being an agent for promoting the oxidation of organic matters.

The chemistry of living bodies differs from that of the laboratory in a feature that is peculiar to it —that instead of performing its reactions directly it uses special agents. It employs intermediaries which, while they are not entirely unknown to mineral chemistry, yet rarely intervene in it. If it is desired, for example, to add a molecule of water to starch to form sugar, the chemist would do it by heating the starch with acidulated water. The organism, which is performing this process all the time, or after every meal, does it in a different way, without special heating and without the acid. A soluble ferment, a diastase or enzyme, serves as the oxidizing agent to produce the same result. Looking at the beginning and the end, the two operations are the same. The special agent gives up none of its substance. It withdraws after having accomplished its work, and not a trace of it is left. Here, in the mechanism of the action of these soluble ferments, resides the mystery, still complete, of vital chemistry. It may be conceived that these agents, which leave none of their substance behind their operations, which suffer no loss, do not have to be represented in considerable quantities, however great the need of them may be. They only require time to do their work. The most remarkable characteristic of the soluble ferments lies, in fact, here, in the magnitude of the action as contrasted with infinitesimal proportion of the agent, and the necessity of having time for the accomplishment of the operation.

Iron behaves in precisely the same way in the combustion of organic substances. These substances are incapable at ordinary temperatures of fixing oxygen directly, and will not burn till they are raised to a high temperature; but in the presence of iron they are capable of burning without extreme heat, and undergo slow combustion. And as iron gives up none of its substance in the operation, and acts, as a simple intermediary, only to draw oxygen from the inexhaustible atmosphere and present it to the organic substance, we see that it need not be abundant to perform its office, provided it have time enough. This action resembles that of the soluble ferments in that there is no mystery about it, and its innermost mechanism is perfectly known.

Iron readily combines with oxygen—too readily, we might say, if we regarded only the uses we [Pg 809] make of it. It exists as an oxide in Nature; and the metallurgy of it has no other object than to revivify burned iron, remove the oxygen from it, and extract the metal. Of the two oxides of iron, the ferrous, or lower one, is an energetic base, readily combining with even the weakest acids, and forming with them ferrous or protosalts. Ferric oxide, on the other hand, is a feeble base, which combines only slowly with even strong acids to form ferric salts or persalts, and not at all with weak acids like carbonic acid and those of the tissues of living beings. It is these last, more highly oxidized ferric compounds that provide organic substances with the oxygen that consumes them, when, as a result of the operation, they themselves return to the ferrous state.

Facts of this sort are too nearly universal not to have been observed very long ago, but they were not fully understood till about the middle of this century. The chemists of the time—Liebig, Dumas, and especially Schönbein, Wöhler, Stenhouse, and many others—established the fact that ferric oxide provokes at ordinary temperatures a rapid action of combustion on a large number of substances: grass, sawdust, peat, charcoal, humus, arable land, and animal matter. A very common example is the destruction of linen by rust spots; the substance of the fiber is slowly burned up by the oxygen yielded by the oxide. About the same time, Claude Bernard inquired whether the process took place within the tissues, in contact with living matter in the same way as we have just seen it did with dead matter—the remains of organisms that had long since submitted to the action of physical laws—and received an affirmative answer. Injecting a ferric salt into the jugular vein of an animal, he found it excreted, deprived of a part of its oxygen, as a ferrous salt.

This slow combustion of organic matter, living or dead, accomplished in the cold by iron, represents only one of the aspects of its biological function. A counterpart to it is necessary in order to complete the picture. It is easy to perceive that the phenomenon would have no bearing or consequence if it was limited to this first action. With the small provision of oxygen in the iron salt used up, and, if reduced to the minimum of oxidation, the source of oxygen being exhausted,

the combustion of organic matter would stop. The oxidation obtained would be insignificant, while the oxidation should be indefinite and unlimited, and it is really so.

There is a counterpart. The iron salt, which has gone back to the minimum of oxidation and become a ferrous salt, can not remain long in that state in contact with the air and with other sources of the gas to which it is exposed. It has always been known that ferrous compounds absorb oxygen from the air and pass into the ferric state; we might say that we have seen it done, for the transformation is accompanied by a characteristic change of color, by a transition from [Pg 810] the pale green tint of ferrous bases to the ochery or red color of ferric compounds.

We can understand now what should happen when the ferruginous compound is placed in contact alternately with organic matter and oxygen. In the former phase the iron will yield oxygen to the organic matter; in the second phase it will take again from the atmosphere the combustible which it has lost, and will be again where it started. The same series of operations may be continued a second time and a third time, and indefinitely, as long as the alternations of contact with organic matter and exposure to atmospheric oxygen are kept up, the iron simply performing the part of a broker. The same result will occur if atmospheric air and organic matter are constantly together; the consumption will continue indefinitely, and the iron will perform the part of an intermediary till one of the elements of the process is exhausted.

This explanation was necessary to make clear the solution of the mystery of slow or cool combustion, the existence of which has been known since Lavoisier, without its mechanism being understood. That illustrious student gave out the theory that animal heat and the energy developed by vital action originated in the chemical reactions of the organism, and that, on the other hand, the reactions that produce heat consisted of simple combustions, slow combustions, that differed only in intensity from that of the burning torch. The development of chemistry has shown that this figure was too much simplified from the reality, and that most of these phenomena, while they are in the end equivalent to a combustion, differ greatly from it in mechanism and mode of execution. By this we do not mean to say that all the combustions are of this character, and that there do not exist in the organism a large number of such as Lavoisier understood, and of such as the combustions effected by the intervention of iron furnish the type of. Lavoisier's successors, Liebig among them, tried to find reactions conformed to this type. Their attempts were unsuccessful, but they had the happy result of revealing, if not the real function of iron in the blood, at least that of the red matter in which it is fixed.

The question of the presence of iron in the coloring matter of the blood gave rise to long discussions. Vauquelin denied it. He made the mistake of looking for iron in the form of a known compound, in direct combination with the blood, while later researches have shown that it is found almost exclusively in the red matter that tinges the globules, in a complicated combination that escapes the ordinary tests; or, according to a usual method of expression, it is dissimulated. Liebig also failed to find this combination, and it was not till 1864 that Hoppe-Seyler succeeded [Pg 811] in obtaining it pure and crystallized. But Liebig had already perceived its essential properties, and was able to point out approximately its functions as early as 1845; yet the single fact that there was no assimilation possible between this substance and the salts of iron, cut this question off into a kind of negative suspense. Different from these compounds, it could not behave like them, and accomplish slow combustions of the same type. It is a remarkable fact, and one that illustrates well how iron preserves through all its vicissitudes some trace of its fundamental property of favoring the action of oxygen on substances, that this composition, so special and so different from the salts of iron, behaves nearly as they do. While it is not of itself an energetic combustible, it is, according to Liebig's expression, "a transporter of oxygen"—a luminous view, which the future was destined to confirm. Although the transportation is not produced by the mechanism supposed by Liebig, but by another, the general result is very much the same from the point of view of the physiology of the blood. The coloring matter of the blood conveyed by the globules fixes oxygen in contact with the pulmonary air, and distributes it as it passes through the capillaries upon the tissues. The globule of blood brings nothing else and distributes nothing else, contrary to the opinion that had been held before. The theory of slow combustion effected through iron, while not absolutely contradicted in principle, was not entirely confirmed in detail, so far as concerned iron, or the more prominently ferruginous tissue.

No search was made for other tissues or organs presenting more favorable conditions, for no others were known that had iron in themselves. The liver and the spleen were supposed to receive it from the blood under the complicated form in which it exists there, or under some equivalent form. It was not, therefore, supposed till within a very few years that the two conditions were realized in any organ that were required to secure a slow combustion by iron—that is, combinations resembling ferrous and ferric salts with a weak acid and a source of oxygen. The doubt has been resolved by recent studies. The liver fulfils the requirement. It contains iron existing under forms precisely comparable to the ferrous and ferric compounds, and is washed by the blood which carries oxygen in a state of simple solution in its plasma and of loose combination in its globules. Thus all the conditions necessary for the production of slow combustion are gathered here, and we can not doubt that it takes place. A new function is therefore assigned to the liver, and it becomes one of the great furnaces of the organism.

Compounds of iron are so abundant in the ground and the water that we need not be surprised when we find them in various parts of plants, and particularly in the green parts. Their habitual [Pg 812] presence does not, however, authorize the conclusion that this metal is necessary to the support and development of vegetable life. Some substances, evidently indifferent, foreign, and even injurious, if they exist abundantly in a soil, may be drawn into roots through the movement of the

sap, and fix themselves in various organs. This occurs with copper in certain exceptional circumstances when the soil is saturated with its compounds, and if such a condition should be found to be repeated over a large extent of country, we might be led, by analysis alone of its vegetable productions, to the false conclusion that copper was an essential or even necessary constituent of them. But the value of the part performed by an element can not be determined by analysis alone. Direct proofs are necessary for that, methodical and comparative experiments in cultivation in mediums artificially deprived or furnished with the element the importance of which we wish to estimate. This has been done for combinations of iron, and the utility of that metal, especially to the higher plants, has been made thereby to appear.

If iron is absent from the nutritive medium the plant will wither. If we sprout seeds in a solution from which this metal has been carefully excluded, the development will follow its regular course as long as the plant is in the condition properly called that of germination, or while it does not have to draw anything from the soil. The stem rises and the first leaves are formed as usual. But all these parts will continue pale, and the green matter, the granulation of chlorophyll, will not appear. Now, if we add a small quantity of salt of iron to the ground in which the roots are planted, or a much-diluted solution is sprinkled on the leaves and the stem, the chlorotic plant will recover its health and take on its normal coloration. Experiments of this sort make well manifest that iron is necessary to green plants, and they show, besides, the bearing of its action, and that what is most special and most characteristic in the phenomena of vegetable life may be traced exactly to the organization of that green matter. It was long thought that if iron was necessary for the formation of chlorophyll, it was because it had a part in its constitution. We know now that this is not so. The metal does nothing but accompany the chlorophyll in the granulation in which it is found.

The influence which iron exerts in the development of the lower plants, like the muscidenes, was illustrated with great precision in a study made about thirty years ago by M. Raulin, who experimented with the common mold (*Aspergillus niger*), to determine the coefficient of importance of all the elements that have a part in its vegetation. When the iron was removed from a medium that had been shown capable of giving a maximum crop of that mold, the plants [Pg 813] languished, and the return fell off immediately to one third. Estimating the quantity of metal that produces this effect, it was found that the addition of one part of iron was sufficient to determine the production of a weight of plant nearly nine hundred times as great. The suppression of the iron further caused an irreparable loss, for when it was sought to remedy the wilting of the plants by restoring the iron which had been taken from the medium—an experiment which had been successful with higher plants—the attempt was a failure, and the plants could not be prevented from perishing.

These facts are full of interest in themselves, and they further show well the necessity or utility of iron in plant life, but they teach us no more. They reveal nothing of the mechanism of the action, and if we wish to penetrate further in the matter we always have to turn to animal physiology. —*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

THE MALAY LANGUAGE.

By R. CLYDE FORD,

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A gentleman who had lived for several years among the Indians of the Canadian northwest said that he went among them believing they were an untutored race. But when they told him of a dozen kinds of berries growing in a locality where he knew but two, brought him flowers he could not find after careful search, and around their council fires showed as deep an insight into the mysteries of life as the *savants* of his university, then he concluded they could no longer be called untutored.

And why should they be? Is there no culture or civilization outside of the enlightenment of Europe or America? And because a civilization does not exactly fit the grooves in which most of the world has moved, may it not be a real civilization for all that? If such is possible, then we vote the Malays a cultured people. Of course, their culture is not like our own; it knows no railroads, no telegraphs, boasts of no intricate political machinery, has no complicated social despotisms. Native princes rule for the most part over peaceful states, and politics means no more than the regulation of quiet village life. But what need of railroads, when the rivers are avenues of trade and communication? Why telegraphs, when the world is bounded by the jungle horizon? Or why, in short, severe civil and social enactments, when the common *Wahlspruch* of life is, "Fear disgrace rather than death"? Such a civilization, we admit, is a humble one; but it also has the [Pg 814] advantage of being a happy one. And where contentment dwells, where honesty prevails, where the home is a stronghold, there are culture and civilization, even though they may not coincide with our own.

The Malays are not barbarians, and their language by its grace and adaptability has shown its right to be. To-day it is the mother tongue of more than forty millions of people, and the *lingua franca* of Chinamen, Hindus, European, and natives. It is spoken from Madagascar to the distant islands of the Pacific, and from the Philippines to Australia. With it one can barter in Celebes and

sell in Java; converse with a sultan in Sumatra or a Spaniard in Manila. Moreover, it is soft and melodious, rich in expression, poetical in idiom, and simple in structure—a language almost without grammar and yet of immense vocabulary, with subtle distinctions and fine gradations of thought and meaning; a language that sounds in one's ears long after *Tanah Malayu* and the coral islands and the jungle strand have sunk into hazy recollection, just as they once dropped out of sight behind one's departing ship.

Malay is written in the Arabic character, which was adopted with Mohammedanism, probably in the thirteenth century. Anciently, the Malays used a writing of their own, but it is not yet clearly settled what it was. There are now thirty-four characters employed, each varying in form, according as it is isolated, final, medial, or initial. Naturally, the Arabic influence over the language has been a marked one; the priest who dictates in the religion of a people is a molder and shaper of language. We have only to recall the Catholic Church and the influence of the Latin tongue in the mouths of her priests to know that this is so. Many Arabic words and phrases have been adopted, but more in the language of literature than in that of everyday speech. A large number of expressions of court and royalty, and terms of law and religion, are Arabic; also the names of months, days, and many articles of commerce and trade; nevertheless, the language of common speech is still Malay.

Another influence, also, has been felt in the Malay—that of the Sanskrit language. The presence of many Sanskrit words has caused some very ingenious theories to be constructed in proof that the Malays were of Indian origin, and such word fragments the survival of the primitive tongue. Such theories, however, have not stood the test of philology, and the fact still remains that the language is essentially unique, with an origin lost in the darkness of remote antiquity. However, Sanskrit influence has been much greater, and has penetrated much deeper into the elemental structure of the language than the Arabic. In fact, the aboriginal language, before it felt the animating spirit of the Aryan tongue, must have been a barren one, the language of a primitive [Pg 815] man, a fisherman, a hunter, a careless tiller of the soil. As Maxwell says in his Manual of the Malay Language, the Sanskrit word *hala* (plow) marks a revolution in Malayan agriculture and, one may say further, Malayan civilization. What changed the methods of cultivating the soil, changed the people themselves. It is probable that this change came through contact with people to whom Sanskrit was a vernacular tongue, but whether through conquest by the sword or by religion is hard to tell. Perhaps it was by both. At any rate, it was deep and strong, and left a lasting impression on the language. Sanskrit names fastened on trees, plants, grain, fruits, household and agricultural implements, parts of the body, articles of commerce, animals, metals and minerals, time and its division and measurement, family relationships, abstract conceptions, warfare, and fundamental ideas of religion and superstition. Such a conquest must have been an early and tremendous one.

Strangely enough, Malay is almost a grammarless tongue. It has no proper article, and its substantives may serve equally well as verbs, being singular or plural, and entirely genderless. However, adjectives and a process of reduplication often indicate number, and gender words are added to nouns to make sex allusions plain. Whatever there is of declension is prepositional as in English, and possessives are formed by putting the adjectives after the noun as in Italian. Nouns are primitive and derivative, the derivations being formed by suffixes or prefixes, or both, and one's mastery of the language may be gauged by the idiomatic way in which he handles these *Anhängsel*. Adjectives are uninflected.

The use of the pronouns involves an extensive knowledge of Oriental etiquette—some being used by the natives among one another, some between Europeans and natives, some employed when an inferior addresses a superior and *vice versa*, some used only when the native addresses his prince or sovereign; and, last of all, some being distinctly literary, and never employed colloquially. Into this maze one must go undaunted, and trust to time and patience to smooth out difficulties.

Verbs, like nouns, are primitive and derivative, with some few auxiliaries and a good many particles which are suffixed or prefixed to indicate various states and conditions. These things are apt to be confusing, and when the student learns that a verb may be past, present, or future without any change in form, he does not know whether to congratulate himself or not. Prepositions, too, are many and expressive; conjunctions, some colloquial, some pedantic.

We now come to a peculiarity which Malay has in common with other Indo-Chinese languages—the "numeral co-efficients," as Maxwell calls them, which are always employed with a certain class of objects, just as we say "head" of horses, "sail" of ships, etc. They are very many as [Pg 816] compared with English, and very idiomatic in their use. For instance, the Malay says, "Europeans, three *persons*," "cats, four *tails*," "ships, five *fruits*," "cocoanuts, three *seeds*," "spears, two *stems*," "planks, five *pieces*," "houses, two *ladders*," and so on to fifteen or twenty different classes of articles or objects. By some this has been regarded as a peculiarity of the languages of southeastern Asia; but the same thing may be noticed in the Indian languages of our own continent.

As a language Malay is easily learned and has much to repay for so doing. It is full of wonders and surprises—among other things is the natural home of euphemism, where a spade is called anything but a spade. For instance, to die is beautifully expressed in Malay as a return to the mercy of Allah. The language is decidedly rich in poetical expression and imagery. A neighbor is one whom you permit to ascend the ladder of your cottage, and your friend is a sharer of your joys and sorrows. Interest is the flower of money, a spring is an eye of water, the sun the eye of

day, and a policeman all eyes. A walk is a stroll to eat the wind, a man drunk is one who rides a green horse, and a coward a duck without spurs. A flatterer is one who has sugar cane on his lips, a sharper is a man of brains, a fool a brain-lacker.

In his proverbs also the Malay shows a matchless use of metaphor and imagery, his words having the softness of the jungle breeze, and at the same time the grimness of the jungle shades. Nowhere does the nature of his race or the peculiar genius of his language show out better than in these terse, pithy sayings which the Malay uses to sweeten his speech or lend effectiveness to it. The real Malay is a creature of the forest or the sea, whence he draws his livelihood, and it is but natural that he should envelop his daily and perhaps dangerous life with homely philosophy. He loves the freedom which he enjoys; take him away from it and he eats his heart out in homesickness. "Though you feed a jungle fowl from a golden plate, it will return to the jungle again." In his humble life he has discovered that blood, be it good or bad, counts for something, and he thinks of the forest lairs; "a kitten and small, but a tiger's cub." He is beset with dangers by sea and land; often he is between the devil and the deep. "One may escape the tiger, and fall into the jaws of the crocodile." He recognizes the inevitable, and draws what consolation he can. "When the prow is wrecked the shark gets his fill"—a very stoical recognition of ill winds. "For fear of the ghost he hugs the corpse," is often the solution of his dilemma. Sometimes he indulges in drollery, but is never unphilosophical. "To love one's children, one must weep for them now and then; to love one's wife, one must leave her now and then." The language is full of such [Pg 817] expressions; they are the natural products of the speech of a poetical and Nature-loving folk. Without attempting a classification we give a few of the most characteristic proverbs, drawing largely on a collection made in the Malay Peninsula by W. E. Maxwell, at one time British resident there:

Will the crocodile respect the carcass?
Follow your heart, death; follow your feelings, destruction.
You find grasshoppers where you find a field.
Earth does not become grain.
Don't grind pepper for a bird on the wing.
The flower comes, age comes.
When the father is spotted, the son is spotted.
The plant sprouts before it climbs.
When he can't wring the ear, he pulls the horn.
The creel says the basket is poorly made.
Ask from one who has,
Make vows at a shrine,
Sulk with him who loves you.
When the house is done the chisel finds fault.
As the crow goes back to his nest (no richer, no poorer).
Whoever eats chilies burns his mouth.
Because of the mouth the body comes to harm.
If you are at the river's mouth at nightfall, what's the use of talking of return?
A broken thread may be mended, but charcoal never.
The pea forgets its pod.
As water rolls from a *kladi* leaf.
A shipwrecked vessel may float again, a heart once broken is broken forever.
It is a project, and the result with God.
He carries a torch in daylight.
A slave who does well is never praised; if he does badly, never forgiven.
It rains gold afar, but stone at home.
What if you sit on a cushion of gold with an uneasy mind!
When money leaves, your friend goes.
If you dip your hand into the fish tub, go to the bottom.
Whoever digs a hole falls into it himself.
If your legs are long, have your blanket long.
Like a frog under a cocoanut shell, he thinks he sees the sky.
If you can't get rattan, bind with roots.
The plantain does not bear twice.
He sits like a cat, but leaps like a tiger. [Pg 818]
The tortoise lays a thousand eggs and tells no one; the hen lays a single egg and tells all the world.
Those will die of thirst who empty the jar when it thunders in a dry time.
Handsome as a princess, poisonous as a snake.
Small as an ant, wise as a mouse-deer.

