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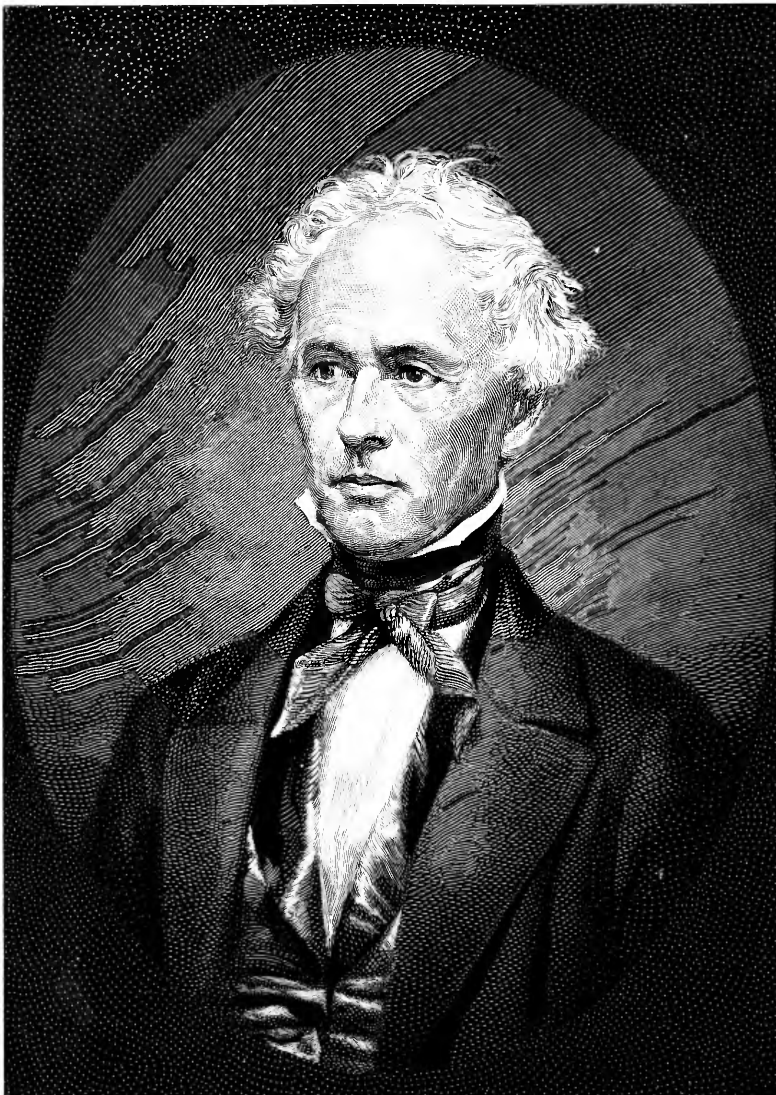

WILLIAM C. REDFIELD

APPLETONS' POPULAR SCIENCE MONTHLY.

NOVEMBER, 1896.

THE MORAL STANDARD.

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IN the present paper I purpose to discuss briefly the nature of the moral standard, strictly so called. The simplest way of approaching the subject will perhaps be to pass in rapid review the other principal criteria of conduct, by contrast with which the essential character of the moral criterion itself will be brought into conspicuous relief.

From the study of the world's culture history it becomes clear that the extra-moral, or what we shall here call the pre-ethical standards of conduct, have arisen from three different roots. As we shall presently see, these roots ultimately run into one, as looking at the matter from the evolutionary standpoint we should of course expect; but inasmuch as the criteria developed by them are in their later forms sharply marked off from one another, it will be desirable for the sake of clearness to treat them separately. The three principal roots, then, out of which, apart from the true moral root, the influences governing and directing men's lives have arisen, are: (1) The theological or religious root; (2) the social or ceremonial root; and (3) the legal or political root. We will examine these one by one:

1. All religions as they pass out of the primitive cult stage of ancestor-worship originate certain specific rules of conduct, which, as they consolidate, grow up into a more or less definite code. For the source and power of such a code we have not far to seek. Arising at the outset from the personal mandates of the deified ancestor or chief, the directions concerning action emanating from this quarter gradually assume a more emphatic, mysterious,

and impressive character, as with the merging of many tribal deities into a national god, and of various national gods into a single supreme power, they come to be regarded as the supernaturally given utterances of the invisible, omniscient, omnipresent, but still manlike governor of the universe. The precept or direction, therefore, takes the form of a command, and right and wrong in action are made synonymous with obedience or disobedience to such command. Along with development in definiteness and consistency of a code thus made up goes increasing stress upon the pleasures and pains by enunciation of which the commands are accompanied. Right action, or obedience to the will of the divine ruler, is attended by divine approval, and is fostered by promises of heavenly reward; wrong action, as disobedience to his will, calls down divine anger and the threat of penalties in the future life.

Whatever may be the particular differences separating the various theological codes of conduct from one another, they thus reveal striking similarities in sundry important respects. With greater or less distinctness they all claim supernatural origin; establish their behests and their interdicts upon the basis of external, ultra-human yet still manlike authority; and find support for their declarations in the presentation of consequences lying outside the natural order. The theological system of conduct of the low savage tribe and that developed among the nations of the civilized world of course differ in the character of the acts distinguished as good and bad, in the quality of the rewards and penalties offered, in the attitude of mind encouraged, and in other equally significant ways. Yet they have these points in common: the commands are supernatural, the sanctions are supernatural, the code is based upon ultra-rational considerations and backed by the presentation of ultra-rational results.

That it is the theological code of conduct which, throughout the Christian ages and down even to our own day, has been almost universally accepted as the one possible foundation of morality, we need not here pause to insist. If the tables of the law given to Moses on Mount Sinai are not still regarded as the original source of our knowledge of the distinctions of conduct, there is still a tacit belief that such knowledge depends upon supernatural revelation. As by one course or another, therefore, our commonly held ideas of morality lead us back to the theological root, it will be well to note the bearings of theological principles upon the questions with which morality is concerned. The following points are, I think, specially worthy of attention:

Since the theological code of conduct regards virtue simply as obedience to divine command, and measures morality by the correspondence of action with the divine will, we are bound to infer that right and wrong have in themselves no inherent quality, but are made so simply by the enactment of an external power. The quality of a line of conduct thus resides not in essentials—the intrinsic tendency of an action and its bearings upon life, but in non-essentials—the accidental fact that it is forbidden or enjoined by God. For example, Jehovah lays certain restrictions upon the man and woman in the Garden of Eden; and disregard of these restrictions is sin. He commands Abraham to commit a horrible crime, and because of his readiness to do so he is paraded before us as the father of the faithful and a model for our own imitation. For a direct statement of the position here indicated, reference may be made to No. XIII of the thirty-nine articles of the English Episcopal Church. The unmistakable meaning of this article is that a good deed, such as the gift of a cup of cold water to a thirsty wayfarer, has in itself no inherent quality of goodness. Performed in a state of grace and from faith in Jesus Christ, it is well-pleasing to God, but only on that account. Let the blessing be offered, not out of faith in Christ, but from spontaneous sympathy with suffering humanity, and what has official theology to say to the matter? "We doubt not that it has the nature of sin."

Implied in all this of course lies the further fact that morality looks Godward and not manward. Sin is sin because it is unpleasing to God, not because it is injurious to man. How disastrous the effects of such a conception as this may be, the history and literature of Christendom are at hand to show us. If such an astute thinker as Duns Scotus, insisting on the perfect freedom of the divine will, could declare that if God had prescribed murder and theft, murder and theft would not have been sins; if a high-minded moralist like Sir Thomas Browne could write, "I give no alms to satisfy the hunger of my brother, but to fulfill and accomplish the will and command of my God," it may be taken for granted that, in the average of cases, such a view of conduct could not but be degrading to those entertaining it. Out of this view sprang the belief, widespread throughout the middle ages and continuing down to our own day, that a man may clear his conscience of the burden of wrong acts by making his peace with God. Given the point of view, and this conception is strictly logical; since God is the person offended, and his pardon will make all right again. Formerly, people endeavored to compound for the sins of a lifetime by building churches, endowing monasteries, or leaving their ill-gotten wealth to the priests. In our own epoch the old belief lingers on in the orthodox doctrine of penitence and the forgiveness of sin.

Beyond all this, it is of the nature of a theological code of conduct to get the important and unimportant in action sadly mixed up together, and even to cause them occasionally to change their places. Thus, in our own *régime*, undue emphasis is habitually laid upon the ceremonial side of life. Examination of the Ten Commandments reveals six that are roughly describable as utilitarian, the remaining four (a large proportion) referring to religious observance. In common conversation, attendance at church, and careful regard for other so-called religious duties are habitually placed on a level with, or even higher than, the careful fulfillment of secular requirements. Popular ideas concerning the Sabbath furnish a striking illustration of the point to which we now refer.

2. We pass now to the pre-ethical code of conduct arising from what we here term the social, or, better, the ceremonial root.