LIFE ON A SOUTH SEA WHALER.[13]

By FRANK T. BULLEN.

Cachalots, or sperm whales, must have been captured on the coasts of Europe in a desultory way from a very early date, by the incidental allusions to the prime products spermaceti and

ambergris which are found in so many ancient writers. Shakespeare's reference—"The sovereign'st thing on earth was parmaceti for an inward bruise"—will be familiar to most people, as well as Milton's mention of the delicacies at Satan's feast—"Grisamber steamed"—not to carry quotation any further.

But in the year 1690 the brave and hardy fishermen of the northeast coasts of North America established that systematic pursuit of the cachalot which has thriven so wonderfully ever since, although it must be confessed that the last few years have witnessed a serious decline in this great branch of trade.

For many years the American colonists completely engrossed this branch of the whale fishery, contentedly leaving to Great Britain and the continental nations the monopoly of the northern or arctic fisheries, while they cruised the stormy, if milder, seas around their own shores.

As, however, the number of ships engaged increased, it was inevitable that the known grounds should become exhausted, and in 1788, Messrs. Enderby's ship, the Emilia, first ventured round Cape Horn, as the pioneer of a greater trade than ever. The way once pointed out, other ships were not slow to follow, until, in 1819, the British whale ship Syren opened up the till then unexplored tract of ocean in the western part of the North Pacific, afterward familiarly known as the "Coast of Japan." From these teeming waters alone, for many years an average annual catch of forty thousand barrels of oil was taken, which, at the average price of £8 per barrel, will give some idea of the value of the trade generally.

From the crushing blow of the civil war the American sperm-whale fishery has never fully recovered. When the writer was in the trade, some twenty-two years ago, it was credited with a fleet of between three and four hundred sail; now it may be doubted whether the numbers reach an eighth of that amount. A rigid conservatism of method hinders any revival of the industry, which is practically conducted to-day as it was fifty or even a hundred years ago; and it is probable that another decade will witness the final extinction of what was once one of the most important maritime industries in the world. [Pg 819]

In the following pages an attempt has been made—it is believed for the first time—to give an account of the cruise of a South Sea whaler from the seaman's standpoint. Its aim is to present to the general reader a simple account of the methods employed and the dangers met with in a calling about which the great mass of the public knows absolutely nothing.

At the age of eighteen, after a sea experience of six years from the time when I dodged about London streets, a ragged Arab, with wits sharpened by the constant fight for food, I found myself roaming the streets of New Bedford, Massachusetts.

My money was all gone, I was hungry for a ship; and so, when a long, keen-looking man with a goatlike beard, and mouth stained with dry tobacco juice, hailed me one afternoon at the street corner, I answered very promptly, scenting a berth. "Lookin' fer a ship, stranger?" said he. "Yes; do you want a hand?" said I anxiously. He made a funny little sound something like a pony's whinny, then answered: "Wall, I should surmise that I want between fifty and sixty hands, ef yew kin lay me onto 'em; but, kem along, every dreep's a drop, an' yew seem likely enough." With that he turned and led the way until we reached a building, around which was gathered one of the most nondescript crowds I had ever seen. There certainly did not appear to be a sailor among them—not so much by their rig, though that is not a great deal to go by, but by their actions and speech. However, I signed and passed on, engaged to go I knew not where, in some ship I did not know even the name of, in which I was to receive I did not know how much or how little for my labor, nor how long I was going to be away.

From the time we signed the articles, we were never left to ourselves. Truculent-looking men accompanied us to our several boarding houses, paid our debts for us, finally bringing us by boat to a ship lying out in the bay. As we passed under her stern, I read the name Cachalot, of New Bedford; but as soon as we ranged alongside, I realized that I was booked for the sailor's horror—a cruise in a whaler. Badly as I wanted to get to sea, I had not bargained for this, and would have run some risks to get ashore again; but they took no chances, so we were all soon aboard. Before going forward, I took a comprehensive glance around, and saw that I was on board of a vessel belonging to a type which has almost disappeared off the face of the waters. A more perfect contrast to the trim-built English clipper ships that I had been accustomed to I could hardly imagine. She was one of a class characterized by sailors as "built by the mile, and cut off in lengths as you want 'em," bow and stern almost alike, masts standing straight as broomsticks, and bowsprit soaring upward at an angle of about forty-five degrees. She was as old-fashioned in her rig as in her hull. Right in the center of the deck, occupying a space of about ten feet by eight, was a square erection of brickwork, upon which my wondering gaze rested longest, for I had not the slightest idea what it could be. But I was rudely roused from my meditations by the harsh voice of one of the officers, who shouted, "Naow then, git below an' stow yer dunnage, 'n look lively up agin!" Tumbling down the steep ladder, I entered the gloomy den which was to be for so long my home, finding it fairly packed with my shipmates. The whole space was undivided by partition, but I saw at once that black men and white had separated themselves, the blacks taking the port side and the whites the starboard. Finding a vacant bunk by the dim glimmer of the ancient teapot lamp that hung amidships, giving out as much smoke as light, I hurriedly shifted my coat for a "jumper" or blouse, put on an old cap, and climbed into the fresh air again. [Pg 820]

Even *my* seasoned head was feeling bad with the villainous reek of the place. I had hardly reached the deck when I was confronted by a negro, the biggest I ever saw in my life. He looked me up and down for a moment, then opening his ebony features in a wide smile, he said: "Great snakes! why, here's a sailor man for sure! Guess thet's so, ain't it, Johnny?" I said "yes" very curtly, for I hardly liked his patronizing air; but he snapped me up short with "yes, *sir*, when yew speak to me, yew blank limejuicer. I'se de fourf mate of dis yar ship, en my name's Mistah Jones, 'n yew jest freeze on to dat ar, ef yew want ter lib long 'n die happy. See, sonny?" I *saw*, and answered promptly, "I beg your pardon, sir, I didn't know." "Ob cawse yew didn't know, dat's all right, little Britisher; naow jest skip aloft 'n loose dat fore-taupsle." "Ay, ay, sir," I answered cheerily, springing at once into the fore-rigging and up the ratlines like a monkey, but not too fast to hear him chuckle, "Dat's a smart kiddy, I bet." On deck I could see a crowd at the windlass heaving up anchor. I said to myself, "They don't waste any time getting this packet away." Evidently they were not anxious to test any of the crew's swimming powers. They were wise, for had she remained at anchor that night I verily believe some of the poor wretches would have tried to escape. [Pg 821]

The anchor came aweigh, the sails were sheeted home, and I returned on deck to find the ship gathering way for the heads, fairly started on her long voyage.

Before nightfall we were fairly out to sea, and the ceremony of dividing the crew into watches was gone through. I found myself in the chief mate's or "port" watch (they called it "larboard," a term I had never heard used before, it having long been obsolete in merchant ships), though the huge negro fourth mate seemed none too well pleased that I was not under his command, his being the starboard watch under the second mate.

I was pounced upon next morning by "Mistah" Jones, the fourth mate, whom I heard addressed familiarly as "Goliath" and "Anak" by his brother officers, and ordered to assist him in rigging the "crow's-nest" at the main royal-mast head. It was a simple affair. There were a pair of cross-trees fitted to the mast, upon which was secured a tiny platform about a foot wide on each side of the mast, while above this foothold a couple of padded hoops like a pair of giant spectacles were secured at a little higher than a man's waist. When all was fast one could creep up on the platform, through the hoop, and, resting his arms upon the latter, stand comfortably and gaze around, no matter how vigorously the old barky plunged and kicked beneath him. From that lofty eerie I had a comprehensive view of the vessel. She was about three hundred and fifty tons and full ship-rigged—that is to say, she carried square sails on all three masts. Her deck was flush fore and aft, the only obstructions being the brick-built "try-works" in the waist, the galley, and cabin skylight right aft by the taffrail. Her bulwarks were set thickly round with clumsy-looking wooden cranes, from which depended five boats. Two more boats were secured bottom up upon a gallows aft, so she seemed to be well supplied in that direction.

The weather being fine, with a steady northeast wind blowing, so that the sails required no attention, work proceeded steadily all the morning. The oars were sorted, examined for flaws, and placed in the boats; the whale line, Manilla rope like yellow silk, an inch and a half round, was brought on deck, stretched, and coiled down with the greatest care into tubs holding, some two hundred fathoms, and others one hundred fathoms each. New harpoons were fitted to poles of rough but heavy wood, without any attempt at neatness but every attention to strength. The shape of these weapons was not, as is generally thought, that of an arrow, but rather like an arrow with one huge barb, the upper part of which curved out from the shaft. The whole of the barb turned on a stout pivot of steel, but was kept in line with the shaft by a tiny wooden peg which passed through barb and shaft, being then cut off smoothly on both sides. The point of the harpoon had at one side a wedge-shaped edge, ground to razor keenness; the other side was flat. The shaft, about thirty inches long, was of the best malleable iron, so soft that it would tie into a knot and straighten out again without fracture. Three harpoons, or "irons" as they were always called, were placed in each boat, fitted one above the other in the starboard bow, the first for use being always one unused before. Opposite to them in the boat were fitted three lances for the purpose of *killing* whales, the harpoons being only the means by which the boat was attached to a fish, and quite useless to inflict a fatal wound. These lances were slender spears of malleable iron about four feet long, with oval or heart-shaped points of fine steel about two inches broad, their edges kept keen as a surgeon's lancet. By means of a socket at the other end they were attached to neat handles, or "lance poles," about as long again, the whole weapon being thus about eight feet in length, and furnished with a light line, or "lance warp," for the purpose of drawing it back again when it had been darted at a whale. The other furniture of a boat comprised five oars of varying lengths from sixteen to nine feet, one great steering oar of nineteen feet, a mast and two sails of great area for so small a craft, spritsail shape; two tubs of whale line containing together eighteen hundred feet, a keg of drinking water, and another long, narrow one with a few biscuits, a lantern, candles and matches therein; a bucket and "piggin" for baling, a small spade, a flag or "wheft," a shoulder bomb gun and ammunition, two knives, and two small axes. A rudder hung outside by the stern. [Pg 822]

With all this gear, although snugly stowed, a boat looked so loaded that I could not help wondering how six men would be able to work in her; but, like most "deep-water" sailors, I knew very little about boating. I was going to learn.

The reports I had always heard of the laziness prevailing on board whale ships were now abundantly falsified. From dawn to dark work went on without cessation. Everything was rubbed and scrubbed and scoured until no speck or soil could be found; indeed, no gentleman's yacht or man-of-war is kept more spotlessly clean than was the Cachalot.

On the fourth day after leaving port we were all busy as usual except the four men in the "crow's-nests," when a sudden cry of "Porps! porps!" brought everything to a standstill. A large school of porpoises had just joined us, in their usual clownish fashion, rolling and tumbling around the bows as the old barky wallowed along, surrounded by a wide ellipse of snowy foam. All work was instantly suspended, and active preparations made for securing a few of these frolicsome fellows. [Pg 823] A "block," or pulley, was bung out at the bowsprit end, a whale line passed through it and "bent" (fastened) on to a harpoon. Another line with a running "bowline," or slip noose, was also passed out to the bowsprit end, being held there by one man in readiness. Then one of the harpooners ran out along the back ropes, which keep the jib boom down, taking his stand beneath the bowsprit with the harpoon ready. Presently he raised his iron and followed the track of a rising porpoise with its point until the creature broke water. At the same instant the weapon left his grasp, apparently without any force behind it; but we on deck, holding the line, soon found that our excited hauling lifted a big vibrating body clean out of the smother beneath. "'Vast hauling!" shouted the mate, while, as the porpoise hung dangling, the harpooner slipped the ready bowline over his body, gently closing its grip round the "small" by the broad tail. Then we hauled on the noose line, slacking away the harpoon, and in a minute had our prize on deck. He was dragged away at once and the operation repeated. Again and again we hauled them in, until the fore part of the deck was alive with the kicking, writhing sea pigs, at least twenty of them. All hands were soon busy skinning the blubber from the bodies. Porpoises have no skin—that is, hide—the blubber or coating of lard which incases them being covered by a black substance as thin as tissue paper. The porpoise hide of the bootmaker is really leather, made from the skin of the *Beluga*, or "white whale," which is found only in the far north. The cover was removed from the "try-works" amidships, revealing two gigantic pots set in a frame of brickwork side by side, capable of holding two hundred gallons each—such a cooking apparatus as might have graced a Brobdingnagian kitchen. Beneath the pots was the very simplest of furnaces, hardly as elaborate as the familiar copper hole sacred to washing day. Square funnels of sheet iron were loosely fitted to the flues, more as a protection against the oil boiling over into the fire than to carry away the smoke, of which from the peculiar nature of the fuel there was very little. At one side of the try-works was a large wooden vessel, or "hopper," to contain the raw blubber; at the other, a copper cistern or cooler of about three hundred gallons capacity, into which the prepared oil was baled to cool off, preliminary to its being poured into the casks. Beneath the furnaces was a space as large as the whole area of the try-works, about a foot deep, which, when the fires were lighted, was filled with water to prevent the deck from burning.

It may be imagined that the blubber from our twenty porpoises made but a poor show in one of the pots; nevertheless, we got a barrel of very excellent oil from them. The fires were fed with "scrap," or pieces of blubber from which the oil had been boiled, some of which had been [Pg 824] reserved from the previous voyage. They burned with a fierce and steady blaze, leaving but a trace of ash. I was then informed by one of the harpooners that no other fuel was ever used for boiling blubber at any time, there being always amply sufficient for the purpose.

We were now in the haunts of the sperm whale, or "cachalot," a brilliant lookout being continually kept for any signs of their appearing. One officer and a foremast hand were continually on watch during the day in the main crow's-nest, one harpooner and a seaman in the fore one. A bounty of ten pounds of tobacco was offered to whoever should first report a whale, should it be secured; consequently there were no sleepy eyes up there.

At last, one beautiful day, the boats were lowered and manned, and away went the greenies on their first practical lesson in the business of the voyage. There were two greenies in each boat, they being so arranged that whenever one of them "caught a crab," which of course was about every other stroke, his failure made little difference to the boat's progress. They learned very fast under the terrible imprecations and storm of blows from the iron-fisted and iron-hearted officers, so that before the day was out the skipper was satisfied of our ability to deal with a "fish" should he be lucky enough to "raise" one. I was, in virtue of my experience, placed at the after oar in the mate's boat, where it was my duty to attend to the "main sheet" when the sail was set, where also I had the benefit of the lightest oar except the small one used by the harpooner in the bow.

The very next day after our first exhaustive boat drill, a school of "blackfish" was reported from aloft, and with great glee the officers prepared for what they considered a rattling day's fun.

The blackfish (*Phocæna sp.*) is a small toothed whale, not at all unlike a miniature cachalot, except that its head is rounded at the front, while its jaw is not long and straight, but bowed. It is as frolicsome as the porpoise, gamboling about in schools of from twenty to fifty or more, as if really delighted to be alive. Its average size is from ten to twenty feet long and seven or eight feet in girth; weight, from one to three tons. Blubber about three inches thick, while the head is almost all oil, so that a good rich specimen will make between one and two barrels of oil of medium quality.

We lowered and left the ship, pulling right toward the school, the noise they were making in their fun effectually preventing them from hearing our approach. It is etiquette to allow the mate's boat first place, unless his crew is so weak as to be unable to hold their own; but as the mate always has first pick of the men this seldom happens. So, as usual, we were first, and soon I heard the order given, "Stand up, Louey, and let 'em have it!" Sure enough, here we were right [Pg 825] among them. Louis let drive, "fastening" a whopper about twenty feet long. The injured animal plunged madly forward, accompanied by his fellows, while Louis calmly bent another iron to a "short warp," or piece of whale line, the loose end of which he made a bowline with round the main line which was fast to the "fish." Then he fastened another "fish," and the queer sight was

seen of these two monsters each trying to flee in opposite directions, while the second one ranged about alarmingly as his "bridle" ran along the main line. Another one was secured in the same way, then the game was indeed great. The school had by this time taken the alarm and cleared out, but the other boats were all fast to fish, so that didn't matter. Now, at the rate our "game" were going, it would evidently be a long while before they died, although, being so much smaller than a whale proper, a harpoon will often kill them at a stroke. Yet they were now so tangled or "snarled erp," as the mate said, that it was no easy matter to lance them without great danger of cutting the line. However, we hauled up as close to them as we dared, and the harpooner got a good blow in, which gave the biggest of the three "Jesse," as he said, though why "Jesse" was a stumper. Anyhow, it killed him promptly, while almost directly after another one saved further trouble by passing in his own checks. But he sank at the same time, drawing the first one down with him, so that we were in considerable danger of having to cut them adrift or be swamped. The "wheft" was waved thrice as an urgent signal to the ship to come to our assistance with all speed, but in the meantime our interest lay in the surviving blackfish keeping alive. Should *he* die and, as was most probable, sink, we should certainly have to cut and loose the lot, tools included.

We waited in grim silence while the ship came up, so slowly, apparently, that she hardly seemed to move, but really at a good pace of about four knots an hour, which for her was not at all bad. She got alongside of us at last, and we passed up the bight of our line, our fish all safe, very much pleased with ourselves, especially when we found that the other boats had only five between the three of them.

Chain slings were passed around the carcasses, the end of the "fall," or tackle rope, was taken to the windlass, and we hove away cheerily, lifting the monsters right on deck. A mountainous pile they made. After dinner all hands turned to again to "flench" the blubber and prepare for trying out. This was a heavy job, keeping us busy until it was quite dark, the latter part of the work being carried on by the light of a "cresset," the flames of which were fed with "scrap," which blazed brilliantly, throwing a big glare over all the ship. The last of the carcasses was launched overboard by about eight o'clock that evening, but not before some vast junks of beef had been cut off and hung up in the rigging for our food supply.

"Trying out" went on busily all night, and by nightfall of the next day the ship had resumed her normal appearance, and we were a tun and a quarter of oil to the good. Blackfish oil is of medium quality, but I learned that, according to the rule of "roguery in all trades," it was the custom to mix quantities such as we had just obtained with better class whale oil, and thus get a much higher price than it was really worth. [Pg 826]

We had now been eight days out, having had nothing, so far, but steady breezes and fine weather. As it was late autumn—the first week in October—I rather wondered at this, for even in my brief experience I had learned to dread a "fall" voyage across the "Western Ocean."

Gradually the face of the sky changed, and the feel of the air, from balmy and genial, became raw and cheerless. The little wave tops broke short off and blew backward, apparently against the wind, while the old vessel had an uneasy, unnatural motion, caused by a long, new swell rolling athwart the existing set of the sea.

We were evidently in for a fair specimen of Western Ocean weather, but the clumsy-looking, old-fashioned Cachalot made no more fuss over it than one of the long-winged sea birds that floated around, intent only upon snapping up any stray scraps that might escape from us. Higher rose the wind, heavier rolled the sea, yet never a drop of water did we ship, nor did anything about the deck betoken what a heavy gale was blowing. During the worst of the weather, and just after the wind had shifted back into the northeast, making an uglier cross sea than ever get up, along comes an immense four-masted iron ship homeward bound. She was staggering under a veritable mountain of canvas, fairly burying her bows in the foam at every forward drive, and actually wetting the clews of the upper topsails in the smothering masses of spray, that every few minutes almost hid her hull from sight.

It was a splendid picture; but—for the time—I felt glad I was not on board of her. In a very few minutes she was out of our ken, followed by the admiration of all. Then came, from the other direction, a huge steamship, taking no more notice of the gale than as if it were calm. Straight through the sea she rushed, dividing the mighty rollers to the heart, and often bestriding three seas at once, the center one spreading its many tons of foaming water fore and aft, so that from every orifice spouted the seething brine. Compared with these greyhounds of the wave, we resembled nothing so much as some old lightship bobbing serenely around, as if part and parcel of the mid-Atlantic.

The gale gradually blew itself out, leaving behind only a long and very heavy swell to denote the deep-reaching disturbance that the ocean had endured. And now we were within the range of the sargasso weed, that mysterious *fucus* that makes the ocean look like some vast hayfield, and keeps the sea from rising, no matter how high the wind. It fell a dead calm, and the harpooners amused themselves by dredging up great masses of the weed, and turning out the many strange creatures abiding therein. [Pg 827]

We were all gathered about the fo'lk'sle scuttle one evening, a few days after the gale referred to above, and the question of whale-fishing came up for discussion. Until that time, strange as it may seem, no word of this, the central idea of all our minds, had been mooted. Every man seemed to shun the subject, although we were in daily expectation of being called upon to take

an active part in whale-fighting. Once the ice was broken, nearly all had something to say about it, and very nearly as many addle-headed opinions were ventilated as at a Colney Hatch debating society. For we none of us *knew* anything about it. It was Saturday evening, and while at home people were looking forward to a day's respite from work and care, I felt that the coming day, though never taken much notice of on board, was big with the probabilities of strife such as I at least had at present no idea of—so firmly was I possessed by the prevailing feeling.

The night was very quiet. A gentle breeze was blowing, and the sky was of the usual "trade" character—that is, a dome of dark blue fringed at the horizon with peaceful cumulus clouds, almost motionless. I turned in at 4 A. M. from the middle watch and, as usual, slept like a babe. Suddenly I started wide awake, a long, mournful sound sending a thrill to my very heart. As I listened breathlessly, other sounds of the same character but in different tones joined in, human voices monotonously intoning in long-drawn-out expirations the single word "bl-o-o-o-ow." Then came a hurricane of noise overhead, and adjurations in no gentle language to the sleepers to "tumble up lively there, no skulking, sperm whales." At last, then, fulfilling all the presentiments of yesterday, the long-dreaded moment had arrived. Happily, there was no time for hesitation; in less than two minutes we were all on deck, and hurrying to our respective boats. The skipper was in the main crow's-nest with his binoculars. Presently he shouted: "Naow then, Mr. Count, lower away soon's y'like. Small pod o' cows, an' one 'r two bulls layin' off to west'ard of 'em." Down went the boats into the water quietly enough; we all scrambled in and shoved off. A stroke or two of the oars were given to get clear of the ship and one another, then oars were shipped and up went the sails. As I took my allotted place at the main-sheet, and the beautiful craft started off like some big bird, Mr. Count leaned forward, saying impressively to me: "Y'r a smart youngster, an' I've kinder took t'yer; but don't ye look ahead an' get gallied, 'r I'll knock ye stiff wi' th' tiller; [Pg 828] y'hear me? N' don't ye dare to make thet sheet fast, 'r ye'll die so sudden y' won't know whar y'r hurted." I said as cheerfully as I could, "All right, sir," trying to look unconcerned, telling myself not to be a coward, and all sorts of things; but the cold truth is that I was scared almost to death, because I didn't know what was coming. However, I did the best thing under the circumstances, obeyed orders and looked steadily astern, or up into the bronzed impassive face of my chief, who towered above me, scanning with eagle eyes the sea ahead. The other boats were coming flying along behind us, spreading wider apart as they came, while in the bows of each stood the harpooner with his right hand on his first iron, which lay ready, pointing over the bow in a raised fork of wood called the "crutch."

All of a sudden, at a motion of the chief's hand, the peak of our mainsail was dropped, and the boat swung up into the wind, laying "hove to," almost stationary. The centerboard was lowered to stop her drifting to leeward, although I can not say it made much difference that ever I saw. *Now*, what's the matter? I thought, when to my amazement the chief addressing me said, "Wonder why we've hauled up, don't ye?" "Yes, sir, I do," said I. "Wall," said he, "the fish hev sounded, an' 'ef we run over 'em, we've seen the last ov 'em. So we wait awhile till they rise agin, 'n then we'll prob'ly git thar' 'r thareabouts before they sound agin." With this explanation I had to be content, although if it be no clearer to my readers than it then was to me, I shall have to explain myself more fully later on. Silently we lay, rocking lazily upon the gentle swell, no other word being spoken by any one. At last Louis, the harpooner, gently breathed "Blo-o-o-w"; and there, sure enough, not half a mile away on the lee beam, was a little bushy cloud of steam apparently rising from the sea. At almost the same time as we kept away all the other boats did likewise, and just then, catching sight of the ship, the reason for this apparently concerted action was explained. At the mainmast head of the ship was a square blue flag, and the ensign at the peak was being dipped. These were signals well understood and promptly acted upon by those in charge of the boats, who were thus guided from a point of view at least one hundred feet above the sea.

"Stand up, Louey," the mate murmured softly. I only just stopped myself in time from turning my head to see why the order was given. Suddenly there was a bump, at the same moment the mate yelled, "Give't to him, Louey, give't to him!" and to me, "Haul that main sheet, naow haul, why don't ye?" I hauled it flat aft, and the boat shot up into the wind, rubbing sides as she did so with what to my troubled sight seemed an enormous mass of black India rubber floating. As we *crawled* up into the wind, the whale went into convulsions befitting his size and energy. He [Pg 829] raised a gigantic tail on high, thrashing the water with deafening blows, rolling at the same time from side to side until the surrounding sea was white with froth. I felt in an agony lest we should be crushed under one of those fearful strokes, for Mr. Count appeared to be oblivious of possible danger, although we seemed to be now drifting back on to the writhing leviathan. In the agitated condition of the sea it was a task of no ordinary difficulty to unship the tall mast, which was of course the first thing to be done. After a desperate struggle, and a narrow escape from falling overboard of one of the men, we got the long "stick," with the sail bundled around it, down and "fleeted" aft, where it was secured by the simple means of sticking the "heel" under the after thwart, two thirds of the mast extending out over the stern. Meanwhile, we had certainly been in a position of the greatest danger, our immunity from damage being unquestionably due to anything but precaution taken to avoid it.

By the time the oars were handled, and the mate had exchanged places with the harpooner, our friend the enemy had "sounded"—that is, he had gone below for a change of scene, marveling, no doubt, what strange thing had befallen him. Agreeably to the accounts which I, like most boys, had read of the whale-fishery, I looked for the rushing of the line round the loggerhead (a stout wooden post built into the boat aft), to raise a cloud of smoke with occasional bursts of flame; so, as it began to slowly surge round the post, I timidly asked the harpooner whether I should throw any water on it. "Wot for?" growled he, as he took a couple more turns with it. Not knowing

"what for," and hardly liking to quote my authorities here, I said no more, but waited events. "Hold him up, Louey, hold him up, cain't ye?" shouted the mate, and to my horror, down went the nose of the boat almost under water, while at the mate's order everybody scrambled aft into the elevated stern sheets.

The line sang quite a tune as it was grudgingly allowed to surge round the loggerhead, filling one with admiration at the strength shown by such a small rope. This sort of thing went on for about twenty minutes, in which time we quite emptied the large tub and began on the small one.

Suddenly our boat fell backward from her "slantindicular" position with a jerk, and the mate immediately shouted, "Haul line, there! look lively, now! you—so on, etcetera, etcetera" (he seemed to invent new epithets on every occasion). The line came in hand over hand, and was coiled in a wide heap in the stern sheets, for, silky as it was, it could not be expected in its wet state to lie very close. As it came flying in, the mate kept a close gaze upon the water immediately beneath us, apparently for the first glimpse of our antagonist. When the whale broke [Pg 830] water, however, he was some distance off, and apparently as quiet as a lamb. Now, had Mr. Count been a prudent or less ambitious man, our task would doubtless have been an easy one, or comparatively so; but, being a little over-grasping, he got us all into serious trouble. We were hauling up to our whale in order to lance it, and the mate was standing, lance in hand, only waiting to get near enough, when up comes a large whale right alongside of our boat, so close, indeed, that I might have poked my finger in his little eye, if I had chosen. The sight of that whale at liberty, and calmly taking stock of us like that, was too much for the mate. He lifted his lance and hurled it at the visitor, in whose broad flank it sank, like a knife into butter, right up to the pole-hitches. The recipient disappeared like a flash, but before one had time to think, there was an awful crash beneath us, and the mate shot up into the air like a bomb from a mortar. He came down in a sitting posture on the mast thwart; but as he fell, the whole framework of the boat collapsed like a derelict umbrella. Louis quietly chopped the line and severed our connection with the other whale, while in accordance with our instructions we drew each man his oar across the boat and lashed it firmly down with a piece of line spliced to each thwart for the purpose. This simple operation took but a minute, but before it was completed we were all up to our necks in the sea—still in the boat, it is true, and therefore not in such danger of drowning as if we were quite adrift; but, considering that the boat was reduced to a mere bundle of loose planks, I, at any rate, was none too comfortable. Now, had he known it, was the whale's golden opportunity; but he, poor wretch, had had quite enough of our company, and cleared off without any delay, wondering, no doubt, what fortunate accident had rid him of our very unpleasant attentions.

I was assured that we were all as safe as if we were on board the ship, to which I answered nothing; but, like Jack's parrot, I did some powerful thinking. Every little wave that came along swept clean over our heads, sometimes coming so suddenly as to cut a breath in half. If the wind should increase—but no—I wouldn't face the possibility of such a disagreeable thing. I was cool enough now in a double sense, for, although we were in the tropics, we soon got thoroughly chilled.

Help came at last, and we were hauled alongside. Long exposure had weakened us to such an extent that it was necessary to hoist us on board, especially the mate, whose "sudden stop," when he returned to us after his little aërial excursion, had shaken his sturdy frame considerably, a state of body which the subsequent soaking had by no means improved. In my innocence I imagined that we should be commiserated for our misfortunes by Captain Slocum, and certainly [Pg 831] be relieved from further duties until we were a little recovered from the rough treatment we had just undergone. But I never made a greater mistake. The skipper cursed us all (except the mate, whose sole fault the accident undoubtedly was) with a fluency and vigor that was, to put it mildly, discouraging.

A couple of slings were passed around the boat, by means of which she was carefully hoisted on board, a mere dilapidated bundle of sticks and raffle of gear. She was at once removed aft out of the way, the business of cutting in the whale claiming precedence over everything else just then. The preliminary proceedings consisted of rigging the "cutting stage." This was composed of two stout planks a foot wide and ten feet long, the inner ends of which were suspended by strong ropes over the ship's side about four feet from the water, while the outer extremities were upheld by tackles from the main rigging, and a small crane abreast the try-works.

These planks were about thirty feet apart, their two outer ends being connected by a massive plank which was securely bolted to them. A handrail about as high as a man's waist, supported by light iron stanchions, ran the full length of this plank on the side nearest the ship, the whole fabric forming an admirable standing place whence the officers might, standing in comparative comfort, cut and carve at the great mass below to their hearts' content.

So far the prize had been simply held alongside by the whale line, which at death had been "rove" through a hole cut in the solid gristle of the tail; but now it became necessary to secure the carcass to the ship in some more permanent fashion. Therefore, a massive chain like a small ship's cable was brought forward, and in a very ingenious way, by means of a tiny buoy and a hand lead, passed round the body, one end brought through a ring in the other, and hauled upon until it fitted tight round the "small" or part of the whale next the broad spread of the tail. The free end of the fluke chain was then passed in through a mooring pipe forward, firmly secured to a massive bitt at the heel of the bowsprit (the fluke-chain bitt), and all was ready.

The first thing to be done was to cut the whale's head off. This operation, involving the greatest amount of labor in the whole of the cutting in, was taken in hand by the first and second mates,

who, armed with twelve-foot spades, took their station upon the stage, leaned over the handrail to steady themselves, and plunged their weapons vigorously down through the massive neck of the animal—if neck it could be said to have—following a well-defined crease in the blubber. At the same time the other officers passed a heavy chain sling around the long, narrow lower jaw, hooking one of the big cutting tackles into it, the "fall" of which was then taken to the windlass and hove tight, turning the whale on her back. A deep cut was then made on both sides of the [Pg 832] rising jaw, the windlass was kept going, and gradually the whole of the throat was raised high enough for a hole to be cut through its mass, into which the strap of the second cutting tackle was inserted and secured by passing a huge toggle of oak through its eye. The second tackle was then hove taut, and the jaw, with a large piece of blubber attached, was cut off from the body with a boarding knife, a tool not unlike a cutlass blade set into a three-foot-long wooden handle.

Upon being severed the whole piece swung easily inboard and was lowered on deck. The fast tackle was now hove upon while the third mate on the stage cut down diagonally into the blubber on the body, which the purchase ripped off in a broad strip or "blanket" about five feet wide and a foot thick. Meanwhile the other two officers carved away vigorously at the head, varying their labors by cutting a hole right through the snout. This, when completed, received a heavy chain for the purpose of securing the head. When the blubber had been about half stripped off the body, a halt was called in order that the work of cutting off the head might be finished, for it was a task of incredible difficulty. It was accomplished at last, and the mass floated astern by a stout rope, after which the windlass pawls clattered merrily, the "blankets" rose in quick succession, and were cut off and lowered into the square of the main hatch or "blubber room." A short time sufficed to strip off the whole of the body blubber, and when at last the tail was reached, the backbone was cut through, the huge mass of flesh floating away to feed the innumerable scavengers of the sea. No sooner was the last of the blubber lowered into the hold than the hatches were put on and the head hauled up alongside. Both tackles were secured to it and all hands took to the windlass levers. This was a small cow whale of about thirty barrels—that is, yielding that amount of oil—so it was just possible to lift the entire head on board; but as it weighed as much as three full-grown elephants, it was indeed a heavy lift for even our united forces, trying our tackle to the utmost. The weather was very fine, and the ship rolled but little; even then, the strain upon the mast was terrific, and right glad was I when at last the immense cube of fat, flesh, and bone was eased inboard and gently lowered on deck.

As soon as it was secured the work of dividing it began. From the snout a triangular mass was cut, which was more than half pure spermaceti. This substance was contained in spongy cells held together by layers of dense white fiber, exceedingly tough and elastic, and called by the whalers "white horse." The whole mass, or "junk," as it is called, was hauled away to the ship's side and firmly lashed to the bulwarks for the time being, so that it might not "take charge" of the deck during the rest of the operations.

The upper part of the head was now slit open lengthwise, disclosing an oblong cistern or "case" [Pg 833] full of liquid spermaceti, clear as water. This was baled out with buckets into a tank, concreting as it cooled into a waxlike substance, bland and tasteless. There being now nothing more remaining about the skull of any value, the lashings were loosed, and the first leeward roll sent the great mass plunging overboard with a mighty splash. It sank like a stone, eagerly followed by a few small sharks that were hovering near.

As may be imagined, much oil was running about the deck, for so saturated was every part of the creature with it that it really gushed like water during the cutting-up process. None of it was allowed to run to waste, though, for the scupper holes which drain the deck were all carefully plugged, and as soon as the "junk" had been dissected all the oil was carefully "squeegeed" up and poured into the try-pots.

Two men were now told off as "blubber-room men," whose duty it became to go below and, squeezing themselves in as best they could between the greasy mass of fat, cut it up into "horse-pieces" about eighteen inches long and six inches square. Doing this, they became perfectly saturated with oil, as if they had taken a bath in a tank of it; for as the vessel rolled it was impossible to maintain a footing, and every fall was upon blubber running with oil. A machine of wonderful construction had been erected on deck in a kind of shallow trough about six feet long by four feet wide and a foot deep. At some remote period of time it had no doubt been looked upon as a triumph of ingenuity, a patent mincing machine. Its action was somewhat like that of a chaff-cutter, except that the knife was not attached to the wheel, and only rose and fell, since it was not required to cut right through the "horse-pieces" with which it was fed. It will be readily understood that, in order to get the oil quickly out of the blubber, it needs to be sliced as thin as possible, but for convenience in handling the refuse (which is the only fuel used) it is not chopped up in small pieces, but every "horse-piece" is very deeply scored as it were, leaving a thin strip to hold the slices together. This, then, was the order of work: Two harpooners attended the try-pots, replenishing them with minced blubber from the hopper at the port side, and baling out the sufficiently boiled oil into the great cooling tank on the starboard. One officer superintended the mincing, another exercised a general supervision over all. So we toiled watch and watch, six hours on and six off, the work never ceasing for an instant night or day. Though the work was hard and dirty, and the discomfort of being so continually wet through with oil great, there was only one thing dangerous about the whole business. That was the job of filling and shifting the huge casks of oil. Some of these were of enormous size, containing three hundred and fifty gallons when full, and the work of moving them about the greasy deck of a rolling ship was [Pg 834] attended with a terrible amount of risk. For only four men at most could get fair hold of a cask,

and when she took it into her silly old hull to start rolling, just as we had got one halfway across the deck, with nothing to grip your feet, and the knowledge that one stumbling man would mean a sudden slide of the ton and a half weight, and a little heap of mangled corpses somewhere in the lee scuppers—well, one always wanted to be very thankful when the lashings were safely passed.

The whale being a small one, as before noted, the whole business was over within three days, and the decks scrubbed and rescrubbed until they had quite regained their normal whiteness. The oil was poured by means of a funnel and long canvas hose into the casks stowed in the ground tier at the bottom of the ship, and the gear, all carefully cleaned and neatly "stopped up," stowed snugly away below again.

SKETCH OF MANLY MILES.

To Dr. Manly Miles belongs the distinction of having been the first professor of practical agriculture in the United States, as he was appointed to that then newly instituted position in the Michigan Agricultural College in 1865.

Professor Miles was born in Homer, Cortland County, New York, July 20, 1826, the son of Manly Miles, a soldier of the Revolution; while his mother, Mary Cushman, was a lineal descendant of Miles Standish and Thomas Cushman, whose father, Joshua Cushman, joining the Mayflower colony at Plymouth, Massachusetts, in 1621, left him there with Governor Bradford when he returned to England.

When Manly, the son, was eleven years old, the family removed to Flint, Michigan, where he employed his time in farm work and the acquisition of knowledge, and later in teaching. He had a common-school education, and improved all the time he could spare from his regular occupations in reading and study. It is recorded of him in those days that he was always successful in whatever he undertook. In illustration of the skill and thoroughness with which he performed his tasks, his sister relates an incident of his sowing plaster for the first time, when his father expressed pleasure at his having distributed the lime so evenly and so well. It appears that he did not spare himself in doing the work, for so completely was he covered that he is said to have looked like a plaster cast, "with only his bright eyes shining through." A thrashing machine was brought on to the farm, and Manly and his brother went round thrashing for the neighbors. [Pg 835] Industrious in study as well as in work, the boy never neglected his more prosaic duties to gratify his thirst for knowledge. He studied geometry while following the plow, drawing the problems on a shingle, which he tacked to the plow-beam. Whenever he was missed and inquiry was made about him, the answer invariably was, "Somewhere with a book." He was most interested in the natural sciences, particularly in chemistry in its applications to agriculture, and in comparative physiology and anatomy, and was a diligent student and collector of mollusks.