Casual consideration might lead one to suppose that ceremonial factors have played a relatively unimportant part in the history of civilization. Such a supposition, however, as further investigation could soon prove, would involve an entire misapprehension of the facts of human development. Indeed, strictly speaking, it is with the ceremonial code that such a discussion as this ought to begin, since out of it, in the consolidation of social life, both the regulations that we call religious and the regulations that we call political have been gradually evolved. Ceremonial government, as Mr. Spencer has shown, is not only the earliest and most general kind of government, but is also a government which "is ever spontaneously recommencing." Moreover, it has ever had and continues to have, as the facts of daily existence show us, the largest share in regulating men's lives.

It thus happens that distinctions of right and wrong constantly refer to a standard of convention, all questions of the tendencies of actions and of their wider relations to life being consciously or unconsciously left out of account. Like the theological code, therefore, the ceremonial code habitually passes over the inherent qualities of actions. Its sanctions are generally extraneous, not essential, and its inevitable trend is to confuse the really important with the relatively unimportant in conduct, often with the most unfortunate results. How far the ceremonial code demands respect, to what point it is mainly useful, and under what conditions it passes into a tyranny, crushing individuality and repressing the vital forces of life, are questions which, though to the last degree important, can not here be considered. What we have now to do is to notice the wide area over which the social code operates; the imperative character of its enactments; and the confusion to which it frequently gives rise—a confusion resulting from the fact that in the conflict of influences by which we are daily met, the morally right is again and again sacrificed to the socially correct. The "proper and therefore wrong" of one of our writers is indeed a piece of merely rhetorical exaggeration, but the distinction between rectitude and propriety—between the criterion of the moral and the criterion of the social code—has none the less to be emphasized.

3. In the early stages of social evolution custom tends to harden into definite precept; hence the third pre-ethical standard of conduct—the legal or political standard. Guidance by custom is, as I have above implied, the primordial form of guidance in the low tribal group; but out of this arise gradually both the sacred law, or the command of the deified ancestor or chief, and the secular law, or the command of the living ruler. At the outset, indeed, no distinction between sacred and secular is to be made, the enactment of the chieftain, while he is still alive, passing insensibly into a religious enactment when, dying, he takes his place among the tribal gods. But differentiation presently begins, and it is with the secular side of the matter after such differentiation that we are now concerned. Law, then, emerges when the spontaneously evolved customs of a social group are gathered up and crystallized in the dictates of the strong man or chieftain, and when vaguely diffused social sentiment thus receives distinct formulation and powerful personal support.

It is evident that from the legal as from the theological point of view right and wrong are primarily associated with obedience and disobedience to external authority. Conformity to the particular requirements of the established body of laws implies allegiance, and allegiance is virtue; while insubordination constitutes the very essence of evil, the element which makes crime crime. The sanctions of the legal code are, therefore, once again extraneous sanctions; its restraints and incentives, penalties and rewards, imposed from the outside.

Thus, comparing the three principal pre-ethical codes with one another, we find them characterized by certain important points of similarity. In each case fortuitous and not necessary consequences of action have been taken as the basis of restraint; in each case outside compulsion has furnished the required impulses and deterrents; in each case, therefore, the sanctions have been almost entirely accidental and extraneous, and not to any adequate extent fundamental and essential.

And now we have only to place the moral code alongside of these pre-ethical codes in order to throw its radical and differential qualities into immediate and striking relief. For what is the code of morality strictly so called? It is the code under which actions are classified in virtue of their essential natures—that is, of their necessary bearings upon life. It formally postulates as the ultimate end of conduct that which, after all, we find implied in a more or less crude and confused fashion in all ethical systems whatsoever—well-being; and it considers conduct in its direct or indirect relation to that end—that is, in the connection of actions immediately with well-being, or mediately with the conditions prerequisite to its attainment. Its fundamental assumptions are therefore at once simple, and, despite all *doctrinaire* theorizing to the contrary, practically though latently universal. We are alive. This is obviously for all of us the final fact, and no less obviously every proposed test of life's activities must ultimately be resolved into terms of this unresolvable first principle. Now, the facts of actual life favor neither the fatuous preconceptions of the optimist nor the equally wild asseverations of the pessimist. We can not assert, with Malebranche and Leibnitz, that this is the best of all possible worlds; or with Hartley, that "all individuals are actually and always infinitely happy"—a proposition which, as Mr. Leslie Stephen has well said, sounds like optimism run mad. But neither, on the other hand, can we accept the dogma of Chabot, that what we mistakenly call the cosmos is really the work of a crazy devil; or follow Schopenhauer in his statement that the universe is just as bad as it conceivably could be without falling to pieces altogether; or treat seriously the suggestion of Novalis, that the simultaneous suicide of all human creatures is the one way of escape from miseries that are both unbearable and irremediable. Optimism would logically negative any attempt to tamper with the facts of a world wherein it has already pertly concluded that whatever is is right; pessimism no less inevitably leads to a like passivity by treating life in its essence as radically too evil a thing to be susceptible of any improvement. But life, as I have said, fits the theories of neither pessimist nor optimist. It is not wholly bad, it is not wholly good; it is a thing of mingled yarn, good and ill together, with immeasurable capacity, in its higher forms especially, for the development of one element or the other. Moral conduct I therefore conceive to be, in a single phrase, conduct which betters existence, which adds to its sum total of happiness or decreases its sum total of pain. Action which makes life as a whole more fully worth living is as such right action; action which diminishes its value is as such wrong. The results upon which morality thus bases its incentives and restraints are therefore the actual results involved in the very constitution of things and not consequences artificially imposed by any external power. We reach in this way the ultimate conception of the immanent moral law, and for myself I see no way either of avoiding the resolution of all other possible criteria of conduct into the criterion thus established, or of getting behind such a standard in search of a final principle of a more universal, fundamental, and axiomatic character. Here, and here alone, it seems to me, we strike bed-rock.

The moral motive, therefore, arises not by contemplation of the gratification given by a certain line of conduct to God, or by recollection of superimposed pleasures, secular or supernatural, present or future; or by any reference to the social habits or conventions with which the said line of conduct may or may not accord. Such moral motive has nothing to do with obedience to the revealed will of God, or with the extraneous conceptions of heaven and hell, or with punishment or reward from earthly rulers, or with the favor or disfavor of public opinion. It arises from the vivid ideal representation of the relation between action and life. The compulsion of morality, therefore, is inner and not outer compulsion, its authority inner and not outer authority, its restraints those arising from the connection of cause and effect, its sanctions natural, not supernatural, essential and not fortuitous. The foundations of the moral code thus belong to the very nature of sentient life itself, and its dictates therefore possess a validity, a reach, a significance, a sacredness, to which no others can conceivably lay claim.

And here, perhaps, to prevent possibility of misconception, something should be said about the relation of the moral to the cosmic process. Briefly, then, I accept in the main the position adopted by the late Prof. Huxley in his Romanes Lecture on Evolution and Ethics. That there is a fundamental distinction between the "state of Nature" brought about by uninterrupted cosmic forces, and the "state of art," produced with partial success by the rational power of man, working sometimes with but often athwart those forces, and that reason and sympathy—the latter constituting by all odds the most important element in the social tissue—have brought entirely new dynamic factors into play upon the arena of life, are propositions from which I see no way of escape. It can not be too frequently asserted that what we call the order of Nature is not an ethical order at all—that the laws of Nature, as such, have nothing to do with morality. The ethical element begins, I think, faintly to emerge with the relation of sentiency to those laws, though the establishment of a moral order depends entirely upon the "artificial" factors introduced by the consciousness of man. It is, of course, true that these "artificial" factors are themselves products of cosmic processes, and that the order out of which they have grown itself imposes limitations of the severest, and often the narrowest, kind to man's intelligent reaction against it.

> This is the art which does mend Nature, but
> The art itself is Nature.

Nevertheless, for the sake of clearness, the contrast of the "natural" and the "artificial," of the workings of Nature apart from the interference of man and the workings of Nature *plus* such interference—in a word, of the cosmic and the ethical—has to be insisted on. Nature has achieved certain results, though by slow, blundering, and (Montesquieu notwithstanding) extravagantly wasteful methods. Her processes, however, with all their, to us, ruthless cruelty and prodigality, have, in the rough average of cases, made for what—rather metaphorically, perhaps—Mr. Spencer has called "fullness of life"; and such increasing fullness of life may therefore be described—to borrow a teleological phrase, though I do not myself accept the teleological implication —as the "end" of evolution. And here it is that reason steps in and seeks, within the limits everlastingly imposed by cosmic conditions, to find means helping to the same great "end"—now a true rational end—which, while at least as effective as the methods employed by Nature, shall be no longer characterized by what in the "acquired dialect of morals" (to use Huxley's phrase) we have learned to call Nature's indifference and brutality. Man, then, by reason of his intelligence, has great power of tampering with the cosmic order; and how far it is wise to do this and just where the proper compromises have to be made remain to-day among the most difficult of the social problems which we have to face, though in view of the foregoing discussion we may lay it down as a general principle that the ethical process should be allowed to interfere with the cosmic process only when the "end" aforesaid may be more adequately, perfectly, and economically secured thereby. At any rate, we must admit that Goethe was right when he said that it is man's privilege to "distinguish, elect, and direct,"* and Arnold when he wrote, "Man must begin, know this, where Nature ends."†

Returning from this digression, we will consider for a moment the evolution of the moral code as above defined.

When I described the earlier and outward regulative codes of conduct as pre-ethical codes I did not simply mean that in the sequence of human affairs they actually came before the moral code itself. The relationship is closer and more vital than such a statement would imply. My full meaning is that the pre-ethical codes have all along combined to establish and maintain the social conditions, in the absence of which no observations of cause and effect in conduct could have been made and registered —in the absence of which, therefore, the moral criterion strictly so called would never have arisen. As out of the primordial ceremonial code arose the codes we call religious and political, so out of these combined has gradually emerged and differentiated the moral code proper, as with that consolidation of social life to

* *Das Göttliche.*

† Sonnet: In Harmony with Nature.

which ceremony, law, religion, morality, have all tended, men have come slowly to understand that in the recognition of conduct and consequence as everlastingly united in the category of cause and effect lies in all questions of action the one valid, authoritative, and final court of appeal.

"Might till Right is ready," said Matthew Arnold, and in the civilization of the race the might of the outward authority—supernatural, political, social—has gone before and has prepared the way for the right of the inward authority we describe as moral. Men have been trained to the self-compulsion of the moral motive by enforced obedience to the external compulsions of ceremony, religion, law. The strong hand of the earthly despot, only gradually relaxed as the education for freedom went on; the binding power of tyrannic custom, following life into the minutest recesses of its daily routine; the drastic force of supernatural pleasures and pains, meted out by a personal but omniscient deity who exacted unquestioning allegiance and punished every infraction of his commands—all these elements were required as formative factors in the moral development of mankind. The condition of heteronomy must in the nature of things precede the condition of autonomy, and we only pass from general principle to particular illustration when we say that the outward authorities above dealt with were inevitable prerequisites to the inner authority of morality in the order of the evolution of human life.

Yet it must be remembered that in an indistinct form the moral sanction proper very early began to emerge as an influence in social growth. Natural selection was from the beginning concerned in the picking out and perpetuation of certain qualities—egoistic and altruistic—making for the welfare and expansion of society; and unconsciously at the outset such qualities naturally came to be registered and emphasized in the ceremonial, religious, and legal codes. Among moral characteristics thus nurtured in the primitive stages of political consolidation may be mentioned loyalty, courage, obedience, without which no successful tribal warfare could be carried on, together with a rudimentary form of justice, veracity, and general sympathy, without which the group could never survive in the face of antagonistic tribes whose social feelings were more highly evolved. As the struggle for existence has all along been a struggle among groups as well as among individuals, a premium was laid from the very start upon whatever qualities, altruistic no less than egoistic, would make for social strength and efficiency. These qualities were early caught up in the life and feeling of each developing group; an ideal answering in its larger aspects to the fundamental needs of the tribe was thrown up; and the vague encouragement yielded by diffused public sentiment was presently backed by the sanctions of law and religion. But, later, another element little by little comes into play. With intellectual progress men begin slowly to realize that certain lines of action make for tribal welfare, and certain other lines to tribal disadvantage; that these observed bearings and results are altogether independent of social custom, the commands of the chief, the utterances of the gods or god; and that thus there is a sanction for conduct deeper and more stable than those currently assigned. Throughout the further evolution of humanity, and down even to our own time, these observed connections between conduct and its consequences continue, it is true, to be interpreted mainly through the medium of the earlier codes—that is to say, even where the natural criterion for conduct is dimly perceived, artificial restraints and incentives are still to the fore. Yet a great gain is none the less achieved, since if the evolving moral code does not replace the earlier codes, it more and more comes to constitute a kind of final standard, by correspondence with which the precepts of such earlier codes may be tested.

We are thus forced to the inference that in the continued evolution of life and thought the ethical criterion of conduct will detach itself more and more completely from the other criteria of which we have spoken, and will be more habitually referred to as the touchstone by which right and wrong in action alone are to be decided. Especially in view of the rapid spread of scientific habits of thought does it seem likely that such a result will be brought about; since the central principle of science—the principle of natural causation—is precisely that which underlies the moral code, with its interpretation of conduct and consequence in terms of cause and effect. This does not, of course, mean that guidance and inspiration from other quarters will not constantly be sought, or that all impulses that we should here, strictly speaking, call ultra-moral impulses, will be entirely disregarded. But it does certainly mean that there will be an increase of the already manifest tendency to hold in view the ethical criterion as the ultimate test of conduct, to interpret every side of life's activities more constantly in terms of this, and to insist that in every case of discord between the criterion of morality on the one side and any other lower criterion whatsoever upon the other, we shall revise our principles and our practice without hesitation or demurrer, in such way as to bring them into fundamental harmony with the dictates of the moral law.

And here a very serious question arises. In tracing back the radical distinctions of right and wrong to purely naturalistic sources, do we detract in any way from the authority, the im perativeness, the peculiar sanctity and importance of the ethical code? What, in other words, are the remote emotional tendencies involved in the treatment of conduct from the evolutionary point of view here assumed?

I regard this matter as of especial moment on account of the recent contention of Mr. Balfour (1) that practically "no moral code can be effective which does not inspire, in those who are asked to obey it, emotions of reverence; and (2) that practically the capacity of any code to excite this or any other elevated emotion can not be wholly independent of the origin from which those who accept that code suppose it to emanate."* I assent to both these propositions, while I most distinctly join issue with the writer in his inference that by the precepts of the naturalistic moral code the higher emotions, which he rightly holds as fundamentally necessary, can not possibly be called forth.

The gradual decline of the older theology will, I am convinced, bring with it no decadence in our feelings of awe, reverence, sacredness, mystery, but simply a transference of these feelings from the so-called supernatural to the natural—from the power manifested in miracle to the power revealed in law. And thus, by a gradual but inevitable process of adjustment, will it be without possibility of question, when the naturalistic ethics of the future shall have taken the place of the supernaturalistic ethics of the past. Of the moral ideal it may thus be said that it "decomposes but to recompose" with fuller beauty and richer meaning. Rooted fast and deep in the very constitution and conditions of life, itself part of the everlasting order of cosmic growth, written on no tables of stone to be broken or crushed under foot, graven on no page of human fashioning to be torn or obliterated or otherwise destroyed, the moral law thus indeed reveals itself as the eternal law—the utterance and the declaration through the universe itself of that power of which this throbbing world of life and sense and thought is, after all, but the garment and partial expression. Over the unshaken foundations of such a faith as we can thus make our own, the tides of time and change wash and curl in vain. Creeds and speculations, precepts and philosophies, pass away and are forgotten, but such a faith indeed endureth forever.

That to affiliate ethical principles in this way upon natural law adds immeasurably to the deep and terrible responsibilities with which life is coming to confront the modern man, must be acknowledged. From no other point of view does the high seriousness of conduct, the imperiousness of duty, the strenuousness of living, become so emphatic; in no other way are we forced to

* The Foundations of Belief, p. 13.

so tremendous a realization of all that is meant by the fatal chain of action and consequence—a chain the links of which, fragile and delicate and silken as they may seem, are yet woven in the loom of eternity, and are never to be swept asunder. "Not heaven itself upon the past hath power." Injustice, dishonesty, impurity, wrong of every kind, will and must, in the everlasting order of the world, work out their inevitable results, all our prayers, all our remorse notwithstanding.

> . . . There's not a crime
> But takes its proper change still out in crime,
> When rung upon the counter of the world;

and in the administration of the moral law there is no favoritism, no bribery, no loophole of escape.

While the deep realities of existence are thus made deeper and more real, and while the earnestness of conduct and the solemnity of true thought as well as of right action are thrust into almost awful relief, we are forced, moreover, to give up, one by one, the radiant visions of future progress which for thinkers of widely different schools have touched with the glory of infinite promise the hard and obstinate facts of life. The ghost of Malthus has hardly been laid even by Spencerian incantations; and the splendid dream of perfectibility, of the final evanescence of evil—in which the great evolutionary philosopher once loved to indulge—is, we must confess it, only a dream after all. The theory of evolution, as Huxley has said, "encourages no millennial anticipations." The rhythm of life means the ultimate undoing of all that can be done. "Many a planet by many a sun may roll with the dust of a vanished race"; and the time must come, in the dim and mysterious future, when our planet shall be one of these—when, in the striking words of Mr. Leslie Stephen, the earth shall "become a traveling gravestone, and men and their dreams shall have vanished forever." Hence, to quote the same thoughtful writer, "we must be content with hopes sufficient to stimulate action," and must believe "in a future harvest sufficiently to make it worth while to sow, or, in other words, that honest and unselfish work will leave the world rather better off than we found it." And when we study life at large from the point of view here adopted, it may surely be urged that a large basis of substantial hope is given in place of the fallacious and illusory hopes that have been snatched away. A universe of law is, after all, a universe that we can trust. Science teaches us to have confidence in the nature of things; and cause and effect, as Emerson put it, are indeed the "chancellors of God." How would any such confidence be possible if the world were actually governed by caprice, chance, miracle? It is because we can throw ourselves boldly back upon law, because we can interpret human progression, within the limitations by which it must everlastingly be circumscribed, not as an accident, but as part of a gradual and orderly unfolding of cosmic processes, that we can still hold fast to our faith on the one hand, in the permanent significance of duty; on the other hand, in the fundamental actuality of human aspirations. We said just now that we find inspiration to sow the seeds of action only by reason of our faith in the harvest of results. Well, science holds out no promise of the visionary harvest of a "far-off infinite bliss"; but it gives us definite assurance of what, after all, is of vastly greater consequence to us—the steadily growing harvests of the years immediately to be. Little as each more separately can do, that little is thus seen to be well worth the doing; and the old message comes down the ages to us with ever-renewed force—"Work while it is yet day, for the night cometh when no man can work!"