Choosing the profession of medicine, Mr. Miles was graduated M. D. from Rush Medical College, Chicago, in 1850, and practiced till 1859. In the meantime he became greatly interested in the subject of a geographical survey of the State, for which an act was passed and approved in 1858. In the organization of the survey, in 1859, he was appointed Assistant State Geologist in the department of zoölogy; and in the next year was appointed professor of zoölogy and animal physiology in the State Agricultural College at Lansing.

In his work as zoölogist to the State Geological Survey, in 1859, 1860, and 1861, he displayed rare qualities as a naturalist, so that Mr. Walter R. Barrows, in recording his death in the bulletin of the Michigan Ornithological Club, expresses regret that many of the years he afterward devoted to the development of experimental agriculture "were not spent in unraveling some of the important biological problems which the State afforded, which his skill and perseverance would surely have solved." He was a "born collector," Mr. Barrows adds, "as the phrase is, and his keen eyes, tireless industry, and mathematical precision led to the accumulation of thousands of valuable specimens and more valuable observations."

Mr. Bryant Walker, of Detroit, who knew Professor Miles well in later years, and had opportunity to review his zoölogical work, regards the part he took during this service in developing the knowledge of the fauna of the State as having been very prominent. "The catalogues he published in the report for 1860 have been the basis for all work since that time." He kept in correspondence with the most eminent American naturalists of the period, including Cope, Prime, Lea, W. G. Binney, Baird, and Agassiz, and supplied them with large quantities of valuable material. From the many letters written by these naturalists which are in the possession of his friends, we take, as illustrating the character of the service he rendered and of the trust they reposed in him, even previous to his going on the survey, one from Agassiz, of February 4, 1856:

"Dear Sir: As you have already furnished me with invaluable materials for the natural history of [Pg 836] the fishes of your State, I am emboldened to ask another favor of you. I am preparing a map of the Geographical Distribution of the Turtles of North America, and would be greatly indebted to you for any information respecting the range of those found in your State, as far as you have noticed them, even if you should know them only by their common names, my object being simply to ascertain how far they extend over different parts of the country. If you could add specimens of them, to identify them with precision, it would be, of course, so much the better; but as I am

almost ready for the press, I could not for this paper await the return of spring, but would thank you for what you could furnish me now. I am particularly interested in ascertaining how far north the different species inhabiting this continent extend." On the back of this letter was Dr. Miles's indorsement that a box had been sent.

A number of letters from Professor Baird, of 1860 and 1861, relate to the identification of specimens collected by Dr. Miles, and to the fishes of Michigan, and contain inquiries about gulls and eggs. Dr. Miles likewise supplied Cope with a considerable amount of material concerning Michigan reptiles and fishes.

While mollusks were the favorite object of Dr. Miles's investigations, he also made studies and valuable collections of birds, mammals, reptiles, and fishes; and he seems, Mr. Barrows says, "to have possessed, in a high degree, that strong characteristic of a true naturalist, a full appreciation of the value of good specimens. Many of his specimens are now preserved at the Agricultural College, and among his shells are many which are of more than ordinary value from having served as types of new species, or as specimens from type localities, or as part or all of the material which has helped to clear up mistakes and misconceptions about species and their distribution." Mr. Walker speaks of his having done a great work in conchology. His catalogue, which contained a list of one hundred and sixty-one species, was by far the most complete published up to that time. "He described two new species—*Planorbis truncatus* and *Unio leprosus*. The former is one of the few species which are, so far as known, peculiar to Michigan, and is a very beautiful and distinct form; while the latter, although now considered as synonymous with another species, has peculiarities which in the then slight knowledge of the variability of the species was a justification of his position. He was also the discoverer of two other forms which were named after him by one of our most eminent conchologists—viz., *Campeloma Milesii* (Lea) and *Guiobasis Milesii* (Lea)." Mr. Walker believes that "in general, it can be truthfully stated that Dr. Miles did more to develop the general natural history of that State (Michigan) than any other man either before or since he completed his work as State Geologist." [Pg 837]

As professor of zoölogy and animal physiology, Dr. Miles is described by one of his students, who afterward became a professor in the college and then its president, as having been thoroughly interested in the subjects he taught, and shown that interest in his work and in his treatment of his students. He labored as faithfully and industriously with the class of five to which President Clute belonged as if it "had numbered as many score." He supplemented the meager equipment of his department from his more extensive private apparatus and collections, which were freely used for class work; and, when there was need, he had the skill to prepare new pieces of apparatus. "He was on the alert for every chance for illustration which occasion offered: an animal slaughtered for the tables gave him an opportunity to lecture on its viscera; a walk over the drift-covered fields found many specimens of rock which he taught us to distinguish; the mud and the sand banks along the river showed how in the periods of the dim past were formed fossil footprints and ripples; the woods and swamps and lakes gave many useful living specimens, some of which became the material for the improvised dissecting room; the crayon in his hand produced on board or paper the chart of geologic ages, the table of classification, or the drawing of the part of an animal under discussion."

Prof. R. C. Kedzie came to the college a little later, in 1863, when Dr. Miles had been for two years a professor, and found him then the authority "for professors and students alike on beasts, birds, and reptiles, on the stones of the field, and insects of the air," thorough, scholarly, and enthusiastic, and therefore very popular with his classes.

The projection of agricultural colleges under the Agricultural College Land Grant Act of 1862 stimulated a demand for teachers of scientific agriculture, and it was found that they were rare. Of old school students of science there was no lack—able men, as President Clute well says, who were familiar with their little laboratories and with the old theories and methods, but who did not possess the new vision of evolution and the conservation of energy, men of the study rather than the field, and least of all men of the orchard and stock farm; and they knew nothing of the practical application of chemistry to fertilization and the raising of crops and the composition of feed stuffs, of physiology to stock-breeding, and of geology and physics to the study of the soils.

With a thorough knowledge of science and familiarity with practical agriculture Professor Miles had an inclination to enter this field, and this inclination was encouraged by President Abbott and some of the members of the Board of Agriculture. He had filled the professorship of zoölogy and animal physiology with complete success, and had he consulted his most cherished tastes alone he would have remained there, but he gradually suffered himself to be called to another field. The duties of "acting superintendent of the farm" were attached to his chair in 1864. In 1865 he became professor of animal physiology and practical agriculture and superintendent of the farm; in 1869 he ceased to teach physiology, and gave his whole time to the agricultural branch of his work; and in 1875 the work of the superintendent of the farm was consigned to other hands, and he confined himself to the professorship proper of practical agriculture. [Pg 838]

The farm and its appurtenances, with fields cumbered with stumps and undrained, with inadequate and poorly constructed buildings, with inferior live stock, and everything primitive, were in poor condition for the teaching or the successful practice of agriculture. Professor Miles's first business was to set these things in order. Year by year something was done to remove evils or improve existing features in some of the departments of the life and management of the premises, till the concern in a certain measure approached the superintendent's ideal—as being a laboratory for teaching agriculture, conducting experiments, and training men, rather

than a money-making establishment.

In this new field, Professor Kedzie says, Professor Miles was even more popular than before with students, and created an enthusiasm for operations and labors of the farm which had been regarded before as a disagreeable drudgery. The students "were never happier than when detailed for a day's work with Dr. Miles in laying out some difficult ditch or surveying some field. One reason why he was so popular was that he was not afraid of soiling his hands. His favorite uniform for field work was a pair of brown overalls. The late Judge Tenney came to a gang of students at work on a troublesome ditch and inquired where he could find Dr. Miles. 'That man in overalls down in the quicksands of the ditch is Dr. Miles'; the professor of practical agriculture was in touch with the soil."

Prof. Byron D. Halsted, of the New Jersey Agricultural College Experiment Station, who was an agricultural pupil of Dr. Miles in Lansing, characterizes him as having been a full man who knew his subjects deeply and fondly. "In those days I am safe in writing that he represented the forefront of advanced agriculture in America. He was in close touch with such men as Lawes and Gilbert, Rothamstead, England, the famous field-crop experimenters of the world, and as for his knowledge of breeds of live stock and their origin, Miles's Stock-Breeding is a classic work. Dr. [Pg 839] Miles, in short, was a close student, a born investigator, hating an error, but using it as a stepping-stone toward truth. He did American farming a lasting service, and his deeds live after him."

While loved by his students, most of whom have been successful and many have gained eminence as agricultural professors or workers in experiment stations, and while receiving sympathy and support from President Abbott, Dr. Miles was not appreciated by the politicians, or by all of the Board of Agriculture, or even by the public at large. Unkind and captious criticisms were made of his work, and it was found fault with on economical grounds, as if its prime purpose had been to make money. He therefore resigned his position in 1875, and accepted the professorship of agriculture in the Illinois State University. Thence he removed to the Houghton Farm of Lawson Valentine, near Mountainville, N. Y., where he occupied himself with scientific experimental investigation. He was afterward professor of agriculture in the Massachusetts Agricultural College, at Amherst. In announcing this appointment to the students, Dr. Chadbourne, then president of the institution, and himself a most successful teacher, stated that he considered Dr. Miles as the ablest man in the United States for that position. In 1886, shortly after Dr. Chadbourne's death, Dr. Miles returned to his old home in Lansing, Michigan, where he spent the rest of his life in study, research, and the writing of books and articles for scientific publications.

During these later years of his life he took up again with what had been his favorite pursuit in earlier days, but with which he had not occupied himself for thirty years—the study of mollusks—with the enthusiasm of a young man, Mr. Walker says, who being interested in the same study, was in constant correspondence with him at this time; "and as far as his strength permitted labored with all the acumen and attention to details which were so characteristic of him. I was particularly struck with his familiarity with the present drift of scientific investigation and thought, and his thorough appreciation of modern methods of work. He was greatly interested in the work I was carrying on with reference to the geographical distribution of the mollusca, and, as would naturally be supposed from his own work in heredity in connection with our domestic animals, took great pleasure in discussing the relations of the species as they are now found and their possible lines of descent. He was a careful and accurate observer of Nature, and if he had not drifted into other lines of work would undoubtedly have made his mark as a great naturalist. As it is, his name will always have an honored place in the scientific history of Michigan."

When Professor Miles began to teach in the Michigan Agricultural College, the "new education" [Pg 840] was new indeed, and the textbook method still held sway. But the improved methods were gradually taking the place of the old ones, and Professor Miles was one of the first to co-operate in them, and he did it with effect. He used text-books, "but his living word," President Clute says, "supplemented the book; and the animal from the farm under his knife and ours, the shells which he led us to find under the rotten logs and along the rivers and lakes, the insects he taught us to collect and classify, the minerals and fossils he had collected on the geological survey of Michigan, all were used to instruct and inspire his students, to cultivate in them the scientific spirit and method."

Among the more important books by Professor Miles are Stock-Breeding, which had a wide circulation and has been much used as a class-book; Experiments with Indian Corn, giving the results of some important work which he did at Houghton Farm; Silos and Ensilage, which helped much in diffusing knowledge of the silo in the times when it had to fight for recognition; and Land Drainage. Of his papers, he published in the Popular Science Monthly articles on Scientific Farming at Rothamstead; Ensilage and Fermentation; Lines of Progress in Agriculture; Progress in Agricultural Science; and How Plants and Animals Grow. To the American Association for the Advancement of Science he contributed papers on Energy as a Factor in Rural Economy; Heredity of Acquired Characters (also to the American Naturalist); Surface Tension of Water and Evaporation; Energy as a Factor in Nutrition; and Limits of Biological Experiments (also to the American Naturalist). Other articles in the American Naturalist were on Animal Mechanics and the Relative Efficiency of Animals as Machines. In the Proceedings of the American Educational Association is an address by him on Instruction in Manual Arts in Connection with Scientific Studies. The records of the U and I Club, of Lansing, of which he was a valued member for ten years, contain papers on a variety of scientific subjects which were read before it, and were highly appreciated. This list does not contain all of Professor Miles's contributions to the

literature of science, for throughout his life he was a frequent contributor to the agricultural and scientific press, and a frequent speaker before associations and institutes, "where his lectures were able and practical."

No special record is made of the work of Professor Miles in the American Agriculturist, but the correspondence of Professor Thurber with him furnishes ample proof that he was one of the most trusted advisers in the editorial conduct of that journal. The familiar tone of Professor Thurber's letters, and the undoubting assurance with which he asked for information and aid on various subjects, well demonstrate how well the editor knew whom he could rely upon in an emergency. [Pg 841]

In all his work the great desire of Professor Miles was to find and present the truth. His merits were recognized by many scientific societies. He was made a corresponding member of the Buffalo Society of Natural Sciences in 1862; a corresponding member of the Entomological Society of Philadelphia in January, 1863; a correspondent of the Academy of Natural Sciences of Philadelphia in 1864; a member of the American Association for the Advancement of Science in 1880, and a Fellow of the same body in 1890; and held memberships or other relations with other societies; and he received the degree of D. V. S. from Columbia Veterinary College, New York, in March, 1880.

His students and friends speak in terms of high admiration of the genial qualities of Professor Miles as a companion. The resolutions of the U and I Club of Lansing describe him as an easy and graceful talker, a cheerful dispenser of his learning to others. "To spend an hour in his 'den,' and watch his delicate experiments with 'films,'" says President Clute, "and see the light in his eyes as he talked of them, was a delight." "He was particularly fond of boys," says another, "and never seemed happier than when in the company of boys or young men who were trying to study and to inform themselves, and if he could in any way assist them he was only too glad to do so"; and he liked pets and children. Incidents are related showing that he had a wonderful accuracy in noting and recollecting the minutest details that came under his observation—a power that he was able to bring to bear instantly when its exercise was called for.

Dr. Miles kept up his habits of reading and study to the last days of his life; but all public work was made difficult to him in later years by an increasing deafness. He was tireless in investigation, patient, and always cheerful and looking for the bright side; and when one inquired of him concerning his health, his usual answer was that he was "all right," or, if he could not say that, that he would be "all right to-morrow."

No sketch of Dr. Miles is complete without a word of tribute to his high personal character, his life pure and noble in every relationship, his unswerving devotion to truth, and the unfaltering loyalty to his friends, which make his memory a benediction and an inspiration to all who knew him well.

He was married in 1851 to Miss Mary E. Dodge, who remained his devoted companion until his death, which occurred February 15, 1898.

Editor's Table. [Pg 842]

SCIENCE AND CULTURE.

We do not know from whom the philosopher Locke quotes the saying, "*Non vitæ sed scholæ discimus*," but he translates it well, "We learn not to live, but to dispute." The adage has reference to the old systems of education which had for their aim neither the discovery of truth nor the perfecting of the human faculties in any broad sense, but the fitting of the individual to take his place in a world of conventional ideas and discuss conventional topics upon conventional lines. In other words, the preparation was for school, not for life, the whole subsequent career of the individual being regarded simply as a prolongation of the intellectual influences and discipline of the school. That system, which was ecclesiastical in its origin, has now, save for strictly ecclesiastical purposes, passed away. We consider life as the end of school and not school as the end of life.

It may be questioned, however, whether we have as yet thoroughly adapted our educational methods to this change of standpoint. Do we as yet take a sufficiently broad view of life? If we conceive life narrowly as essentially a business struggle, and adapt our procedure to that conception, the results will show very little relation to the larger and truer conception according to which life means development of faculty, activity of function, and a harmonious adjustment of relations between man and man. If, again, we make too much of knowledge that has only a conventional value, having little or no bearing on the understanding of things or the accomplishment of useful work, we are so far falling into the old error of "learning for school." The address by Sir Archibald Geikie, which we published last month, gives a useful caution against undervaluing "the older learning." The older learning can certainly be made an effective instrument for the cultivation of taste, of sympathy, and of intellectual accuracy along certain lines. It tends further, we believe, to promote a certain intellectual self-respect, which is a valuable quality. In the study of language and literature the human mind surveys, as it were, its own peculiar possessions, and thus acquires a sense of proprietorship which a study of the external world can hardly give. Still, it is well to cultivate a consciousness of the essentially

limited and arbitrary nature of such knowledge. It is important, we may admit, to have a good text of such an author as Chaucer; but the minutiæ into which critics of his text enter can not be said to possess any broad human interest. Whether he wrote this word or that word, adopted this spelling or that, can not be a question on which much depends; and could one know the exact truth on a thousand such points, he would not really be much the wiser. Among Chaucer scholars he could speak with a good deal of confidence; but the knowledge of these details would not really help to round out any useful *system* of knowledge, nor could any single fact possess the illuminating power which sometimes belongs to some single and, at first sight, unimportant fact in the realm of natural knowledge.

This is not said with any intention of disparaging the culture that comes of literary study. It is a [Pg 843] culture that tends to brighten human intercourse and to sweeten a man's own thoughts. It is a culture eminently favorable to flexibility of mind and quick insight into human character. So far it is a culture "for life"; but too often it tends to become a culture "for school"—that is to say, when things are learned simply to meet conventional demands and conform to the fashion of the time.

A true and sufficient culture can never, as we conceive, be founded on literature and language alone. No mind can be truly liberalized without imbibing and assimilating the fundamental principles of science. There is darkness in the mind that believes that anything can come out of nothing and which has never obtained a glimpse of the exactness with which Nature solves her equations. In the region of mechanics alone there are a thousand beautiful and varied illustrations of the unfailing constancy of natural laws. It is a liberal education to trace the operation of one law under numberless disguises, and thus arrive at an ineradicable conviction that the same law must be reckoned with always and everywhere. The persistence of force, the laws of the composition and resolution of forces, the laws of falling bodies and projectiles, the conservation of energy, the laws of heat, to mention only a few heads of elementary scientific study, are capable, if properly unfolded and illustrated, of producing in any mind open to large thoughts a sense of harmony and a trust in the underlying reason of things, which are constitutive elements of the very highest culture. Only, care must be taken to approach these studies in a right spirit. There is a way of regarding the laws of Nature which tends to vulgarize rather than refine the mind. If we approach Nature merely as something to be exploited, we get no culture from the study of it; but if we approach it as the great men of old did, and feel that in learning its laws we are grasping the thoughts which went to the building of the universe, and, by so doing, are affirming our own high calling as intelligent beings, then every moment given to the study of Nature means intellectual, moral, and spiritual gain. When we look into literature there is much to charm, much to delight and satisfy; and doubtless, in relation to what any one man can accomplish, the field is infinite; but still we know we are looking into the limited. On the other hand, when we are face to face with Nature, we know we are looking into the infinite, and that, however many veils we may take away, there is still "veil after veil behind."

It is needless to say that there are thousands of minds in the world possessed of good native power, but laboring under serious disability for the want of that culture which science alone can bestow. Some of these are sick with morbid longings for unattainable knowledge, and openly or secretly rebellious at the limitations of a Nature whose powers they have never even begun to explore. To such persons anything like an adequate insight into the harmony amid diversity of Nature's laws would come with all the force of a revelation, and would, we may well believe, clear their minds of the feverish fancies which have made them so restless and dissatisfied; but, alas! it is rarely that such enlightenment comes to those who have not in youth imbibed a portion of the scientific spirit. In this class are to be found the victims of spiritualism, of the Keeley motor, and even of that grotesque satire, the success of which we remember almost with fear and [Pg 844] trembling, the "sympsychograph." Still, to all such we would say:

> "Come forth into the light of things;
> Let Nature be your teacher."

The "Nature" which we require to teach us for the peace and tranquillity of our souls is the Nature of everyday phenomena, the Nature that forms the clouds and rounds the raindrops, that springs in the grass and pulses in the tides, that glances in the sunbeam and breathes in the flower, that works witchery in the crystal and breaks into glory in the sunset. The mind that knows what can be known of these things has feasted full of wonder and beauty, and makes no greedy demand for higher grace or mightier miracle.

Then again there are those who for want of a little elementary scientific knowledge, and particularly for want of an assured conviction that Nature gives nothing for nothing, are continually attempting the impossible in the way of projected inventions. They catch at a phrase and think it must represent a fact; they fall victims to a verbal mythology of their own manufacture. If there was much hope of their learning anything of value through disappointment, they might be left to the teaching of experience, costly as the lessons of that master are. But they do not learn: their hopes are blasted, their fortunes, if they had any, are wrecked, but their infatuations survive. Where is the inventor of a perpetual motion who ever ceased to have confidence in his peculiar contrivance? The thing may be as motionless as a tombstone, save when urged by external force into a momentary lumbering activity; but all the same, it only needs, its misguided author thinks, a little doctoring, a trifling change here or there, to make it tear round like mad. And so with other inventors of the impossible: they take counsel not with Nature, but with their own wholly incorrect notions of what the operations of Nature are. The least power of truly analyzing a natural phenomenon, and separating the factors that produce it,

would show them the falsity of their ideas; but that power they do not possess.

We can not, then, plead too strongly for the teaching of science, not with a view to results in money, but with a view to the improvement of the mind and heart of the learner, or, in other words, as a source of culture. Literature introduces us to the world of human thought and action, to the kingdom of man; and science shows us how the thought and powers of man can be indefinitely enlarged by an ever increasing acquaintance with the laws of the universe. Literature alone leaves the mind without any firm grasp of the reality of things, and science alone tends to produce a hard, prosaic, and sometimes antisocial temper. Each helps to bring out the best possible results of the other; and it is only by their joint action that human faculties and human character can ever be brought to their perfection.

SURVIVAL OF THE FITTEST.

It is singular what a propensity some writers have to misunderstand and misrepresent the views of Mr. Herbert Spencer, even upon points in regard to which he has made every possible effort to avoid occasion for misapprehension. The term "survival of the fittest" is one which Mr. Spencer himself introduced as being, perhaps, a little less open to misunderstanding than the Darwinian expression "natural selection." The latter seemed to imply purposive action, and Mr. Spencer thought that this implication would be less prominent if the phrase were changed to "survival of [Pg 845] the fittest." From the very first, however, he recognized that the difference between the two terms in this respect was, if we may so express it, purely quantitative; and he took care to make it clear that by "the fittest" he did not in the least intend to signify any form of ideal or subjective fitness, but simply a superior degree of adaptation, as a matter of actual fact, to environing conditions. The conditions at any given moment are as they are, and the "fitness" of any particular organism is such a correspondence with those conditions as permits and favors its perpetuation. The conditions do not create fitness; they merely eliminate unfitness; nor does Mr. Spencer conceive any agency as producing *ab extra* the fitness which enables an organism or a number of organisms to survive. He differs, however, from what is perhaps the dominant school of biology to-day, in holding that the higher forms of organic life are, as he expresses it, "directly equilibrated" with their surroundings through the inheritance of physical features resulting from effort and habit.

To whatever cause it may be attributed, few writers whose intellectual activity has extended over so long a term of years as Mr. Spencer's have been so consistent in their utterances at different stages as he. The "Synthetic Philosophy" is the realization of a scheme of thought no less wonderful in its coherence and solidity than in its compass, the author having planted himself from the first at a point of view which gave him a clear command of his entire field. To say that no other system of thought equally comprehensive and equally coherent exists in the world to-day would be to make a statement which few competent and dispassionate authorities would deny. Notwithstanding this, there are writers not a few, particularly of the class "who write with ease," who, as we said at the outset, have a propensity for misunderstanding Mr. Spencer, and who consequently accuse him of inconsistencies and self-contradictions for which nothing that he has ever said affords any warrant. One of these gentlemen is the Duke of Argyll, who has lately offered the world another superfluous book under the title of Organic Evolution Cross-examined. The duke particularly concerns himself with Mr. Spencer's teaching in regard to the "survival of the fittest," and Mr. Spencer, in the columns of Nature, replies to him in a brief but sufficient manner. It is safe to say that Mr. Spencer's philosophy will show Cyclopean remains generations after the name of his ducal critic shall have passed forever into the mists of oblivion; and the "survival of the fittest" will thus be illustrated in a sense in which Mr. Spencer himself never used the words.

Scientific Literature.

SPECIAL BOOKS.

The study of the methods through which the topographical features and rock forms of particular districts have been worked out, as presented in numerous popular monographs, is a fascinating one; and we can hardly doubt that many persons who would never otherwise have thought of it [Pg 846] have been made interested in geology by some of these masterly picturesque descriptions of regions with which they were superficially familiar. Other treatises on the origin of surface features, dealing with the subject more fundamentally, but likewise of limited scope, are not wanting. Yet, as Prof. *James Geikie* well says, there is no English work to which readers not skilled in geology can turn for a general account of the whole subject. Professor Geikie has therefore prepared his elaborate book on *Earth Sculpture*[14] to supply this want, to furnish an introductory treatise for those persons who may be desirous of acquiring some broad knowledge of the results arrived at by geologists as to the development of land forms generally. A vast number of geological questions are involved in the exhaustive treatment of the subject. All the forces with which geologists become acquainted in the study of the earth, and their operation, come into consideration. The effects of these forces assume aspects that vary according to the nature of the material on which they operate, and they are again modified according to the peculiar combinations of forces at work. The subject is therefore not the easy one it may be

supposed at first sight to be, and the reader who peruses Professor Geikie's work with the intention of mastering it will find he has some studying to do. Yet Professor Geikie is clear, and it is only because he has gone deeper than the others that he may be harder. The first point he insists upon is that in the fashioning of the earth's surface no hard-and-fast line separates past and present. The work has been going on for a long time, and is still in progress, under a law of evolution as true for the crust of the globe as for the plants and animals. In setting out upon our inquiry we must in the first place know something about rocks and the mode of their arrangement, of the structure or architecture of the earth's crust. This leads to the distinction between the igneous and the subaqueous, the volcanic, plutonic, and metamorphic, and the derivative rocks on which epigene agencies have performed their shaping work. These rocks have been modified in various ways, and the surface appearance of the earth has been affected by forces operating from the interior, and by external factors, the work of which is called denudation. The agents of denudation are described—air, water, heat, frost, chemical action, plants, and animals—often so closely associated in their operations that their individual shares in the final result can hardly be determined. The various influences of these factors as exerted upon different forms of geological structure and different sorts of rocks are then taken up and described as applied to land forms in regions of horizontal, or gently inclined, and of highly folded and disturbed strata, and in regions affected by normal faults or vertical displacements. Land forms due directly or indirectly to igneous action and the influence of rock character on the determination of land forms are subjects of special chapters. Glacial action is one of the most important factors in modifying the forms of northern lands, and is treated with considerable fullness. Æolian action—of the air and wind—has peculiar and important effects in arid regions, and underground water in limestone districts, and these receive attention. Then come basins—those due to crustal deformation, crater lakes, river lakes, glacial basins, and others, and coast lines. Finally, a classification is given of these land forms as plains or plateaus of accumulation and of erosion, original or tectonic and subsequent or relict hills and mountains, original or tectonic and subsequent or erosion valleys, basins, and coast lines, and the conclusions are [Pg 847] reached that we do not know, except as a matter of probability, whether we have still visible any original wrinkles of the earth's crust; and that some of the estimates of the time it has taken to produce the changes of which we witness the results have been very much exaggerated.

The curious conclusions obtained by Dr. *Le Bon* in his psychological investigations,[15] delivered to us in startling language, are said to be the fruit of extensive travel and of the personal measurement of thousands of skulls. His memoir on cervical researches, published in 1879, upholds the theory that the volume of the skull varies with the intelligence. This theory has perhaps suffered a permanent adumbration. Facts seem to prove that the bony structure of the skull, or even its cranial capacity, gives no positive indication of intellect.

In the present volume the theme of discussion is the soul of races. Anthropological classification is set aside and mankind is divided into four groups according to mental characteristics: the primitive, inferior, average, and superior races—the standard of judgment being the degree of their aptitude for dominating reflex impulses. It is perhaps worthy of note that while the Frenchman belongs to a superior race, the Semitic peoples are placed in the class below, or the average sort. For the primitive varieties it is not necessary to observe a South Sea islander, the lower strata of Europeans furnishing numerous examples. When greater differentiation is reached, the word "race" is used in a historical sense. It requires, however, more complete fusion than some nations exhibit to earn this title; for, although there are Germans and Americans, "it is not clear as yet that there are Italians." The race having been once evolved, acquires wondrous potentialities with Dr. Le Bon. He compares it to the totality of cells constituting a living organism, asserts that its mental constitution is as unvarying as its anatomical structure, that it is a permanent being independent of time and founded alone by its dead. It is a short step to endow this entity with a soul consisting of common sentiments, interests, and beliefs—what in brief, robbed of hyperbole, we should call national character. He states that the notion of a country is not possible until a national soul is formed. This, in time, like germ-plasm, becomes so stable that assimilation with foreign elements is impossible. Like natural species, it has secondary characteristics that may be modified, but its fundamental character is like the fin of the fish or the beak of the bird. The acquisition of this soul marks the apogee of the greatness of a people. Psychological species, however, are not eternal, but may decay if the functioning of their organs is troubled profoundly.

The soul of the race is best expressed in its art, not in its history or institutions, and, as it can not bequeath its soul, so it can not impress its civilization or art upon an alien race. It was on account of this incompatibility of soul that Grecian art failed to be implanted in India. The unaltering constituent of the soul corresponds to character, while intellectual qualities are variable. By character is meant perseverance, energy, power of self-control, also morality. The latter is hereditary respect for the rules on which a society is based. This definition would make polygamy a moral notion for Mormons. The knowledge of character "can be acquired neither in laboratories nor in books, but only in the course of long travel." Whence it is learned that different races can [Pg 848] not have mutual comprehension. Luckily for the student who is unable to travel, the same phenomenon may be observed in the gulf that separates the civilized man and woman. Although highly educated, "they might converse with each other for centuries without understanding one another." These differences between races and individuals demonstrate the falsity of the notion of equality. Indeed, through *science* "man has learned that to be slaves is the natural condition of all human beings." Naturally he becomes dispirited, anarchy seizes upon the uneducated and sullen indifference the more cultivated. "Like a ship that has lost its compass, the modern man

wanders haphazard through the spaces formerly peopled by the gods and rendered a desert by science." In France morality is gradually dying out, while the United States is threatened by a gigantic civil war. What to do is problematical, since we are informed "that people have never derived much advantage from too great a desire to reason and think," and what is most harmful to a people is to attain too high a degree of intelligence and culture, the groundwork of the soul beginning to decline when this level is reached. The remedy suggested to us is "the organization of a very severe military service and the permanent menace of disastrous wars." But if we fail to see the improving tendency of this advice, it is probably because we are like historians, "simple-minded," while Dr. Le Bon is much too complex for our understanding. According to his own theory, there is no hope that we may comprehend him, since the outpourings of a soul of the Latin race can not be transferred by a simple bridge of translation to the apprehension of an Anglo-Saxon mind, separated, as he would term it, by "the dead weight of thousands of generations."

GENERAL NOTICES.

In preparing the new edition of his *Text-Book of Mineralogy*[16] first published in 1877, Prof. *E. S. Dana* has found it necessary to rewrite the whole as well as to add much new matter and many new illustrations. The work being designed chiefly for use in class or private instruction, the choice of topics discussed, the order and fullness of treatment, and the method of presentation have been determined by that object. The different types of crystal forms are described under the thirty-two groups now accepted, classed according to their symmetry. In the chapters on physical and chemical mineralogy, the plan of the former edition is retained of presenting somewhat fully the elementary principles of the science on which the mineral characters depend, and the author has tried to give the student the means of becoming practically familiar with the modern means of investigation. Especial attention is given to the optical qualities of crystals as revealed by the microscope; and frequent references are introduced to important papers on the different subjects discussed. The descriptive part of the volume is essentially an abridgment of the sixth edition of Dana's System of Mineralogy, published in 1892, to which the student is referred for fuller and supplementary information. A full topical index is furnished in addition to the usual index of species.

The title, *The Story of the Railroad*,[17] carries with it the suggestion of an eventful history. The West, in the author's view, begins with the Missouri River. The story of its railroad is the story of the line, now very multiple, that leads to the Pacific Ocean. The beginning of white men's travels in these routes is traced by the editor to the Spanish adventurers of the sixteenth century, who [Pg 849] made miserable journeys in search of gold or visionary objects, through regions now traversed by some of the more southern lines. Then came trappers; next costly and painfully undertaken Government expeditions into the then regions of the unknown, the stories of which were the boyhood delight of men now living. The period of practical traversing of the continent began with the raging of the California gold fever, when the journey of many weeks was tiresomely made with ox teams, in the face of actual perils of the desert, starvation, thirst, and the Indians. After California became important, stage and express lines were put on; but still, at the time Mr. Warman takes up the story, less than sixty years ago, the idea of building a railroad to the Pacific was regarded as too visionary to be entertained, and Asa Whitney sacrificed a fortune trying to induce somebody to take it up. The first dreams were for a short route to the Orient. Eventually the idea was developed that the American West might be worth going after, and then the idea of a railroad to it began to assume practical form. Young Engineer Dodge, afterward Major General, began surveys before the civil war; after it General Sherman gave the scheme a great impulse, and the Union Pacific Railroad was built—when and how are graphically and dramatically told in Mr. Warman's book. Next came the Atchison, Topeka, and Santa Fé, and other transcontinental lines, the histories of all of which are related in similar style, with stories of adventures, perils encountered, and lively incidents, including the war between two of the lines for the possession of the Arkansas Cañon; financial mishaps, and political scandal. Then came the settlement of the plains, road-making in Mexico, and the opening of Oklahoma, all of which were made possible by the railroads, and have in turn contributed to support them. The beginnings and growth of the express business are described, and the later lines that have penetrated the plains are mentioned.

Prof. *William Benjamin Smith's* treatise on the *Infinitesimal Analysis*[18] has been written, the author says, on what appeared, in the light of ten years' experience in teaching the calculus, to be lines of least resistance. The aim has been, within a prescribed expense of time and energy, to penetrate as far as possible into the subject, and in as many directions, so that the student shall attain as wide knowledge of the matter, as full comprehension of the methods, and as clear consciousness of the spirit and power of this analysis as the nature of the case would admit. The author has accordingly often followed what seemed to be natural suggestions and impulses toward near-lying extensions or generalizations, and has even allowed them to direct the course of the discussion. In accordance with the plan and purpose of the book as given, "Weierstressian rigor" has been excluded from many investigations, and the postponement has been compelled of some important discussions, which were considered too subtle for an early age of study. Real difficulties, however, have not been knowingly disguised, and pains have been taken on occasion to warn the reader that the treatment given is only provisional, and must await further precision or delimitation. Where the subject has been found too large for the compass of the intended work, or too abstruse or difficult for the contemplated students, the treatment has been

compressed or curtailed. The book is, in fact, written for such as feel a genuine interest in the subject; and the illustrations and exercises have been chosen with frequent reference to practical or theoretic importance or to historic interest.

Mr. *George Jacob Holyoake* has written with much enthusiasm the *Jubilee History of the Leeds Industrial Co-operative Society*.[19] Many schemes have been started on lines similar to those of this one, but very few besides it have grown from the very beginning, and, having become to all appearance a permanent institution, can look back upon a career of fifty years with complete satisfaction. The society began in times of public distress. The ground was prepared for it by the "Redemption" Society, which was founded at Leeds in 1845, by admirers of Robert Owen, after the experiment at Queenswood had failed. It practiced a kind of co-operation and had some [Pg 850] distinguished friends to wish it well. Among the speakers at its meetings was Dr. Frederic Hollick, still living, now a resident of New York city. The co-operative society was started as a means of getting cheaper flour for its members. On February 25, 1847, an appeal headed "Holbeck Anti-Corn Mill Association" was issued to the working classes of Leeds and vicinity by the "working people of Messrs. Benyon & Co.'s mill," Holbeck, inviting combination and subscriptions for establishing a mill to be the property of the subscribers and their successors, "in order to supply them with flour and flour only." Meetings were held, an organization was effected, and the mill was started. The history of the society and how it grew, how "flour only" was stricken from its scheme and other things were added and it branched out, how co-operative stores were established, how it gained the confidence of the public and the respect of rivals in business, its successes and its mistakes, its triumphs and failures, are told by Mr. Holyoake, year by year, in a detail in which everything is set down and nothing covered up. In 1897 the cooperative society had productive departments of flour, bakery, bespoke clothing, boot and shoe factory, brush factory, cabinet making, building, millinery, and dressmaking, employing 541 hands and turning over £26,949; 80 large stores for the sale of these and various other kinds of goods in Leeds and vicinity; drapery branches and boot and shoe stores; 43 butchering branches; and 37,000 subscribing purchasers. Its capital stood at £447,000; and its sales for the year amounted to £1,042,616.

D. Appleton and Company have added to their Home Reading Series *The Earth and Sky*, a primer of Astronomy for Young Readers, by Prof. *Edward S. Holden*. It is intended to be the first of a series of three or more volumes, all treating of astronomy in one form or another, and suited for reading in the school. The treatment is based on the principle that "it is not so simple as it appears to fix in the child's mind the fundamental fact that it is Nature which is true, and the book or the engraving which is a true copy of it. 'It says' is the snare of children as well as of their more sophisticated elders. The vital point to be insisted on is a constant reference from words to things." The volume is written as a conversation with a young lad. He is first shown how he may know for himself that the earth is not flat, though it certainly appears to be so. The next step is to show him that he may know that the earth is in fact round, and that it is a globe of immense size. Its situation in space is next considered, and the child's mind is led to some formal conclusions respecting space itself. It is then directed to the sun, to the moon and its changes, to the stars and their motions, to the revolution of the earth, etc.

In 1887 *E. S. Holden* published through the Regents of the University of California a list of recorded earthquakes on the Pacific coast, it being the first systematic publication of the sort. The purpose of it was to bring to light all the general facts about the various shocks, and enable studies to be made of particular earthquake phenomena. It was necessary at the Lick Observatory to keep a register of the times of occurrence of all shocks on account of their possible effects on the instruments. With this was associated in 1888, when the observatory began its active work, the collection of reports of shocks felt elsewhere on the Pacific coast. Mr. Holden now reprints this pamphlet through the Smithsonian Institution in *A Catalogue of Earthquakes felt on the Pacific Coast, 1769 to 1897*, with many corrections and additions, including a complete account of the earthquake observations at Mount Hamilton from 1887 to 1897, and an abstract of the great amount of information that has been collected regarding other Pacific coast earthquakes during the same interval.

The *Psychologie als Erfahrungs-Wissenschaft* of *Hans Cornelius* is not intended for a complete account and review of the facts of psychical life, but rather to present the fundamentals of a purely empirical theory, excluding all metaphysical views. Such an account should not start from any arbitrary abstractions or hypotheses, but simply from actually ascertained, directly perceived psychical experiences. On the other hand, an empirical definition should be required for all the terms that are used in a comprehensive description of the experience; and no term should be [Pg 851] used without the psychical manifestation described by it being pointed out. After an introduction in which the method and place of psychology, subjective and objective, physiological and genetic, are referred to, the elementary facts of consciousness are discussed. The coherency of knowledge is treated of in the next chapter, and in the third, Psychical Analysis and the conception of unobserved consciousness; and the succeeding chapters are devoted to Sensation, Memory, and Fancy; The Objective World, Truth and Error, and Feeling and Will. (Published at Leipsic, Germany: B. G. Teubner.)