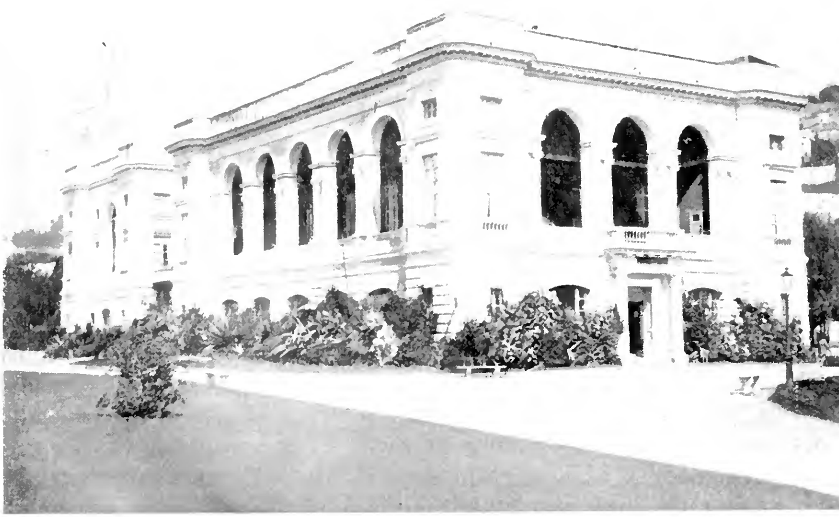
PUBLIC AQUARIUMS IN EUROPE.

By BASHFORD DEAN,
COLUMBIA UNIVERSITY.

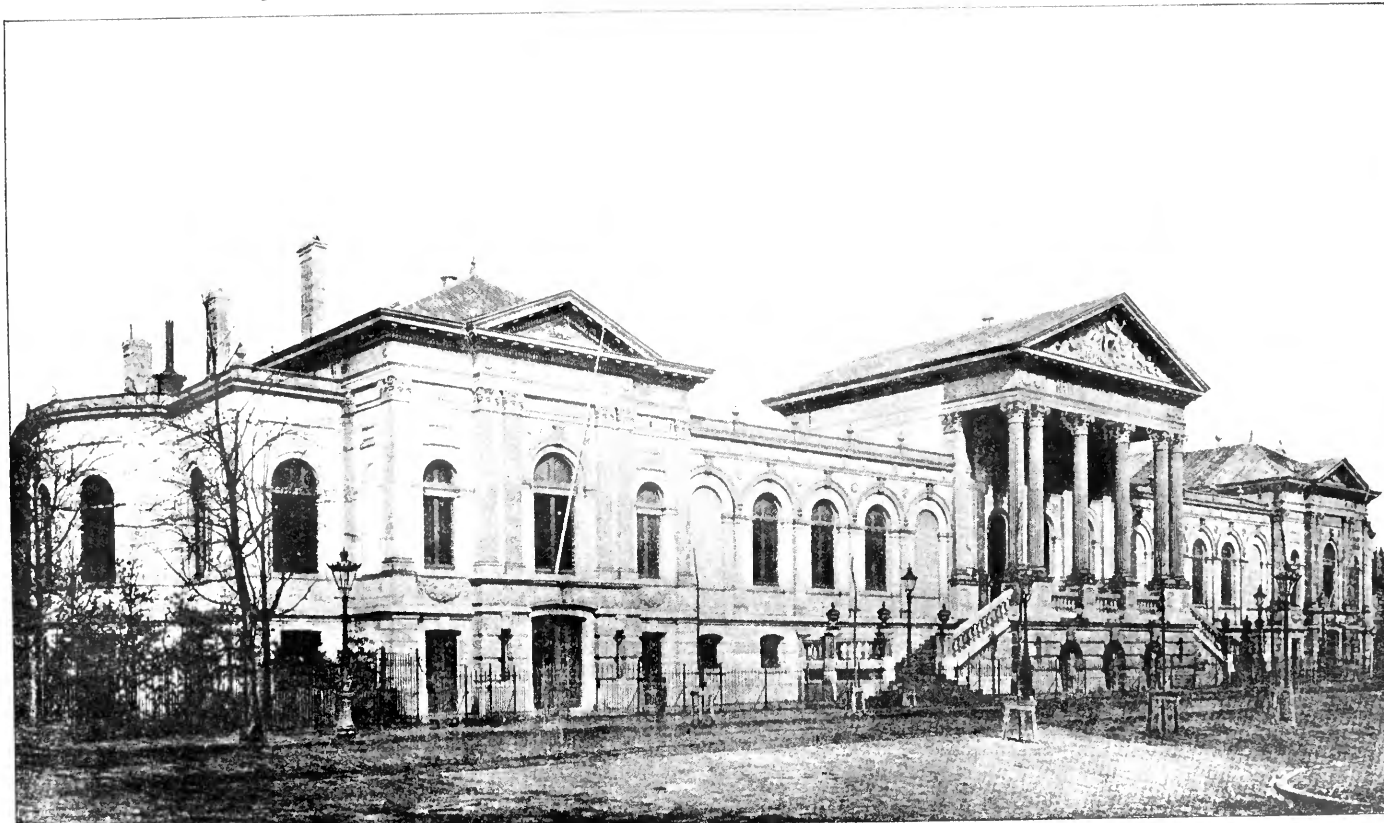
THE life of the sea has ever had a peculiar interest to people of every class and calling—the strange and bright-colored fishes, the sea stars and anemones, the rich forests of seaweeds, the ghostly and luminous jellyfishes introduce to their observers a submerged world which bears with it every charm of the unreal and the unknown. A feeling of awe is not absent in the long, dusky corridor of an aquarium, as with hushed voices the visitors are gazing through the bright-colored windows; through each they may see the depths of a miniature ocean. Here a common interest brings together visitors of every class, and in the changing crowd are strangely mingled types of faces—refined, illiterate, scholarly, rustic—all fixed and earnest, absorbed with the brilliance and variety of the ever-changing scenes. Within the entrance of a gallery a number of sailors have long stood motionless before one of the larger tanks, watching the undulating movements of the swimming ray and the feeding of a dull-looking shark, with perhaps none the less interest that they have seen these fishes many times before. A few yards away a group of children are visiting the aquarium for the first time; they stand spellbound, gazing open-mouthed at the graceful movements of a sea horse; or is it that they have discovered the large eight-armed cuttlefish which is slowly writhing itself into a less conspicuous corner of its rocky den? And yonder a gray-bearded

Russian zoölogist—noted enough if one were to give his name—is taking the opportunity of examining for the first time a clump of living crinoids.

The aquarium is altogether a modern institution, dating back scarcely more than a third of a century. Its practicability appears to have first been prominently brought before the public by an Englishman, Mr. W. Alford Lloyd, who during the sixties took an active part in the founding of the aquariums of Paris (that of the Jardin d'Acclimation), Hamburg, Hanover, and of the Crystal Palace, then the most famous of all. In fact, it was notably due to his efforts that throughout Europe aquariums became fashionable, to a degree indeed which caused the great cities to vie with each other in their prompt efforts to build and equip them. In those early days the style of the buildings was prevalently grotto-like. To see the fishes one was to be given the impression of actually going deep into the sea by descending first into a cavern, down rock-cut steps to the murmur of trickling (if very artificial) brooks. These early aquariums, of great interest from the standpoint of naturalism, were at first exceedingly popular, amply remunerating their stockholders when organized by private capital. Some of these, however, owing in nearly every instance to injudicious management, came later to deteriorate, and after becoming concert halls, or adding circuslike attractions, have ultimately failed.



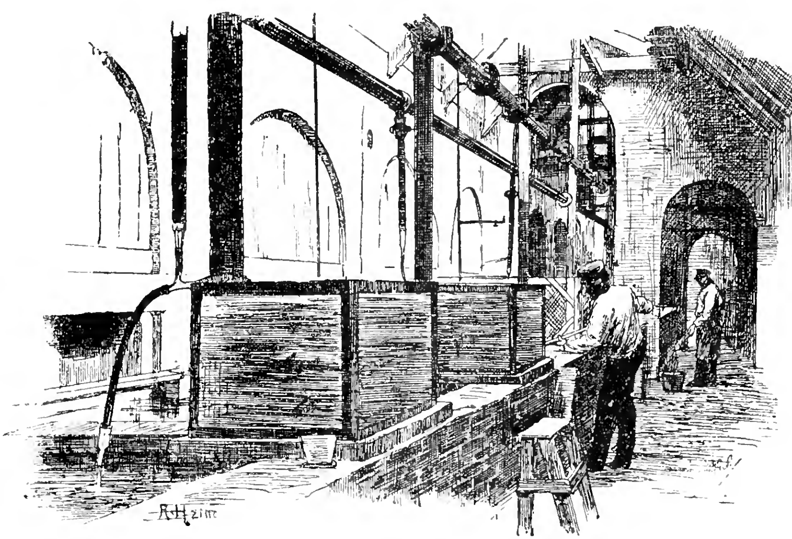
The Naples Aquarium.



The Amsterdam Aquarium.

At the present day it has become a difficult matter to classify the various aquariums of Europe, since they present so wide a range in size, quality, and purpose. Some are destined solely for the public use and can not be said to be of aid to scientific studies; others are devoted almost entirely to the advancement of biological research; and others still vary widely between these extremes, with an equally wide range in the character of their financial support. Many of the aquariums of the orthodox biological stations, however, have been situated in out-of-the-way places, convenient for the purposes of the student, but inaccessible to the general visitor. These may be admirably arranged and maintained —among them, for example, the aquarium room of the French station at Banyuls, on the Mediterranean, near Spain—yet they can not be strictly regarded as belonging to the class of public aquariums. For this reason, partly, more than a score of biological laboratories might at once be omitted from discussion. On the other hand, the Stazione Zoologica of Naples, while devoted to the highest type of research work, must be given the foremost rank among popular aquariums. And the Amsterdam Aquarium, holding rank on the popular side probably second to Naples, is also of value as a purely scientific station, although lower in caste than the Stazione. So, too, should the Plymouth Biological Laboratory be mentioned as of interest in its well-equipped aquarium. Together with those that have just been mentioned, the more strictly popular aquariums of Europe should include those of Paris, Berlin, and Brighton.

These aquariums are so widely separated from each other that they have come to differ not a little in the details of their equipment and management. And it is, indeed, only when the visitor has examined a number of these institutions that he begins to realize that there is a common principle underlying their general construction. Thus, for example, he would find in each the great darkened corridor, from which on every side, as through large windows, he may look into the brightly lighted tanks. Through these he may peer to a distance of twenty feet before his view is stopped by the rough, rock-cut background; nor does the line showing the surface of the water appear against the glass to destroy his illusion of ocean depth. The cunning builders have taken pains to have this line higher than the windowlike opening of the tank, so that the water surface, instead of marring the effect, in reality aids it, for the eye of the visitor, at a lower plane than the surface, sees upward but the totally reflected images of the forms below. Not that the glass fronts of the aquaria are exceedingly large—their height is rarely more than four or five feet in view of the danger of breakage through water pressure—although the idea of water depth is certainly not sacrificed on this account, for the concreted bottom of the tank may be made to slope downward from the base of the glass plate till the needed depth is reached. Nor does the similarity in the various aquariums extend only to the corridor to which the general visitor is admitted. In their internal arrangements an even more strikingly similar ground plan is found to prevail. In all cases the attempt has been made to keep from the mind of the visitor the idea that water pipes, pumping engines, and blouse-wearing attendants—none of which withal are oppressively tidy—are necessary to the well-being of the tanks. And it is for this reason especially that the region behind the tanks is usually kept from profane eyes. Dark passageways lead to it, shielded

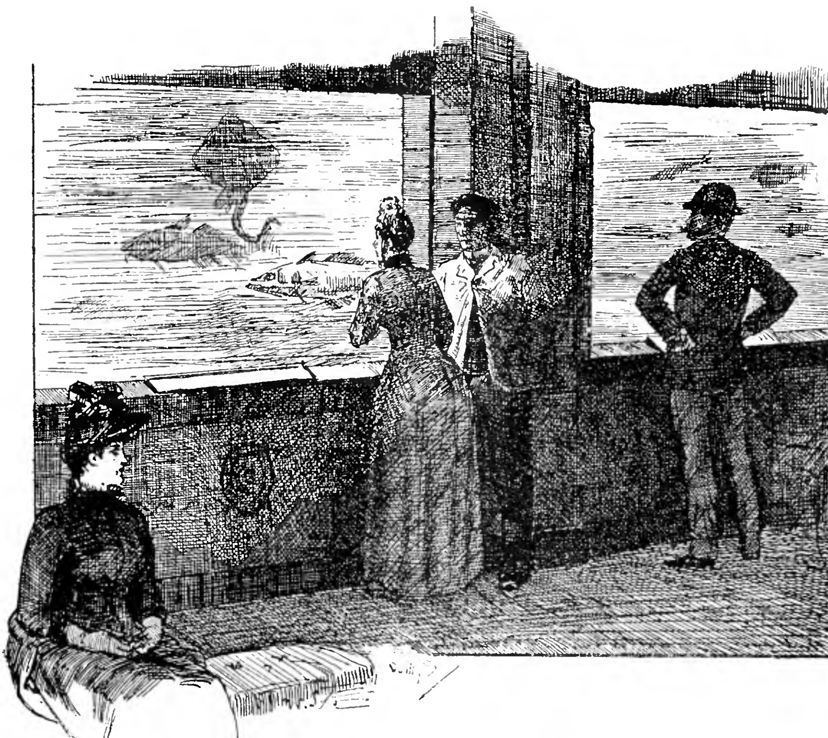


AMSTERDAM AQUARIUM—SERVICE OF THE BASINS.

by hidden doors, and one who enters, coming from the dusky corridor, is at first blinded with a flood of light. Above him is the glass roofing of a conservatory, and sunshine is pouring down upon the rockwork of the tanks, thence to be reflected into the public hall. At his feet extends a concreted pathway; on either side are the tanks, or more strictly rock-lined pools, at whose farther ends can be seen the glass plates through which, in the corridor, the visitors are gazing. Above and around are serpent-like pipes, stretching at full length, abruptly coiling as they dip to the water surface or pass downward below the floor, a confusing maze, bubbling and hissing with steaming water. The system in the management of the water supply becomes, however, clearly understood when the mystery of strangeness has passed away. It has merely to conform to the hygienic law of its inmates in providing that the water of each pool shall be clean and well aërated. To attain the former end, the water is constantly drained from the aquaria and replaced by fresh and filtered water; and to insure proper aëration, the incoming stream is usually passed into the tank in such a way that it draws downward with it in its current a cloud of air-bubbles—these to subdivide finely and to be in part absorbed. In the sea-water basins the "reservoir system" has been found most effective in securing the healthfulness of the water, and is at present in general use. It has certainly an advantage from the standpoint of economy, since by its means a given bulk of water may be used and re-used for months and even years, with better results, indeed, than if a fresh supply of sea water had been employed, for the latter, it is claimed, introduces a constant stream of impurities which can not be removed by filtration. The reservoir system is certainly an easy one to understand. In the basement or cellar of the aquarium building is situated a concreted cistern, whose capacity is ten to fifty times as great as that of the sum of the sea-water tanks throughout the building. In this cool, dark, and uniformly temperatured cistern the water seems to have the power, even in the course of a few days, to purify and "rest," its sediment settling and its air-drinking power becoming restored. It is into this cistern, accordingly, that the water drained from all parts of the building is returned after it has been roughly filtered; and it is directly from this cistern again that the water is pumped upward as the resupply. By this plan of circulation it is usually arranged that the water of each tank may become changed several times during the day.

From this review of the general subject we may next pass to the examination of the various aquariums of Europe.

Naples.—First in importance, as has already been noted, stands the aquarium at Naples, highest in rank, also, as a station of marine biological research. Its situation and surroundings are eminently attractive; it stands in a public garden on the side of the gulf, amid fashionable driveways, surrounded by bright-colored lawns and a wealth of century plants and cactus; in front are the outlines of distant Capri and the blue waters of the gulf; in full view is Vesuvius. The building itself is like a huge white palace, conspicuous from nearly every higher part of the city. Its main wing, shown in the foreground in the adjoining picture, is the older, dating from 1875, when the station was founded by Prof. Anton Dohrn; the wing immediately behind it is the newly built physiological laboratory. The aquarium occupies the basement of the main structure, and is open to the public daily, although to the rest of the building, including the laboratories, library, and rooms of investigators, strangers are not generally admitted. The doorway leading to the aquarium is shown in the illustration; through it one passes into the main corridor, a long, dark, concreted room, lighted only through wall-tanks, displaying admirably the showy fauna of the gulf, to which, indeed, the aquarium is largely indebted for its high rank. Imbedded in the walls of the sides and of the main partition of the room there are in all about two dozen large aquaria. In these the water appears clear and blue; their background of rough rockwork has been