An extremely interesting book is given us in the publications of the Wisconsin Geological and Natural History Society of studies by *George W.* and *Elizabeth Peckham*, of the *Instincts and Habits of the Solitary Wasps*. These insects are familiar enough to us all, as we meet them or see their nests of one or a few cells every day, and then think no more of them. But Mr. and Mrs. Peckham, following them to their haunts and keeping company with them, have found them

manifesting remarkable instincts and exercising curious customs, which they describe in the style of persons who are in love with their work. The opportunity for the studies was given in two gardens, one on the top of a hill and the other lower down, with an island in a lake close by and acres of woodland all about, offering a rich variety of nesting places. There are more than a thousand species of these solitary wasps in the United States, to only about fifty of the social ones, and they live without knowledge of their progenitors and without relations with others of their kind.

The eighth volume of the report of the *Iowa Geological Survey* comprises the accounts of surveys completed during 1897 in six counties, making up the whole number of twenty-six counties in which the areal work has been completed. This does not, however, represent the whole extent of the operations of the survey, for some work has been done in nearly every county in the State, and in many counties it will require but little additional work to make a complete report. In addition to the areal work, too, special studies of coal, clay, artesian waters, gypsum, lead, zinc, etc., have engaged attention. A growing public appreciation of the work of the survey as illustrated in the demand for the volumes of the reports and for special papers, is recognized by the State Geologist, Mr. *Samuel Calvin*; and an increasing use of the reports as works for reference and for general study in high schools and other educational institutions is observed. The survey is now collecting statistics of production of various minerals mined in the State.

One of the features most likely to attract attention in the *Annual Report of the State Geologist* of New Jersey for 1897 is the paper of Mr. C. C. Vermeule on the Drainage of the Hackensack and Newark Tide Marshes. In it a scheme is unfolded for the reclamation and diking of the flats, under which an ample navigable waterway shall be developed, and the cities which now stop at their edges may be extended and built up to the very banks of the new harbor, made a highway for ocean sailing vessels. An interesting paper is published by Lewis Woolman on Artesian and Bored and other Wells, in which many important wells are described with reference to the geological strata they penetrate. Other papers relate to iron mining and brick and clay industries, mineral statistics, and statistics of clays, bricks, and terra cotta. The field reports describe progress in the surveys of the surface geology, the Newark system, and the upper Cretaceous formations.

On the basis of a reconnoissance made by him for Alexander Agassiz, Mr. *Robert T. Hill* has published through the Bulletin of the Museum of Comparative Zoölogy at Harvard University, a paper on *The Geological History of the Isthmus of Panama and Portions of Costa Rica*. He finds that there is considerable evidence that a land barrier in the tropical region separated the two oceans as far back as Jurassic time, and continued through the Cretaceous period. The geological structure of the Isthmus and Central American regions, so far as investigated, when considered aside from the paleontology, presents no evidence by which the former existence of a free communication of oceanic waters across the present tropical barriers can be established. The [Pg 852] paleontological evidence indicates the ephemeral existence of a passage at the close of the Eocene period. All lines of inquiry give evidence that no communication has existed between the two oceans since the close of the Oligocene.

The *Twenty-second Annual Report of the Department of Geology and Natural Resources* of Indiana, *W. S. Blatchley*, State Geologist, embraces, in part, the results of the work of the several departments of the survey during 1897. These appear in the form of papers of economic importance on the petroleum, stone, and clay resources of the State, natural gases and illuminating oils, a description of the curious geological and topographical region of Lake and Porter Counties, and an extended paper on the Birds of Indiana, with specific descriptions. A large proportion of the energies of the department were employed during the year in gathering data for a detailed report on the coal area of the State, which is now in course of preparation.

The *Report of the United States Commissioner of Education* for 1896-'97 records an increase in the enrollment of schools and colleges of 257,586, the whole number of pupils being 14,712,077 in public institutions and schools, and 1,513,016 in private. The increase is confined to the public institutions, the private ones having suffered from "hard times." Among the numerous papers published in the volume containing the report are those on Education in Great Britain and Ireland, France, Denmark, Norway, Central Europe, and Greece; Commercial Education in Europe; the Teaching of Civics in France, Switzerland, and England; Sunday Schools, including accounts of the several denominational systems; the Legal Rights of Children; and sketches of Horace Mann and Henry Barnard and their work in furthering education.

Mr. *David T. Day's* report on the *Mineral Resources of the United States* for 1896 appears as Part V of the Eighteenth Annual Report of the United States Geological Survey, in two volumes of fourteen hundred pages in all; the first of which is devoted to Metallic Products and Coal, and the second to Nonmetallic Products except Coal. The report covers the calendar year 1896, and shows only a slight increase in total values over 1895. Of some substances, however—gold, copper, aluminum, and petroleum being the most important ones—the value was the greatest ever attained. Of other substances, including lead, bituminous coal, building stones, mineral waters, salt, and pyrites, the product was increased in amount, but the value was less. A paper, by Mr. George F. Becker, on the Witwatersrand Banket, records observations made by him in the Transvaal gold fields.

A Geological Reconnoissance of the Coal Fields of the Indian Territory, published in the Contributions to Biology of the Hopkins Seaside Laboratory of Leland Stanford Junior University, by *Noah Fields Drake*, is based upon a six months' examination made by the author during the

spring, summer, and fall of 1896, of the larger part of the coal measures and adjacent formations of Indian and Oklahoma Territories. The best maps that could then be had being exceedingly inaccurate, sketch maps were made of areas that were especially important. On account of features of particular geological interest, nearly all the area south and east of the Canadian River and the bordering areas of the Boone chert and limestones were sketched and studied rather closely.

The *American Catholic Historical Society* at Philadelphia publishes in its *Quarterly Records* much that, while it must be of deep interest to historical students holding the Roman Catholic faith, possesses, perhaps, a strong though more general interest to all students of American history; for the men of that faith have had no small part in the colonization and development of this country. The number for June, 1898, contains a portrait and a bibliographical sketch of the Rev. Peter Henry Lemke, O. S. B., of Pennsylvania, Kansas, and Elizabeth, N. J.; a poem on the Launch of the American Frigate United States, whose commander was a Catholic; articles on the Sir John James Fund, and Catholic Chronicles of Lancaster, Pa., and Extracts from the Diary of the Rev. Patrick Kenny.

A memoir on *A Determination of the Ratio (χ) of the Specific Heats at Constant Pressure and at Constant Volume for Air, Oxygen, Carbon Dioxide, and Hydrogen* gives the result of a series of [Pg 853] investigations by Drs. *O. Lummer* and *E. Pringshein*, of Charlottenburg, Germany, made with the aid of a grant from the Hodgkins Fund of the Smithsonian Institution. Besides being of exceptional importance in thermodynamics, the specific heat ratio is of interest as affording a clew to the character of the molecule. In the present investigation coincident results on the gases examined appear to have been reached for the first time. (Published by the Smithsonian Institution.)

From the greater lightness of the air and the higher velocity of its currents, it is evident that the materials it may carry and deposit will be somewhat different in composition and structure from those which are laid down in water. They are as a rule finer, they exhibit a different bedding, and are more capriciously placed. Mr. *Johan August Udden* has made a careful study of the subject, the results of which he publishes under the title of *The Mechanical Composition of Wind Deposits*, as the first number of the Augustana Library Series, at the Lutheran Augustana Book Concern, Rock Island, Ill.

The *History Reader for Elementary Schools* (The Macmillan Company, 60 cents), prepared by *L. L. W. Wilson* and arranged with special reference to holidays, contains readings for each month of the school year, classified according to different periods and phases of American history generally, so chosen that some important topic of the group shall bear a relation to the month in which it is to be read. The groups concern the Indians, the Discovery of America, Thanksgiving, Other Settlements (than those of Virginia and the Pilgrims), Dr. Franklin, Lincoln and Washington, the Revolution, Arbor Day, and Brave Sea Captains, etc., closing with articles in reference to Flag Day. The insertion of an article on the War with Spain seems premature. Public sentiment is not yet at rest on the subject.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Cornell University: No. 160. Hints on Rural School Grounds. By L. H. Bailey. Pp. 20; No. 161. Annual Flowers. By G. N. Lanman and L. H. Bailey. Pp. 32; No. 162. The Period of Gestation in Cows. By H. H. Wing. Pp. 120.—Delaware College: No. 43 (abridged edition). The European and Japanese Chestnuts in the United States. By G. H. Powell. Pp. 16.—Michigan: Nos. 164 and 165. Methods and Results of Tillage, and Draft of Farm Implements. By M. W. Fulton. Pp. 24; Elementary Science Bulletin, No. 5. Branches of Sugar Maple and Beech as seen in Winter. By W. J. Beal. Pp. 4; do., No. 6. Potatoes, Rutabagas, and Onions. By W. J. Beal. Pp. 6.—New Jersey: No. 133. Peach Growing in New Jersey. By A. T. Jordan. Pp. 16; No. 134. Fermentation and Germ Life. By Julius Nelson. Pp. 24.—North Dakota: No. 15. Some Chemical Problems Investigated. Pp. 28.—Ohio: Newspaper Bulletin 188. Sugar Beets and Sorghum in Ohio. Pp. 2.

Aston, W. G. A History of Japanese Literature. New York: D. Appleton and Company. Pp. 408. $1.50.

Berry, Arthur. A Short History of Astronomy. New York: Charles Scribner's Sons. Pp. 440. $1.50.

Brush and Pencil. An Illustrated Magazine of the Arts and Crafts. Monthly. Chicago: Arts and Crafts Company. Pp. 64. 25 cents. $2.50 a year.

Bulletins, Reports, etc. Colgate University, Department of Geology and Natural History: Announcement. Pp. 16.—Field Columbian Museum, Chicago: Annual Report of the Board of Directors for 1897-'98. Pp. 90, with plates.—Financial Reform Association: 1848 to 1898. Fifty Years' Retrospect. London. Pp. 54, with plates; Financial Reform Almanac for 1899. London. Pp. 316. 1 shilling.—New York State Library: Legislative Bulletin for 1898. Pp. 132. 25 cents.—New York University: Catalogue and Announcements for 1898-'99. Pp. 358.—Perkins Institution and Massachusetts School for the Blind: Sixty-seventh Annual Report of the Trustees, to August 31, 1898. Pp. 305.—United States Department of Labor: Bulletin No. 20, January, 1899. Edited by Carroll D. Wright and Oren W. Weaver. Pp. 170.

Byrd, Mary E. Laboratory Manual in Astronomy. Boston: Ginn & Co. Pp. 273.

Cajori, Florian. A History of Physics in its Elementary Branches, including the Evolution of Physical Laboratories. New York: The Macmillan Company. Pp. 323. $1.60.

Callie, J. W. S. John Smith's Reply to "Merrie England, Defense of the Liberal Programme." London: John Heywood. Pp. 88. Sixpence.

Chapman, Frank H., Editor. Bird Lore. February, 1898, Vol. I, No. 1. Bimonthly. New York: The Macmillan Company. Pp. 32. 20 cents. $1 a year.

Davenport, Charles B. Experimental Morphology. Part II. New York: The Macmillan Company. Pp. 509. $2.

Evans, A. H. Birds (The Cambridge Natural History, edited by S. F. Harmer and A. E. Shipley, Vol. IX). New York: The Macmillan Company. Pp. 635. $3.50.

Egbert, Seneca. A Manual of Hygiene and Sanitation. Philadelphia: Lea Brothers & Co. Pp. 368.

Foulke, William Dudley. Slav or Saxon: a Study of the Growth and Tendencies of Russian Civilization. New York: G. P. Putnam's Sons. Pp. 141. $1.

Huntington, Elon. The Earth's Rotation and its Interior Heat. Pp. 33.

Janes, Lewis G. Our Nation's Peril. Social Ideas and Social Progress. Pp. 31. 25 cents. [Pg 854]

McLellan, J. A., and Ames, A. F. The Public School Mental Arithmetic. New York: The Macmillan Company. Pp. 138. 25 cents. Boston: James H. West & Co.

Maltbie, Milo Ray. Municipal Functions. A Study of the Development, Scope, and Tendency of Municipal Socialism. (Municipal Affairs, December, 1898.) New York: Reform Club, Committee of Municipal Administration. Pp. 230. 75 cents.

Mason, Hon. William E. Speech in the United States Senate on the Government of Foreign Peoples. Pp. 26.

Patten, Simon N. The Development of English Thought. New York: The Macmillan Company. Pp. 415. $3.

Pittsburg Press Almanac, The, for 1899. Quarterly. St. Louis: The Press Publishing Company. Pp. 536.

Récéjac, E. Essay on the Basis of the Mystic Knowledge. Translated by Sera Carr Upton. New York: Charles Scribner's Sons. Pp. 287. $2.50.

Reprints. Caldwell, Otis W. The Life History of Lemna Minor. Pp. 32.—Calkins, G. N. Some Hydroids from Puget Sound. Pp. 24, with six plates.—Cope, Edward D. Vertebrate Remains from the Port Kennedy Bone Deposit. Pp. 75, with plates.—Fitz, G. W. Play as a Factor in Development. Pp. 7; The Hygiene of Instruction in Elementary Schools. Pp. 7.—Howard, William Lee. Double Personality; Lenten Hysteria. Pp. 8.—Howe, R. H., Jr. North American Wood Frogs.—Hunt, Charles Wallace. The Engineer: His Work, his Ethics, his Pleasures. (President's Address, American Society of Mechanical Engineers.) Pp. 15.—Hunter, S. J. The Coccidæ of Kansas. Pp. 15, with plates.—Krauss, W. C. The Stigmata of Degeneration. Pp. 360.—Lichty, D. Thalassic Submersion a Means of Disposal of the Dead. Pp. 12.—McDonald, Arthur. Emile Zola. Pp. 16.—Phillips, W. B. Iron Making in Alabama. Montgomery. Pp. 380.—Saunders, De Alten. Phycological Memoirs. Pp. 20, with plates.—Schlicht, Paul J. A New Process of Combustion. Pp. 32.—Stevens, F. L. The Effect of Aqueous Solutions upon the Germination of Fungus Spores. Pp. 30.—Stock, H. H. The International Correspondence Schools, Scranton, Pennsylvania. Pp. 12.—Urn, The. Modern Thought on Modern Cremation. United States Cremation Company. Pp. 40.—Veeder, M. A. The Relative Importance of Flies and Water Supply in Spreading Disease. Pp. 8.

Robinson, Albert Gardner. The Porto Rico of To-day. New York: Charles Scribner's Sons. Pp. 240, with maps. $1.50.

Salazar, A. E. Kalkules de Kañerius de Agua (Calculations of Water Conduits). Santiago de Chile. Pp. 246.

Schnabel, Dr. Carl. Handbook of Metallurgy. Translated by Henry Louis. 2 vols. New York: The Macmillan Company. Pp. 876 and 732. $10.

Seligman, E. R. A. The Shifting and Incidence of Taxation. Second edition. New York: The Macmillan Company. Pp. 337. $3.

Semon, Richard. In the Australian Bush and on the Coast of the Coral Sea. New York: The Macmillan Company. Pp. 552. $6.50.

Spencer, Baldwin, and Gillen, F. J. The Native Tribes of Central Australia. New York: The Macmillan Company. Pp. 671, with plates. $6.50.

Technology Review, The. A Quarterly Magazine relating to the Massachusetts Institute of Technology. January, 1899. Pp. 143. 35 cents.

United States National Museum. Annual Report for the Year ending June 30, 1896. (Smithsonian Institution.) Washington. Pp. 1107, with plates.

Weir, James. The Dawn of Reason. Mental Traits in the Lower Animals. New York: The Macmillan Company. Pp. 234. $1.25.

Westcott, Edward N. David Harum. New York: D. Appleton and Company. Pp. 392. $1.50.

Whipple, G. C. The Microscopy of Drinking Water. New York: John Wiley & Sons. Pp. 300, with nineteen plates. $3.50.

Wilkinson, F. The Story of the Cotton Plant. (Library of Useful Stories.) New York: D. Appleton and Company. Pp. 191. 40 cents.

Fragments of Science.

The Nernst Electric Lamp.—Prof. Walter Nernst, of the University of Göttingen, has recently devised an electric lamp which promises to be an important addition to our present methods of lighting. The part of the lamp which emits the light consists of a small rod of highly refractory material, said to be chiefly thoria, which is supported between two platinum electrodes. The rod is practically a nonconductor when cold, but by heating it (in the smaller sizes a match is sufficient) its conductivity is so raised that a current will pass through it; after the current is once started the heat produced by the resistance of the rod is sufficient to keep up its conductivity, and the latter is raised to a state of intense incandescence, and gives out a brilliant white light. As the preliminary heating by means of a match or other flame would in some cases be an inconvenience, Professor Nernst has devised a lamp which, by means of a platinum resistance attachment, can be started by simply turning a switch. The life of the rods is about five hundred [Pg 855] hours. The lamps are said to work equally well with either alternating or direct currents, and there is no vacuum necessary. If this lamp proves a success as a commercial apparatus, it will be but another example of how slight a matter may make all the difference between success and failure. There have been numerous experimenters trying for the last ten years, and in fact ever since the appearance of the arc lamp, to utilize in an electric lamp the great light-giving power of the refractory earths in a state of incandescence; but, owing to their high resistance at ordinary temperatures, no results were obtained until Professor Nernst thought of heating his thoria rod, and this simple procedure seems to have solved the whole difficulty. It is claimed that the Nernst lamp is a much more economical transformer of electricity into light than the present incandescent electric lamps. An apparatus called a kaolin candle, which has been suggested as an anticipation of Professor Nernst's lamp, was constructed by Paul Jablochkoff in 1877 or 1878. It consisted of a strip of kaolin, along which ran a "match" of some conducting material. The current was passed through this "match" until the kaolin strip became heated sufficiently to become a conductor itself. The lamp did not, however, prove a commercial success.

Laws of Climatic Evolution.—The problem of the laws of climatic evolution was characterized by Dr. Marsden Manson, in a paper read at the British Association, as one of the grandest and most far-reaching problems in geological physics, since it embraces principles and laws applicable to other planets than ours. After presenting a formulation of those laws, the author pointed out that in consequence of their working, a hot spheroid rotating in space and revolving about a central sun, and holding fluids of similar properties to water and air within the sphere of its control, must pass through a series of uniform climates at sea level, gradually decreasing in temperature and terminating in an ice age, and that this age must be succeeded by a series of zonal climates gradually increasing in temperature and extent. The conclusions thus reached were that in the case of the earth zonal distribution of climates was inaugurated at the culmination of the ice age, and is gradually increasing in temperature and extent by the trapping of the solar energy in the lower atmosphere, and that the rise has a moderate limit; that the ice age was unique and due to the physical properties of water and air, and to the difference in specific heat of land and water; and that prior to the ice age local formation of glaciers could occur at any latitude and period. Dr. Manson then observed that Jupiter was apparently in a condition through which the earth has already passed, and Mars was in one toward which the climatic evolution of the earth was tending.