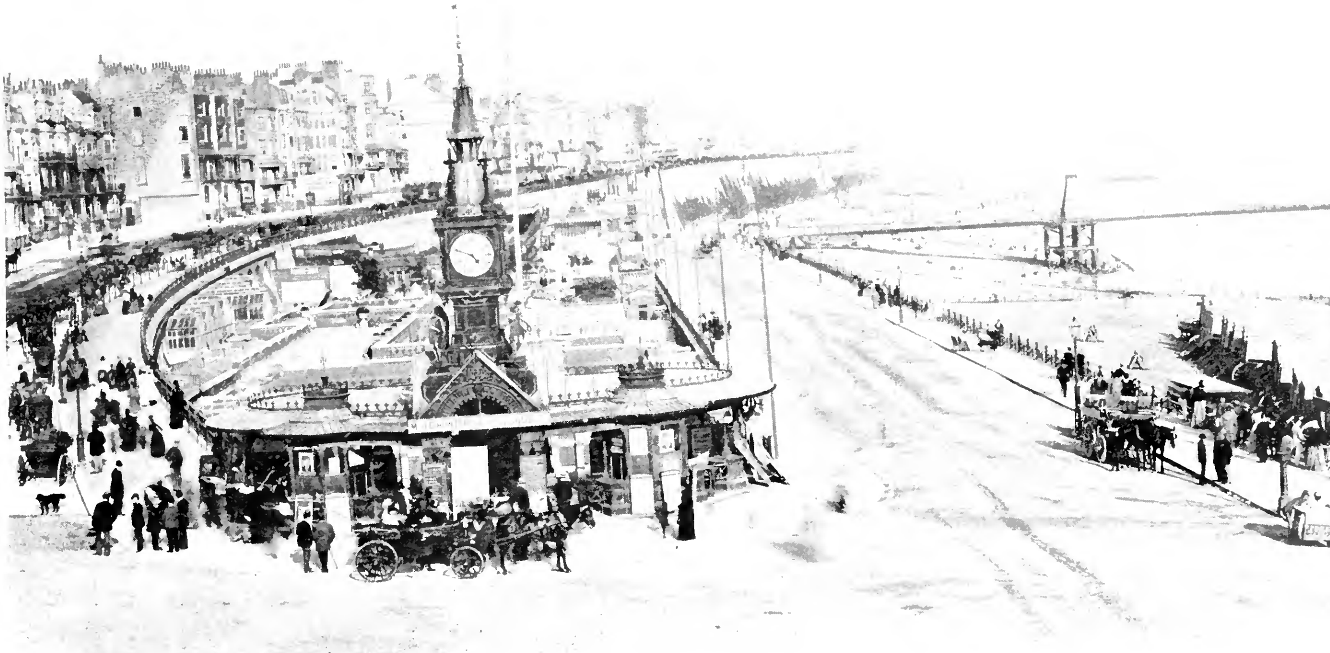


Amsterdam Aquarium—The Tanks.

so arranged that contrasts of bright lights and deep shadows throw in clear relief the colors of the marine life. In the first tank the visitor may find a collection of starfishes and sea urchins, some brilliant in color, clustering on the glass, each with a dim halo of pale, threadlike feet. In the background will be a living clump of crinoids, which flower out like a garden of stately and bright-colored lilies. A neighboring tank will be rich in dark seaweeds, and in its foreground a group of flying gurnards, reddish and brightly spotted, are feeling cautiously along the bottom with the fingerlike rays of their wing-shaped fins. Here, too, a small school of squid is swimming timidly to and fro like delicate and quick-moving fishes, and below them will perhaps be a series of huge triton snails and the clustered eggs of cuttlefish. In another tank a bank of sea anemones exemplifies the large and gaudy forms common to southern waters—buff, orange, yellow, and vermilion—and there may be corals in the background, and a spectral forest of sea fans in white and violet, with a precious fringe of pink coral flowering out in yellow, starlike polyps. There may, again, be in a neighboring tank a host of ascidians, those curiously degenerate vertebrates whose stock could not have been widely unlike the ancestral stem of the fishes. Delicate, transparent, solitary forms, like the lanky *Ciona*, contrast with the deeply crimson *Cynthia* and the huge and mottled masses of many compound forms. Swimming about them may be chains of *Salpa*, and occasionally a number of *Amphioxus*, the latter to be seen only from time to time as they burrow out of the sandy bottom, flurry about as if in sudden fright, and quickly disappear. Variety is one of the striking characters of the arrangement of neighboring tanks. In one, brilliant forms outvie the colors of their neighbors. In another are examples of the closest mimicry of animals to their surroundings, where the stranger has often to examine long before in the seemingly empty tank he can determine on every side the hidden forms. Thus one by one will come into his view the rays and flounders, whose colors render them almost indistinguishable from the gravelly bottom; next he will see the upturned eyes of the curious stargazer, which lies almost buried in the sand; then a series of mottled crustaceans, wedged about in the rocky background, or an occasional crab which wanders cautiously about, carrying a protective garden of seaweeds on his broad, flattened back. Near by will be odd-looking pipefishes and the sea horses, poised motionless in mimicry of the rough stems of the seaweeds. In a larger tank, sea turtles float sluggishly about, and coiling amid broken earthen jars are the fierce-looking, snakelike, sharp-jawed murries, to suggest Roman dinners and the slave-eating experiments of the lordly Pollio.

The aëration of the aquaria is secured effectively by streams of air which are forced in at the water surface and subdivided into bright clouds of minute silvery bubbles. The tanks are cared for from the rear passageways, and the attendants are rarely seen, although it is the constant attention in the arrangement and the restocking of the tanks that has gained the aquarium its well-earned success. Illustrated catalogues in French, German, English, and Italian enable the stranger better to appreciate his visit.

Amsterdam.—The Amsterdam Aquarium is the most recent of the larger aquariums in Europe, dating from 1880. It was then opened, under the directorship of Dr. G. F. Westerman, as an ad-

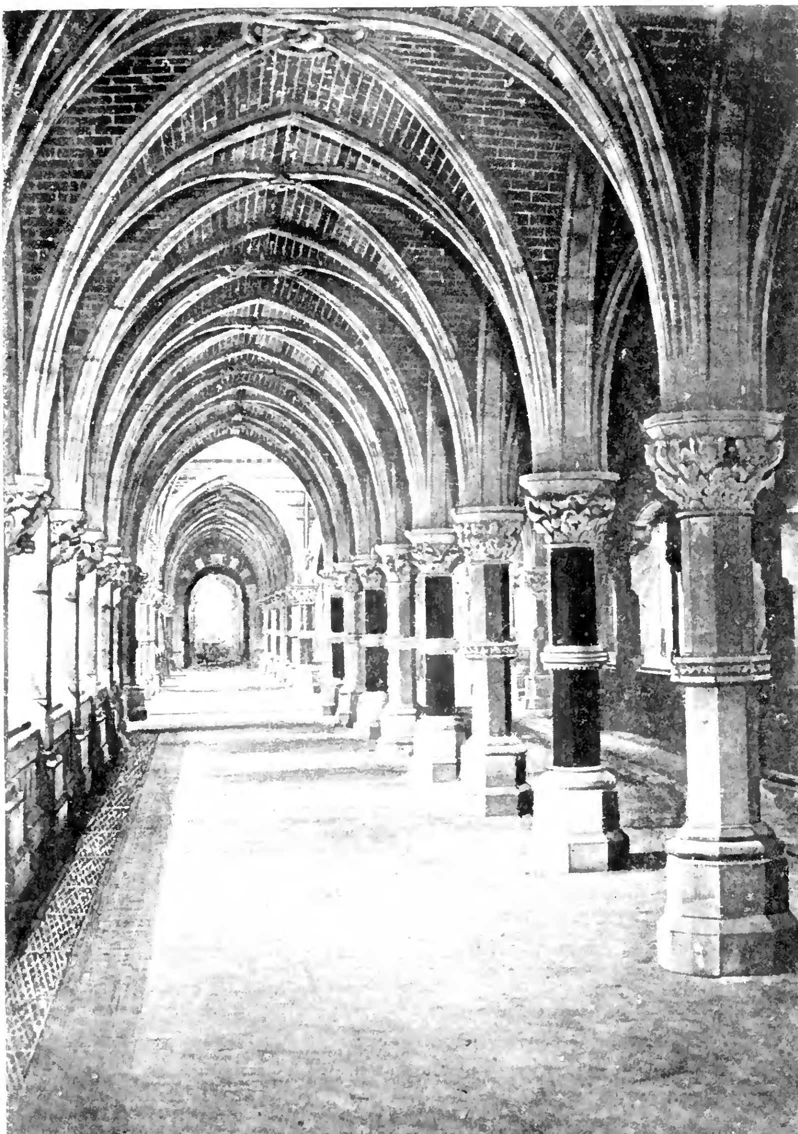


Brighton Aquarium.

junct of the famous Zoölogical Society of Amsterdam, Natura Artis Magistra. The building itself is situated on the broad avenue margining the Zoölogical Garden, and is decidedly an attractive one, although outwardly as cold and dignified as the typical municipal building, with its Roman architecture and its central temple-like structure. Its large size, about a hundred yards in length, has been of great advantage in the arrangement of the details of the interior, permitting the decorative use of columns, arches, and cornices without noticeable sacrifice of space or the appearance of overcrowding. The main corridor, which the visitor enters after he has ascended a broad white stairway, is wide and stately, its marble walls and floor diffusing the light entering from the large glass faces of the aquaria. The corridor is about fifty yards in length, and the aquaria, twenty in all, are arranged on either side, the largest measuring about thirty feet. They have been admirably designed to display their collections of living forms; fishes are notably present, and on every hand their movement is incessant, with gleams of color and changes of outline as they sweep to and fro. The critical observer is particularly impressed with the great number of fishes which have been kept successfully in a single tank; among them he recognizes the prominent forms occurring along the North Sea coasts—turbot and sole, ling, cod, rays, and flounders—even the herring and mackerel, to which confinement is usually most fatal. A collection of fresh-water fishes is not lacking, including a number of American forms, for which the director has been indebted to Mr. E. G. Blackford, of New York city—black bass, amia, and catfish—the latter strongly contrasting in size with their European cousin in an adjoining tank, the giant *Wels* of the Danube. From the extreme end of the aquarium room the visitor passes into a smaller hall, circular in outline, which contains over a score of table tanks displaying forms of attractive fresh-water fishes and salamanders; it is brightly lighted and pleasingly decorated with a marble-tiled floor, fringed by palms and ferns. From this room an entrance leads, on the one hand, into a spacious auditorium, which is made of use in courses of popular lectures, and, on the other hand, by a few marble steps, into a well-lighted museum containing in several rooms a collection of dried or alcoholic preparations of the typical forms of invertebrates and lower vertebrates.

The operative portion of the aquarium includes well-lighted corridors extending on either side of the main hall; the pathway along which the visitor passes has been sunken below the walls of the tanks, whose shelving sides can thus be more conveniently reached by the attendants. A series of darkened corridors next lead into the vaulted basement containing the large storage tanks.

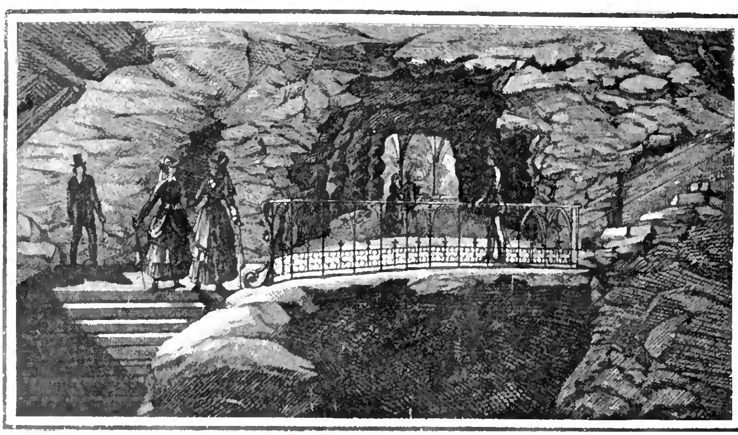
The administration of the aquarium appears throughout an especially painstaking and energetic one, due in no small degree to the labors of its present director, Dr. C. Kerbert.



BRIGHTON AQUARIUM—MAIN CORRIDOR.

PLYMOUTH.—On the Devonshire coast of England the need of a public aquarium has been supplied by the Marine Biological Association. In its laboratory building at Plymouth the entire basement floor has been devoted to the interests of the general visitor, and a well-chosen collection representing the Channel fauna can be studied in its well-arranged tanks. The important work of the station in connection with the British fisheries, added to its exceptional advantages in collecting material, gives Plymouth an important rank among marine aquariums.

PARIS.—At Paris the Aquarium of the Trocadero was in its day—for it stands among the oldest—regarded as the foremost of Europe. At present, however, its condition is somewhat degenerate, and it is apt, partly on this account, to give the critical observer an unfavorable if not disappointing impression upon his first visit. It is ill kept, wet, and untidy; its tanks are poorly cared for and very imperfectly stocked; and the general absence of attendants has permitted many attempts at diamond writing on the costly glass plates of the tanks. These defects, however, do not prevent the visitor from finally recognizing the interest-



BERLIN AQUARIUM—THE THREE GROTTOES.

ing features of the aquarium. Its plan of construction, as in the earlier designs, is typically grottolike. Its main hall is subterranean, and the tanks appear at the surface amid a thicket of overhanging bushes, like a ring of natural pools. The public entrance is cavernous—a descent of rough-hewn rock steps, margined by clumps of ferns and a small but noisy waterfall. The main corridor seems particularly dark and cool, none the less so when the eye comes to note the row of tank outlines and sees in their bluish water the chilly movements of trout. The corridor is ring-shaped, its side walls consisting of the faces of large aquaria, nine in the peripheral margin and two in the central, the latter separated by an alleyway in the line of the diameter of the ring. The great height of the tanks is particularly noteworthy; in some the water measures over twelve feet, giving a depth which results in an enormous pressure upon the glass fronts of the aquaria. This dangerous strain, however, has been cleverly counterbalanced: instead of attempting to employ a large plate of glass to resist the water pressure, the designers have prudently broken the front of the tank into a series of stouter panes, whose outlines are larger above, smaller below, framed massively by log-shaped beams of iron. Rockwork has been largely employed as the background of the aquaria, and the great water depth has favored the use of delicate strings of vertically growing water plants. At present the tanks are almost entirely stocked with fresh-water forms. Adjoining the main corridor has been added a laboratory devoted to experiments in fish culture. Here the hatching troughs are arranged in vertical banks to give the cascadelike waterflow recommended by the earlier culturists.

BERLIN.—Like that of the Trocadero, the Berlin Aquarium, next to be mentioned, ranks among the earliest in Europe, it having been opened, under the directorship of Dr. Brehm, in 1869. From that time onward its success has been remarkable—none the less so that its foundation and management have been due to private enterprise, in the form of a stock company. And to its credit it may safely be said that there has been no other aquarium in Europe which has appealed to a greater number of people and has accomplished its object with greater tact or at the cost of greater efforts.

A visit to the aquarium has come to be one of the interesting sights of Berlin, and the stranger has but little difficulty in finding its tall, stuccoed, buff-colored building at the corner of one of the streets crossing Unter den Linden, although he may feel at first, perhaps, inward qualms at finding the grotto-planned aquarium, of which he has so often heard, incased by a building which differs in no way outwardly from its apartment-house-looking neighbors. He is apt, therefore, to look about him somewhat suspiciously when he discovers that its entrance is strangely theaterlike: there are the box office, the flight of marble steps, the walls over-frescoed with mermaids, the lines of posters, to carry him to its threshold. The serpent gallery is the first to be entered—a long, iron-arched, well-lighted corridor, with glass- or wire-fronted cases on either side. This seems to be intended as the vestibule of the aquarium proper, where the curious visitor can whet his appetite on the sight of tarantulas, land turtles, and lizards before he descends into what seems like the mouth of a huge cavern; for from here onward the walls are of rough stonework, and there are rock-cut steps and darkened stone-arched passageways to lead the visitor from grotto to grotto as he wanders along, gazing at the aquaria on either side. The grotto which is first entered, however, might best be described as a circular, dome-roofed hall, whose rocky walls are broken by pools and basins to harbor turtles and crocodiles. Here in the middle stands the huge aviary, well stocked with bright-colored birds, and adjoining are the cages of the orang and chimpanzee—non-aquatic attractions, for which, strangely enough, the aquarium has always been noted. From this hall a long, dark gallery, whose walls are pitted with aquaria, leads to a second grotto, domed above, pitlike below, down which the visitor passes to a lower series of corridors which twist and turn, descend and rise, but continue to exhibit aquaria on every side till the exit is reached. Thus have been passed the geological and basalt grottoes and the beaver pool, near which a small descending rill has been made of service for hatching fish eggs. One of the curious features of the aquarium is the idea of distance which impresses the visitor as he wanders on and on; and it is even difficult to convince him that the corridors, grottoes, and twisting passageways can be contained within so small a surface area as that of the residence-looking building he has seen at the corner of the street; and he can not fail to wonder at the ingenuity of the architect, not merely in this regard, but in the arrangement of vistas which occur on every hand, and in the deftness with which the working-day side of the aquarium has been concealed.

Such in brief is the general visitor's idea of the Berlin Aquarium; to the adept its internal organization seems even more ingenious and interesting when it comes to be examined. The tanks are cared for by means of a labyrinth of concealed passageways; the storage reservoir is hidden away below the concrete floor of the lowest gallery, and most remarkable of all is the use of an artificial mixture as an economical substitute for sea water. As long used by Dr. Hermes, the present director, this mixture has been found of great practical value, and it certainly enables many fishes to live in spite of the adverse conditions of their confinement for months and even for years. The variety of living forms which one sees in the various tanks is a striking feature of the aquarium, and one is strongly impressed with the range in marine fauna which is thus kept in a district remote from the sea. The arrangement of the aquaria, it may be further added, is often regional; there will thus be grouped in one tank the forms of the North Sea, in another those of the Mediterranean, in a third those of the Baltic.

Brighton.—A brief description of the Brighton Aquarium must not be omitted, finally, from the present discussion; it is certainly the most typical, if not the largest, of the newer aquariums of Europe. From the architectural standpoint, moreover, its interior must unquestionably be given a foremost rank. Brighton will be remembered as admirably adapted to the needs of a public aquarium; its position on the shore of the Channel brings it directly in contact with rich fishing grounds, while, as a seaside resort, its closeness to London affords it an unfailing stream of visitors.