Poisonous Plants.—Statistics in regard to poisonous plants are lacking on account of a general ignorance of the subject, and it is therefore impossible to form even an approximate estimate of the damage done by them. Besides the criminal uses that may be made of them, there are some other problems connected with them that are of general public interest. The common law of England holds those who possess and cultivate such plants responsible for damages accruing from them; and a New York court has awarded damages in a case of injury from poison ivy growing in a cemetery. In order to obtain information on the subject, the botanical division of the Department of Agriculture arranged to receive notices through the clipping bureaus of the cases of poisoning recorded in the newspapers. Thus through the persons named in the articles or through the local postmaster it was put in correspondence with the physician in the case, who furnished the authentic facts. A large number of correct and valuable data were thus secured. It is proved by these facts that all poisonous plants are not equally injurious to all persons nor to all forms of life. Thus poison ivy has no apparent external effect upon animals, and a few of them eat its leaves with impunity; and it acts upon the skin of the majority of persons with varying intensity—on some hardly at all, while others are extremely sensitive to it. A similar variability is found in the effects of poisonous plants taken internally. In some cases often regarded as of that

kind, death is attributable not to any poison which the plant contains, but to immoderate or incautious eating, or to mechanical injury such as is produced in horses by the hairs of crimson clover, or to the effect of parasitic growths, such as ergot on rye. Excluding all which operate in these ways, there are, however, a large number of really poisonous plants, the properties of which are comparatively unknown. It is concerning these that information has been sought by the botanical division. Its report contains descriptions of about forty plants, with figures, belonging to seventeen families. [Pg 856]

The United States Biological Survey.—The Biological Survey of the United States Department of Agriculture aims to define and map the agricultural belts of the country in order to ascertain what products of the soil can and what can not be grown successfully in each, to guide the farmer in the intelligent introduction of foreign crops, and to point out his friends and his enemies among the native birds and animals. For information on these subjects so important to him the farmer has had to rely on his own experiments or those of his neighbors, often carried on at enormous cost to persons little able to bear it. The Survey and its predecessor, the division of ornithology and mammology, have had small parties in the field traversing the public domain for the purpose of studying the geographic distribution of our native land animals and plants and mapping the boundaries of the areas they inhabit. It was early learned that North America is divisible into seven transcontinental belts or life zones and a much larger number of minor areas or *faunas*, each characterized by particular associations of animals and plants. The inference was natural and has been verified that these same zones and areas, up to the northern limit of profitable agriculture, are adapted to the needs of particular kinds or varieties of cultivated crops. The Survey is engaged in tracing as precisely as possible the actual boundaries of these belts and areas, and in finding out and designating the varieties of crops best adapted to each. In this undertaking it aims to point out such exotic products as, from their importance in other lands, are likely to prove of value if introduced on fit soils and under proper climatic conditions. The importance of this work will be realized when it is recollected that all the climatic life zones of the world, except the hottest tropical, are represented in our country. The colored maps prepared by the Survey furnish the best guide the farmer can have for judging what crops will be best adapted for his particular region; and in connection with the work of the entomologist, show the belts along which noxious insects are likely to spread. The report of the Survey, prepared under the direction of its chief, C. Hart Merriam, though full of valuable information not before presented consecutively, is preliminary and only touches the edge of a subject which is susceptible of copious elaboration, and is destined to be worked up with immense profit.

A Neolithic Lake Dwelling.—A crannog, or lake dwelling, discovered in the summer of 1898 on the banks of the Clyde, has received much attention from English archæologists because of its unique situation on a tidal stream, and of its being apparently neolithic or far more ancient than any other crannog yet examined, in all others the relics being of the bronze age. Careful excavations have been made in it and are still in progress, and the refuse mound of the former settlement has been sifted, with results that have made it plain that there were design and execution in the building, and that it was occupied and inhabited for a long period. Positive evidence of fire is afforded in the shape of numerous firestones and calcined embers, and indications of the condition of life at the period are given by the implements, ornaments, and tools recovered. The crannog is about sixteen hundred yards east of the Castle Rock of Dumbarton, and about fifty yards from the river at low tide, but is submerged when the tide is in to a depth of from three to twelve feet, and is one hundred and eighty-four feet in circuit. The piles in the outer circle are of oak, which below the mud surface is still quite fresh. The transverse beams and pavement inside are of wood of the consistence of cheese—willow, alder, and oak—while the smaller branches are of fir, birch, and hazel, with bracken, moss, and chips. The stones in the outer circle and along the causeway leading to the dwelling place seem to have been set in a methodical order, most of the bowlders being about a lift for a man. The refuse mound extends for about twelve feet outside for the greater part of the circuit, and here most of the bone and flint implements have been discovered. The largest article found in the site was a very fine canoe, thirty-seven feet long and forty inches beam, dug out of a single oak tree, which lay in what has proved to have been a dock. A curious ladder was also found here, the rungs of which were cut out of the solid wood, and which has somewhat the general appearance of a post of a post-and-rail fence. The exploration of the site is much interfered with by the rising of the tide, which covers the crannog for a considerable time every day. All the relics found—consisting chiefly of objects of bone, staghorn, jet, chert, and cannel coal, with some querns, the canoe, ladder, etc.—have been placed in the museum at Glasgow. [Pg 857]

Portland Cement.—The following facts are taken from an address delivered before the Franklin Institute by Mr. Robert W. Lesley: "It was not until the end of the last century that the true principles of hydraulic cement were discovered by Smeaton, who, in the construction of the Eddystone Lighthouse, made a number of experiments with the English limestones, and laid down, as a result, the principle that a limestone yielding from fifteen to twenty-five per cent of residue when dissolved in hydrochloric acid will set under water. These limestones he denominated hydraulic limestones, and from the principle so laid down by him come the two great definitions of what we now know as cement, namely, the natural and artificial cements of commerce. The natural variety, such as the Rosendale, Lehigh, and Cumberland cements, was first made by Joseph Parker in 1796, who discovered what he called 'Roman cement,' based upon the calcination at low temperatures of the nodules found in the septaria geological formation in England. This was practically the first cement of commerce, and gave excellent results. Joseph Aspdin, a bricklayer or plasterer, took out a patent in England in 1824 on a high-grade artificial cement, and, at great personal deprivation, succeeded in manufacturing it on a commercial scale

by combining English chalks with clay from the river beds, drying the mixed paste, and after calcining at high heat the material thus produced, grinding it to powder. This cement, which was the first Portland cement in the market, obtained its name from its resemblance when it became stone to the celebrated Portland stone, one of the leading building materials in England. The rocks used in the manufacture of Portland cement are very similar to those from which natural cement is made. The various layers in the natural rock may vary in size or stratification, so that the lime, alumina, and silica may not be in position to combine under heat, or there may be too much of one ingredient, or not enough of the others in close proximity to each other. In making Portland cement, these rocks, properly proportioned, are accordingly ground to an impalpable powder, the natural rock being broken down and the laminæ distributed in many small grains. This powder is then mixed with water, and is made into a new stone in the shape of the brick, or block, in which all the small grains formerly composing the laminæ of the original rock are distributed and brought into a close mechanical juxtaposition to each other. The new rock thus made is put into kilns with layers of coke, and is then calcined at temperatures from 1,600° to 1,800°. The clinker, as it comes from the kiln, is then crushed and ground to an impalpable powder, which is the Portland cement of commerce. Portland cement may be made from other materials, such as chalk and clay, limestone and clay, cement rock and limestone, and marls and clays. In every case the principle is the same, the breaking down and the redistributing of the materials so that the fine particles may be in close mechanical union when subjected to the heat of the kiln."

The French Nontoxic Matches.—It is believed, by Frenchmen at least, that the problem long sought, of finding a composition for a match head in which all the advantages of white phosphorus shall be preserved while its deleterious qualities are eliminated or greatly reduced, has been solved in the new matches which the French Government has placed upon the market. These matches are marked S. C., by the initials of the inventors, MM. Sévène and Cahen, are made in the factories at Trélazé, Begles, and Samtines, and have been well received by the public. In preparing the composition, the chlorate of potash of the old flashing and safety [Pg 858] matches has been retained, and the sesquisulphide of phosphorus is used instead of the white or red phosphorus of the old matches. The latter substance, besides the indispensable qualities of fixity and resistance to atmospheric influences, has the two important properties of inflaming at 95° C., much nearer the igniting point of white phosphorus (60° C.) than of red (260° C.), and being therefore easier to light; and of having a low latent or specific heat. With these properties embodied in the inflammable composition of the head, the new match is expected to be comparatively free from accidental explosions during manufacture and export, to take fire by friction, and to burn steadily and regularly. The expectation has so far been fulfilled. The phosphorus compound has a special odor, in which the sulphur characteristic predominates, but, not boiling under 380° C., does not become offensive in the shops; and the match heads made with it do not emit the phosphorescence which is often exhibited by matches made with white phosphorus. It is only feebly toxic by direct absorption, experiments on guinea pigs indicating that it is only about one tenth as much so as white phosphorus.

Trees as Land Formers.—John Gifford, in a paper presented to the Franklin Institute on Forestry in Relation to Physical Geography and Engineering, mentions as illustrating the way forests counteract certain destructive forces, the mangrove tree as "the great land former which, supplementing the work of the coral polyp, has added to the warm seashore regions of the globe immense areas of land." The trees grow in salt water several feet deep, where their labyrinth of roots and branches collect and hold sediment and flotage. Thus the shore line advances. The seeds, germinating on the plant, the plantlets fall into the water, float away till their roots touch the bottom, and there form the nucleus of new islands and life. The forest constantly improves the soil, provided the latter is not removed or allowed to burn. The roots of trees penetrate to its deeper layers and absorb great quantities of mineral matters, a large percentage of which goes to the leaves, and is ultimately deposited on the surface. "The surface soil is both enriched by these mineral substances and protected by a mulch of humus in varying stages of decomposition. As the lower layers rot, new layers of leaves and twigs are being constantly deposited, so that the forest soil, in the course of time, fairly reeks with nourishing plant food, which seeps out more or less to enrich neighboring soils." The forest is also a soil former. "Even the most tender rootlet, because of its acidity, is able to dissolve its way through certain kinds of rock. This, together with the acids formed in the decomposition of humus, is a potent and speedy agent in the production of soil. The roots of many species of trees have no difficulty whatever in penetrating limestone and in disintegrating rocks of the granitic series. As the rock crumbles, solid inorganic materials are released, which enrich neighboring soils, especially those of the valleys in regions where the forest is relegated to the mountain sides and top, as should be the case in all mountainous regions. In view of the destruction caused by mankind, it is a consoling fact that Nature, although slowly, is gradually improving her waste lands. If not interrupted, the barest rock and the fallowest field, under conditions which may be called unfavorable, will become, in course of time, forest-clad and fertile. The most important function of the forest in relation to the soil, however, is in holding it in place and protecting it from the erosive action of wind and rain."

The Atlantic Slope.—The Atlantic slope of the United States is described in the New Jersey State Geological Survey's report on the Physical Geography of the State as "a fairly distinct geographical province. Its eastern boundary is the sea; its western boundary on the north is the divide between the drainage flowing southeast to the sea and that flowing northeast to the St. Lawrence. Farther south its western limit is the divide between the streams flowing east to the Atlantic and those flowing west to the Ohio and Mississippi Rivers." The line between it and the geographical province next west follows the watershed of the Appalachian system of mountains.

It is divided, according to elevations, into several subprovinces, all of which elongate in a direction roughly parallel to the shore. Next to the coast there is usually a belt of lowland, few or [Pg 859] many miles wide, called the *Coastal Plain*. Inland from the Coastal Plain is an intermediate height, between the Coastal Plain to the east and the mountains to the west, known in the South as the *Piedmont Plateau*. The mountainous part of the slope constitutes the third province, known as the *Appalachian Zone*. The Atlantic slope may be divided into two sections—a northern and a southern—in which the Coastal Plain is narrow and wide respectively. These two sections meet in New Jersey, where the division runs from the Raritan River, just below New Brunswick, to Trenton. South of this line the Coastal Plain expands, and all considerable elevations recede correspondingly from the shore. These three subprovinces are especially well shown in the southern section of the Atlantic slope. They are less well developed in the northern section, and even where the topography is comparable the underlying rock structure is different. In New Jersey a fourth belt, the Triassic formation, is interposed between the Coastal Plain and the Highlands corresponding to the Piedmont Plateau. North of New Jersey the Coastal Plain has little development, though Long Island and some small areas farther east and northeast are to be looked upon as parts of it.

American Fresh-water Pearls.—The facts cited by Mr. George F. Kunz in his paper, published in the Report of the United States Fish Commission, on the Fresh-water Pearls and Pearl Fisheries of the United States, give considerable importance to this feature of our natural history. The mound explorations attest that fresh-water pearls were gathered and used by the prehistoric peoples of the country "to an extent that is astonishing. On the hearths of some of these mounds in Ohio the pearls have been found, not by hundreds, but by thousands and even by bushels—now, of course, damaged and half decomposed by centuries of burial and by the heat of superficial fires." The narratives of the early Spanish explorers make several mentions of pearls in the possession of the Indians. For a considerable period after the first explorations, however, American pearls attracted but little attention, and "for some two centuries the Unios [or 'fresh-water mussels'] lived and multiplied in the rivers and streams, unmolested by either the native tribes that had used them for food, or by the pioneers of the new race that had not yet learned of their hidden treasures." Within recent years the gathering of Unio pearls has attained such importance as to start economical problems warranting and even demanding careful and detailed inquiry. The first really important discovery of Unio pearls was made near Paterson, N. J., in 1857, in the form of the "queen pearl" of fine luster, weighing ninety-three grains, which was sold to Eugénie, wife of Napoleon III, for twenty-five hundred dollars, and is now worth four times that amount. As a result the Unios at Notch Brook, where it was found, were gathered by the million and destroyed. Within a year fully fifteen thousand dollars' worth of pearls were sent to the New York market. Then the shipments gradually fell off. Some of the best American pearls that were next found were at Waynesville, Ohio, where Mr. Israel H. Harris formed an exceedingly fine collection. It contained more than two thousand specimens, weighing more than as many grains. Among them were one button-shaped on the back and weighing thirty-eight grains, several almost transparent pink ones, and one showing where the pearl had grown almost entirely through the Unio. In 1889 a number of magnificently colored pearls were found at different places in the creeks and rivers of Wisconsin, of which more than ten thousand dollars' worth were sent to New York within three months. These discoveries led to immense activity in pearl hunting through all the streams of the region, and in three or four seasons the shells were nearly exhausted. The pearl fisheries of this State have produced at least two hundred and fifty thousand dollars' worth of pearls since 1889. Another outbreak of the "pearl mania" occurred in Arkansas in 1897, and extended into the Indian Territory, Missouri, Georgia, and other States.

Distribution of Cereals in the United States.—To inquiries made preparatory to drawing up a report on the Distribution of Cereals in North America (Department of Agriculture, Biological Survey), Mr. C. S. Plumb received one thousand and thirty-three answers, eight hundred and [Pg 860] ninety-seven of which came from the United States and the rest from the Canadian provinces. These reports showed that in many localities, particularly in the East and South, but little attention is paid to keeping varieties pure, and many farmers use mixed, unknown, or local varieties of ordinary merit for seed. In New England but little grain is grown from sowing, owing to the cheapness of Western grain, and wheat is rarely reported. Oats are now mostly sown from Western seed, and the resulting crop is mown for hay, while most of the corn is cut for green fodder or silage. On certain fine lowlands—as, for example, in the Connecticut Valley—oats, and more especially corn, are often grown for grain. While reports on most of the cereals were rendered from the lower austral zone, or the region south of the Appalachians and the old Missouri Compromise line, this region, except where it merges with the upper austral or the one north of it, is apparently outside the area of profitable cultivation of wheat and oats. In Louisiana and most of the other parts of the lower austral, except in northern Texas and Oklahoma, wheat is almost an unknown crop. The warm, moist climatic conditions here favor the development of fungous diseases to such a degree that the plants are usually ruined or greatly injured at an early stage of growth. In Florida, as a rule, cereals are rarely cultivated except on the uplands at the northern end of the State. In a general way, corn and wheat are most successfully grown in the upper austral zone, or central States, while oats are best and most productive in the transition zone (or northern and Lake States and the Dakotas), or along the border of the upper austral and transition. The gradual acclimation of varieties of cereals, through years of selection and cultivation, has gone so far, however, that some varieties are now much better adapted to one zone than to another.

Spanish Silkworm Gut.—The business of manufacturing silkworm gut in Spain is a considerable industry. The method of preparation is thus described in the Journal of the Society of Arts: After

the silkworm grub has eaten enough mulberry leaves, and before it begins to spin, which is during the months of May and June, it is thrown into vinegar for several hours. The insect is killed and the substance which the grub, if alive, would have spun into a cocoon is drawn out from the dead worm into a much thicker and shorter silken thread, in which operation considerable dexterity and experience are required. Two thick threads from each grub are placed for about four hours in clear cold water, after which they are put for ten or fifteen minutes in a solution of some caustic. This loosens a fine outer skin on the threads, which is removed by the hands, the workman holding the threads in his teeth. The silk is then hung up to dry in a shady place, the sun rendering it brittle. In some parts of the country these silk guts are bleached with sulphur vapor, which makes them beautifully glossy and snow-white, while those naturally dried have a yellowish tint. The quality of the gut is decided according to the healthy condition of the worm, round indicating a good quality and flat an inferior one.

The Nests of Burrowing Bees.—Prof. John B. Smith, having explained to his section of the American Association a method which has been successfully applied, of taking casts in plaster of Paris of the homes of burrowing insects, with their branchings, to the depth of six feet, described some of the results of its application. Bees, of the genus *Calletes*, dig vertically to the depth of eighteen inches or more, then burrow horizontally from two to five inches farther, and construct a thin, parchmentlike cell of saliva, in which the egg is deposited, with pollen and honey for the food of the larva. They then start a new horizontal burrow a little distance from the first, and perhaps a third, but no more. The vertical tubes are then filled up, so that when the bees come to life they must burrow from six to twenty-four inches before they can reach the surface. Another genus makes a twisted burrow; another makes a vertical burrow that may be six feet deep. About a foot below the surface it sends off a lateral branch, and in this it excavates a chamber from one to two and a half inches in diameter. Tubes are sent down from this chamber, as many perhaps as from six to twenty together, and these are lined with clay to make them water-tight. This bee, [Pg 861] when it begins its burrow, makes an oblique gallery from four to six inches long before it starts in the vertical direction, and all the dirt is carried through this oblique gallery. Then the insect continues the tube vertically upward to just below the surface, and makes a small concealed opening to it here, taking care to pile no sand near it. This is the regular entrance to the burrow.

MINOR PARAGRAPHS.

In a report of an inspection of three French match factories, published as a British Parliamentary paper, Dr. T. Oliver records as his impressions and deductions that while until recently the match makers suffered severely from phosphorus poisoning, there is now apparently a reduction in the severe forms of the illness; that this reduction is attributable to greater care in the selection of the work people, to raising the age of admission into the factory, to medical examination on entrance, subsequent close supervision, and repeated dental examination; to personal cleanliness on the part of the workers; to early suspension on the appearance of symptoms of ill health; and to improved methods of manufacture. The French Government is furthering by all possible means new methods of manufacture in the hope of finding a safer one; and a match free from white phosphorus and still capable of striking anywhere is already manufactured.

A mechanical and engineering section is to be organized in the Franklin Institute, Philadelphia, to be devoted to the consideration of subjects bearing upon the mechanic arts and the engineering problems connected therewith. The growth of the various departments of this institution—which has been fitly termed a "democratic learned society," from the close affiliation in it of the men of the professions and the men of the workshops—by natural accretion, and the steadily growing demands for the extension of its educational work during the past decade, have increased the costs for maintenance and administration and have been the cause of a deficit in nearly every year. A movement is now on foot, approved by the board of managers, and directed by a special committee, to secure for it an endowment, toward which a number of subscriptions ranging from two hundred and fifty to twenty-five hundred dollars have already been received.

The earthquake which took place in Assam, June 12, 1897, was described by Mr. R. D. Oldham in the British Association as having been the most violent of which there is any record. The shock was sensible over an area of 1,750,000 square miles, and if it had occurred in England, not a house would have been left standing between Manchester and London. Landslips on an unprecedented scale were produced, a number of lakes were formed, and mountain peaks were moved vertically and horizontally. Monuments of solid stone and forest trees were broken across. Bridges were overthrown, displaced, and in some places thrust bodily up to a height of about twenty feet, and the rails on the railroads were twisted and bent. Earth fissures were formed over an area larger than the United Kingdom, and sand rents, from which sand and water were forced in solid streams to a height of three or four feet above the ground, were opened "in incalculable numbers." The loss of life was comparatively small, as the earthquake occurred about five o'clock in the afternoon, and the damage done was reduced by the fact that there were no large cities within the area of greatest violence; but in extent and capacity of destruction, as distinguished from destruction actually accomplished, this earthquake surpassed any of which there was historical mention, not even excepting the great earthquake of Lisbon in 1755.

The first section of the electric railway up the Jungfrau, which is intended to reach the top of the mountain, was opened about the first of October, 1898. The line starts from the Little Scheidegg station of the existing Wengern Alp Railway, 6,770 feet above the sea, and ascends the mountain masses from the north side, passing the Eiger Glacier, Eiger Wand, Eismeer, and Jungfraujoch stations, to Lift, 13,430 feet, whence the ascent is completed by elevator to the summit, 13,670

feet. The road starts on a gradient of ten per cent, which is increased to twenty per cent about halfway to the Eiger Glacier station, and to twenty-five per cent, the steepest, after passing that station. There are about 85 yards in tunnel on the section now opened, but beyond the Eiger Glacier the road will not touch the surface except at the stations. About 250 yards of the long tunnel have been excavated so far. The stations beyond Eiger Wand will be built within the rock, and will be furnished with restaurants and beds. At the Eiger Wand and Eismeer stations passengers will contemplate the view through windows or balconies from the inside; but at the Jungfraujoch station tourists will be able to go out and take sledges for the great Aletsch Glacier. The cars will accommodate forty passengers each, and the company expects to complete the railroad by 1904. [Pg 862]

Alexander A. Lawes, civil engineer, of Sydney, Australia, suggests a plan of mechanical flight on beating wings as presenting advantages that transcend all other schemes. He believes that the amount of power required to operate wings and the difficulty in applying it are exaggerated beyond all measure. The wings or sustainers of the bird in flight, he urges, are held in the outstretched position without any exertion on its part; and many birds, like the albatross, sustain themselves for days at a stretch. "This constitutes its aërial support, and is analogous to the support derived by other animals from land and water." The sole work done by the bird is propulsion and elevation by the beating action of the wings. Mr. Adams's machine, which he does not say he has tried, is built in conformity to this principle, and its sails are modeled as nearly as possible in form and as to action with those of the bird. The aid of an air cylinder is further called in, through which a pressure is exerted balancing the wings. The wings are moved by treadles, and the author's picture of the aëronaut looks like a man riding an aërial bicycle.

Carborundum, a substance highly extolled by its manufacturers as an abrasive, is composed of carbon and silicon in atomic proportions—thirty parts by weight of carbon and seventy of silicon. It is represented as being next to the diamond in hardness and as cutting emery and corundum with ease, but as not as tough as the diamond. It is a little more than one and a fifth times the weight of sand, is infusible at the highest attainable heat, but is decomposed in the electric arc, and is insoluble in any of the ordinary solvents, water, oils, and acids, even hydrofluoric acid having no effect upon it. Pure carborundum is white. In the commercial manufacture the crystals are produced in many colors and shades, partly as the result of impurities and partly by surface oxidation. The prevailing colors are green, black, and blue. The color has no effect upon the hardness. Crude carborundum, as taken from the furnace, usually consists of large masses or aggregations of crystals, which are frequently very beautifully colored and of adamantine luster.

A peculiarity of Old English literary usage is pointed out by Prof. Dr. L. Kellner, of Vienna, as illustrated in a sentence like "the mob is ignorant, and they are often cruel." This is considered a bad solecism in modern English, but in Old and Middle English constructions of exactly the same kind are so often met with that it is impossible to account for them as slips and mistakes. They may be brought under several heads, as, Number (the same collective noun used as a singular and a plural); Case (the same verb or adjective governing the genitive and accusative, the genitive and dative, or the dative and accusative); Pronoun ("thou" and "ye" used in addressing the same person); Tense (past and perfect, or past and historical present used in the same breath); Mood (indicative and subjunctive used in the same clause). Finite verb and infinitive dependent on the same verb; simple and prepositional infinitives dependent on the same verb; infinitive and verbal noun used side by side; different prepositions dependent on the same verb, like Caxton's "He was eaten by bears and of lions"; direct and indirect speech alternating in the same clause. These facts, which are met with as late as 1611 (Bible, authorized version), point to the conclusion that what to us appears as a grammatical inconsistency was once considered a welcome break in the monotony of construction.

Mr. Fischer Sigwart is quoted in the *Revue Scientifique* as having studied the life of frogs for thirty years, and found that they are night wanderers, keeping comparatively quiet during the day and seeking their prey after dark. In the fall they leave their hunting grounds in the fields and woods and take refuge near swamps and ponds, passing the winter in the banks of rivers or the mud in the bottoms of ponds, whence they come out in the spring, when the process of reproduction begins. The frog is not sexually mature till it is four or five years old. The coupling process lasts from three to thirty days. Between its spring wakening and spawning the frog eats nothing except, perhaps, its own skin, which it moults periodically. After spawning, frogs leave the water and go to the fields and woods. They can be fed, when kept captive, upon insects and earthworms. [Pg 863]

NOTES.

A relation has been discovered by Professor Dolbear and Carl A. and Edward A. Bessey between the chirping of crickets and the temperature, the chirps increasing as frequently as the temperature rises. The Besseys relate, in The American Naturalist, that when, one cool evening, a cricket was caught and brought into a warm room, it began in a few minutes to chirp nearly twice as rapidly as the out-of-door crickets, and that its rate very nearly conformed to the observed rate maintained other evenings out of doors under the same temperature conditions.

C. Drieberg, of Colombo, Ceylon, records, in Nature, a rainfall at Nedunkeni, in the northern province of Ceylon, December 15 and 16, 1897, of 31.76 inches in twenty-four hours. The highest previous records, as cited by him, are at Joyeuse, France, 31.17 inches in twenty-two hours; Genoa, 30 inches in twenty-six hours; on the hills above Bombay, 24 inches in one night; and on

the Khasia Hills, India, 30 inches in each of five successive days. The average annual rainfall at Nedunkeni has been 64.70 inches, but in 1897 the total amount was 121.85 inches. The greatest annual rainfall is on the Khasia Hills, India, with 600 inches. The wettest station in Ceylon is Padupola, in the central province, with 230.85 inches as the mean of twenty-six years, but in 1897 the amount was 243.07 inches.

The Korean postage stamps are printed in the United States. As explained in the United States consular reports, they are of four denominations, and all alike except in color and denomination. Of the inscriptions, the characters on the top are ancient Chinese, and those at the bottom, having the same meaning, are Korean; the characters on the right are Korean and those on the left are Chinese, both giving the denominations, with the English translation just below the center of the stamp. The plum blossom in each corner is the royal flower of the present Ye dynasty, which has been in existence more than five hundred years, and the figures at the corners of the center piece represent the four spirits that stand at the corners of the earth and support it on their shoulders. The national emblem in the center is an ancient Chinese phallic device.

A paragraph in *La Nature* calls to mind that the year 1898 was the "jubilee" of the sea serpent, the first mention of a sight of the monster—whether fabulous or not is still undecided—having been made by the captain and officers of the British ship Dædalus in 1848. They said they saw it between the Cape of Good Hope and St. Helena, and that it was about six hundred feet long. Since then views of sea serpents have been reported nearly every year, but none has ever been caught or seen so near or for so long a time as to be positively identified. There are several creatures of the deep which, seen for an instant, might be mistaken with the aid of an excited imagination for a marine serpent; and it is not wholly impossible that some descendants of the gigantic saurians of old may still be living in the ocean undetected by science.

The results of a study of the winter food of the chickadee by Clarence M. Weed, of the New Hampshire College Agricultural Experiment Station, shows that more than half of it consists of insects, a very large proportion of which are taken in the form of eggs. Vegetation of various sorts made up a little less than a quarter of the food; but two thirds of this consisted of buds and bud scales that were accidentally introduced along with plant-lice eggs. These eggs made up more than one fifth of the entire food, and formed the most remarkable element of the bill of fare. The destruction of these eggs of plant lice is probably the most important service which the chickadee renders during its winter residence. Insect eggs of many other kinds were found in the food, among them those of the tent caterpillar and the fall cankerworm, and the larvæ of several kinds of moths, including those of the common apple worm.

The Merchants' Association of San Francisco has been trying the experiment of sprinkling a street with sea water, and finds that such water binds the dirt together between the paving stones, so that when it is dry no loose dust is formed to be raised by the wind; that sea water does not dry so quickly as fresh water, so that it has been claimed when salt water has been used that one load of it is equal to three loads of fresh water. The salt water which is deposited on the street absorbs moisture from the air during the night, whereby the street is thoroughly moist during the early morning, and has the appearance of having been freshly sprinkled. [Pg 864]

The Tarahumare people, who live in the most inaccessible part of northern Mexico, were described by Dr. Krauss in the British Association as ignorant and primitive, and many still living in caves. What villages they have are at altitudes of about eight thousand feet above the sea level. They are a small and wiry people, with great powers of endurance. Their only food is *pinoli*, or maize, parched and ground. They have a peculiar drink, called *teshuin*, also produced from maize and manufactured with considerable ceremony, which tastes like a mixture of sour milk and turpentine. Their language is limited to about three hundred words. Their imperfect knowledge of numbers renders them unable to count beyond ten. Their religion seems to be a distorted and imperfect conception of Christian traditions, mixed with some of their own ideas and superstitions.

The directory of the School of Anthropology of Paris, which consists chiefly of the professors in the institution, has chosen Dr. Capitan, professor of pathological anthropology, to succeed M. Gabriel de Mortillet, deceased, as professor of prehistoric anthropology. Dr. Capitan's former chair is suppressed.

The highest cog-wheel railroad in Europe and probably in the world is the one from Zermatt, Switzerland, to the summit of the Görner Grat, upward of eleven thousand five hundred feet above the sea. It is between five and six miles long, and rises nearly fifty-two hundred feet, with a maximum grade of twenty per cent. There are two intermediate stations, at the Riffel Alp and the Riffelberg, and the ascent is made in ninety minutes. The height of this road will be surpassed by that of the one now being erected up the Jungfrau.

Extraordinary advantages are claimed by Mrs. Theodore R. MacClure, of the State Board of Health, for Michigan as a summer and health-resort State. The State has more than sixteen hundred miles of lake line, the greater part of which is or can be utilized for summer-resort purposes; there are in its limits 5,173 inland lakes varying in size and having a total area of 712,864 square acres of water. The many rivers running through the State furnish on their banks delightful places for camping and for recreation.

An action of bacteria on photographic plates was described by Prof. P. P. Frankland at the last meeting of the British Association. Ordinary bacterial cultures in gelatin and agar-agar are found

to be capable of affecting the photographic film even at a distance of half an inch, while, when they are placed in contact with the film, definite pictures of the bacterial growths can be obtained. The action does not take place through glass, and therefore, as in the case of Dr. W. J. Russell's observations with some other substances, it is considered probably due to the evolution of volatile chemical materials which react with the sensitive film. Many varieties of bacteria exert the action, but to a different degree. Bacterial growths which are luminous in the dark are much more active than the non-luminous bacteria hitherto tried.

Telephonic communication, it is said, has been established between a number of farms in Australia by means of wire fences. A correspondent of the Australian Agriculturist from a station near Colmar represents that it is easy to converse with a station eight miles distant by means of instruments connected on the wire fences, and that the same kind of communication has been established over a distance of eight miles. Several stations are connected in this way.

We have to record the deaths of F. A. Obach, electrical engineer, at Grätz, Austria, December 27th, aged forty-six years. He was author of numerous papers on subjects of electrical science in English and German publications, and of lectures on the chemistry of India rubber and gutta percha; Dr. Reinhold Ehret, seismologist and author of books on earthquakes and seismometers, who died from an Alpine accident in the Susten Pass; Dr. Joseph Coats, professor of pathology at the University of Glasgow, and author of a manual of pathology, a work on tuberculosis, etc.; Thomas Hincks, F. R. S., author of books on marine zoölogy, February 2d; Major J. Hotchkiss, president in 1895 of the Geological Section of the American Association and author of papers on economic geology and engineering; Wilbur Wilson Thoburn, professor of biomechanics at Leland Stanford Junior University; Dr. Giuseppe Gibelli, professor of botany in the University of Turin; Dr. G. Wolffhüzel, professor of hygiene in the University of Göttingen; Dr. Dareste de Chavannes, author of researches in animal teratology, and formerly president of the French Society of Anthropology; Dr. Rupert Böck, professor of mechanics in the Technical Institute of Vienna; William Colenso, F. R. S., of New Zealand, naturalist and author of investigations of Maori antiquities and myths; Dr. Lench, assistant in the observatory at Zürich, Switzerland; Dr. Franz Lang, rector and teacher of natural history in the cantonal schools of Soleure, Switzerland, and one of the presidents of the Swiss Natural History Society, aged seventy-eight years; Dr. William Rutherford, professor of physiology in the University of Edinburgh, and author of several books in that science, February 21st, in his sixtieth year; and Sir Douglas Galton, president of the British Association in 1895 and an authority and author on sanitation, March 10th, in his seventy seventh year.

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ARTICLES MARKED WITH AN ASTERISK ARE ILLUSTRATED.

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THE END.

FOOTNOTES:

[1] On Dreaming of the Dead. Psychological Review, September, 1895. In this paper I reported several cases showing the nature and evolution of dreams concerning dead friends. I have since received evidence from various friends and correspondents, scientific and unscientific, of both sexes, confirming my belief in a frequency of this type of dream. Professor Binet (L'Année Psychologique, 1896) has also furnished a case in support of my view, and is seeking for further evidence.

[2] In Japan stories of the returning of the dead are very common. Lafcadio Hearn gives one as told by a Japanese which closely resembles the type of dream I am discussing. "A lover resolves to commit suicide on the grave of his sweetheart. He found her tomb and knelt before it and prayed and wept, and whispered to her that which he was about to do. And suddenly he heard her voice cry to him 'Anata!' and felt her hand upon his hand; and he turned and saw her kneeling beside him, smiling and beautiful as he remembered her, only a little pale. Then his heart leaped so that he could not speak for the wonder and the doubt and the joy of that moment. But she said: 'Do not doubt; it is really I. I am not dead. It was all a mistake. I was buried because my parents thought me dead—buried too soon. Yet you see I am not dead, not a ghost. It is I; do not doubt it!'"

[3] Many saints (Saint Ida, of Louvain, for example) claimed the power of rising into the air, and one asks one's self whether this faith may not be based on dream experiences mistranslated by a disordered brain. M. Raffaelli, the eminent French painter, who is subject to these sleeping experiences of floating on the air, confesses that they are so convincing that he has jumped out of bed on awaking and attempted to repeat the experience. "I need not tell you," he adds, "that I have never been able to succeed."

[4] Other pains and discomforts—toothache, for instance—may, however, give rise to dreams of murder.

[5] It may be added that they also present evidence—to which attention has not, I believe, been previously called—in support of the James-Lange or physiological theory of emotion, according to which the element of bodily change in emotion is the cause and not the result of the emotion.

[6] Wealth of Nations, vol. i, p. 112 (Rogers's edition).

[7] Bastable. Public Finance, p. 181.

[8] "The old protectionist, with the stock arguments about the influence of the tariff upon wages and all the rest of it, is beginning to die out. He told us all he had to say about the 'pauper labor' of Europe, by which he often meant the best educated and most skillful artisans of the world. We got tired of hearing about how the importer paid the tax, how it was Europe and England in particular that was all the time squeezing our lives out, till nearly all of us, being of English ancestry ourselves, wondered whether we, even, could be so good as we hoped we were, if we had sprung from something so essentially perverted and bad. We were told, too, that American tourists who went to Europe and spent money there which they ought to have squandered at home were not friends of their country, and that they did us a particularly hostile act when they brought clothing, statuary, or diamond rings back with them from foreign parts. A season of high prices was a real heaven, and wars and fires were good things because they destroyed property that would have to be replaced, and this would create that demand which, reacting on supply, would increase prices. To say that an article was cheap was to say that the political party in power was no longer worthy of public confidence. It was related that each government could make its people so rich, and the idea was thought to have been traced down from Henry C. Carey, that the rest of the world could be safely disregarded altogether.

"Seriously, who believes any of this stuff nowadays? The protectionist is not reckoning with such popular impotency and stupidity. He believes in his fellow-man, and wants to give him a helping hand. He does not care what effect it has on England or Ireland. He is not sure that a protective tariff in and of itself will increase the wages of the workmen. He is even inclined to think that less wages and profits would do well enough for every man, if it were cheaper to live and there were not such extravagant demands upon every person from all sides—this without being a socialist. He is certain that 'a cheap coat' does not necessarily make 'a cheap man,' but the cheaper the coat the better it will be for the wearer. That is what we are all trying to do, improve our processes, increase our effective working power, which means, if you please, to make things cheaper."—*The Manufacturer* (organ of the Manufacturers' Club of Philadelphia).

[9] I have been permitted to review the detailed statements of the accounts of one of the great enterprises which I have called the manufacture of wheat on a large scale on various large farms, separated one from another but under one control, aggregating more than twenty thousand acres, in North Dakota. They are managed mainly from a long distance through agents and foremen, therefore at a relative disadvantage compared to a farmer owning his own land, acting as his own foreman, and saving heavily in expense. Such farmers, making no charge for their own time, are computed to have a cash advantage of one dollar an acre.

A large part of this land has been cropped in wheat for twenty-four years, one farm of six

thousand acres showing an average in excess of eighteen bushels per acre for the term of seventeen years. The details of the product of other farms are not given, but this may be considered a rule. Of course, this cropping can not be carried on indefinitely. The land is now being allowed to rest, and other crops, such as maize, oats, barley, millet, and timothy, are to some extent being raised in rotation, but not to the extent in which individual wheat farms are now passing into rotation, especially in Minnesota.

In this enterprise the manufacture of wheat is the main purpose, but under the changed conditions on the small farms in Minnesota wheat is becoming rather the cash or excess crop in a rotation of four; at present, in North Dakota, wheat constitutes about three fourths the total product.

In these accounts of this great farm are included all charges of every name and nature except what might be called the rent of land: the labor, the harvesting and thrashing, the general expense including the foreman and all other charges; the office expenses, the taxes, the insurance, and, when summer fallow is introduced, the cost of the summer fallow. Suffice it that these figures for 1898—a year of high charge for seed and one which yielded a fraction over the average in product—prove conclusively an average of all charges of less than five dollars an acre for the cost of the product. In different years under these conditions the cost of the wheat varies from a little over twenty cents to approximately thirty-five cents per bushel. The cost of oats, which are cultivated with the wheat mainly for use on the farms, ranges from ten to fifteen cents per bushel.

These are facts. The pending question in this discussion is, How much land, occupied by owners but not now in use, is there in this section of the country on which similar results can be attained, with better results by individual farmers who possess mental energy and practical skill? The figures given by the chiefs of the agricultural experiment stations may rightly be taken in the solution of this question.

[10] The Birds of Eastern Pennsylvania and New Jersey. Prepared under the direction of the Delaware Valley Ornithological Club. By Witmer Stone. Philadelphia, 1894.

[11] Stone. The Birds of Eastern Pennsylvania and New Jersey.

[12] See H. Le Poer. Influence of Number in Criminal Sentences. Harper's Weekly, May 14, 1896.

[13] From The Cruise of the Cachalot. By Frank T. Bullen. (Illustrated.) New York: D. Appleton and Company. Pp. 379.

[14] Earth Sculpture, or the Origin of Land Forms. By James Geikie. New York: G. P. Putnam's Sons. Pp. 397. Price, $2.

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[19] The Jubilee History of the Leeds Industrial Co-operative Society from 1847 to 1897. Traced Year by Year. By George Jacob Holyoake. Leeds (Eng.) Central Co-operative Office. Pp. 260.

Transcriber's Notes:

Obvious printer's errors have been repaired, other inconsistent spellings have been kept, including inconsistent use of hyphen (e.g. "co-operative" and "cooperative") and capitalisation (e.g. "Fresh-Water" and "Fresh-water").

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