The aquarium has been situated in one of the most conspicuous points of the town—the most convenient for aquarial purposes on account of its nearness to the water; the chain bridge is close by, and the two most fashionable driveways, the Madeira Road and the Marine Parade, intersect at its very door posts.

It must be confessed that the exterior of the aquarium is not prepossessing; it suggests the roofed-over foundations of a house; nor is this appearance bettered by the presence of signs and posters. In fact, one is first led to believe that its success is altogether dependent upon the restaurant and small theater which it largely advertises. To enter the aquarium the visitor must descend a long, broad staircase, then pass through an entrance hall and reading room. The main corridor which he thus reaches extends directly in front a distance of four hundred feet; its appearance is, to say the least, an attractive one; it might even be called stately, with its groined arches of brick and terra cotta, and its aisles and row of central columns; it suggests, perhaps, the gallery of an early Italian palace in the shape of its columns and in the height and varied carvings of their capitals. The corridor shows on either side the large, windowlike fronts of the aquaria. These, however, do not appear to be especially brightly lighted; they number in all over fifty, the largest one a hundred feet in length, bending around a space in the central part of the hall. At the present day the stocking of the aquaria is not perhaps as carefully attended to as in earlier years, when the profits of the stockholders were doubtless greater. An effort appears to be made on the part of the management to keep one or two of the small cetaceans, dolphins and porpoises, in the largest tank; and judging from the throng of visitors around the neighboring seals and sea lions, one may reasonably conclude that these pseudo-inhabitants of the aquarium are by no means unpopular. In every season, however, the visitor may find at Brighton an interesting collection of Channel fauna, especially fishes. The general working conditions of the aquarium do not appear widely different from those of Amsterdam.

THE Tibetans whom Mr. St. George R. Littledale met in his journey across their country were men sometimes of strange notions. One of them asked if it was true that there was a big tree near Calcutta, out of the branches of which came all the heat of India; and whether the telescopes of the English party would allow them to see right through the mountains.

ON THE CRATER OF MOUNT SHASTA.

By Prof. A. S. PACKARD.

AT one o'clock on an August morning in 1877 I found myself on the stage bound for Sissons, in Strawberry Valley, a bit of civilization nestled among the pines and redwoods twenty miles from the summit of Mount Shasta. The stage road wound through mountain passes and interminable forests of pines, following up the Sacramento River, here a torrential stream. A turn in the road once gave us a magnificent view of the Shasta cone, rising in a sugar-loaf shape, white as Carrara marble, and seeming to lift itself out of the forest on the right, though it was fifty miles distant.

At Sissons both the cone, which rises to an elevation of 14,440 feet above the Pacific, and its crater to the northwestward, which is about two thousand feet lower, were very distinct. The cone rises about four thousand feet above the timber line, and we could see the rough lava flows and ash fields lying between the summit and the upper edge of the timber belt.

Throughout the woods on the sides of the volcano bears and mountain lions abounded; our driver told me he saw one of the latter walking by the roadside a month previous. We saw deer far up in the woods; antelope range near the summit, and Rocky Mountain sheep, or bighorn, herd in the less accessible cliffs; while some time previous one of that rare and very shy mammal, the Rocky Mountain goat, which inhabits the more inaccessible ranges above the timber line, had been shot.

The view of the mountain that evening by moonlight was very fine. A light, silvery-edged cloud rested on the summit, while the mountain mass below, lighted up by the moonbeams, contrasted with the vast expanse of dark, somber forests in the foreground.

The next day was not favorable for the ascent, but it passed quickly. The forest scenes, enlivened by an encampment of Indians, in the rear of the inn, the rushing mountain torrents, the volcanic cones, or Black Buttes, to the northward, with their lavas, the old moraines, the insect life, all were novel features to an Eastern eye.

It cleared off at sunset; the clouds disappeared, leaving a thin veil of fresh snow on Shasta's peak and crater, now bathed in a ruddy glow, which, as the evening wore on, was replaced by the silvery light of the full-orbed moon.

The 25th was a glorious day, and in the bracing northerly breeze we started on our ride of twenty miles to the camping ground above the timber line. A distance of five or six miles through forests of magnificent oaks, pines, and redwoods brought us to "The Devil's Garden," which, far from being sulphurous in tone, is a large terminal moraine stretching eight miles west of the crater; the sides slope at a high angle, and the surface, like that of our kames in the Eastern States, is flat and of even width, being a quarter to half a mile wide. It looked at first like a lava stream, but the angular blocks of hornblende andesite intermingled with the *débris* bespoke its glacial origin. On the south of us ran down from the peak high, steep lateral moraines.

Passing above the limit of oak trees, we ascend above the belt of pitch pine and silver pines to the region of firs—speaking botanically, through the belt of *Picea amabilis* and then higher up to *P. nobilis* and *P. contorta,* then to a growth of *P. flexilis,* which attains an elevation of about ten thousand feet. With these, though mostly in the lower belts, were associated the characteristic shrubs of California, the *Manzanita* and *Ceanothus,* also a yellow-flowered, stiff plant like greasewood, which ascends far above the limit of trees. The silver-leafed *P. contorta,* near the upper edge of the timber line, grows from twenty to thirty feet high and from twelve to sixteen inches in diameter, with a very white bark. A zone of firs is situated between it and the highest pines. *P. flexilis* seems to be only a variety of *P. contorta*; it is more or less procumbent, lying down flat, covering yawning chasms or seams in the rough lava, so that one can walk upon the trunks and branches when they bridge the spaces between the angular, jagged blocks of lavas.

Late in the afternoon we selected a level place near a bank of snow at an elevation of about nine thousand five hundred feet, and, gathering a few logs of dead pines, we made a rousing fire, and at nighfall unrolled our heavy California blankets, sleeping nearer the stars than I ever had before. It was a clear, cold night; the water froze nearly an inch thick, and at 6.15 the next morning, when we began our ascent of the crater, the thermometer was 25° F.

We rode our horses for an hour until we came to the foot of the ash cone, and by 8.45 were on the summit of the crater. The view in the clear atmosphere was indeed a wide one. Far to the northwest was the Siskiyou range and Pilate's Knob, and to the west the jagged, saw-toothed, snowy peaks of the Salmon Mountains; fifty miles southward was the snow-clad solitary Lassens Peak, twelve thousand feet high; while Klamath Lakes and the lava beds, the seat of the late Modoc war, lay to the northeastward.

The scene was a wild one within the great crater, whose narrow edge is formed of sharp, jagged peaks and pinnacles. Broad, almost unbroken snow fields extended from the edge down for a thousand feet; at the bottom were two frozen lakes like sheets of glass. The crater was extinct, no signs of steam or of recent eruptions meeting the eye. We were told that on the summit of the cone there is a hot-steam vent, the last dying embers of past volcanic action. Mr. Sissons, while guiding a traveler to the summit, was once belated and had to spend the night there, and saved the lives of himself and his companion by lying close to the steam vent, the steam passing up through the snow. On their descent they slid down over the snow fields of the summit to the lava beds below.

The outlet of the crater, or point of overflow at the last eruption, was on the western side, where small masses of black obsidian and white incrustations of lime were observed.

Turning away from this wonderful view, we walked over the snow and down the loose rocky sides to a rock overlooking the Whitney Glacier. This ice stream, which stretched uphill past the crater to its source, is about three miles long, and on the north side of the mountain, at a point about 13,500 feet high, it heads in a snow field, or *mer-de-glace*, which is continuous with the head of the McCloud Glacier. Toward the top a large mass of lava projects above the surface of the ice, which is white and very clear near the top; but below this point the glacier is much discolored, more so than any Alpine glacier I have seen. Owing to the steep and uneven pitch of the rocky bed, the surface of the ice, especially near the upper end of the glacier "cascades," or breaks into needles, being rent by numerous crevasses. On each side is a well-marked lateral moraine, with its steepest side next to the overhanging wall of lava; the moraine on the western side begins much lower down. The one on the east side ends in three ridges of dirt and rock, the two uniting to form the great terminal moraine, and, looking far down the glacial stream, this moraine was seen to pass under the ice, or rather the ice overrode it, since the glacier was seen here and there to project above it. Large bowlders or blocks of lava were scattered over it, and its surface was very uneven, with irregular mounds of *débris* and deep pit-holelike hollows or basins between them. The terminal moraine was overlooked by a small volcano or monticule perhaps a thousand feet high, with nine or ten crater cones rising from its sides—a beautiful example, and reminding me, as I remember them, of the monticules on the flanks of Mount Etna.

At and beyond the end of the present terminal moraine stretches away in the distance a number of old moraines, naked and bare as when they were born, forming plains and overlooked by well-wooded hills. A rapid stream with a white bed runs from the end of the glacier in a northerly direction into Shasta Valley, and at night it is not frozen.

On the northeastern side near the end of the glacier are three well-marked naked old moraines at least two miles in length, which sweep round to the volcano above referred to, and apparently connect with the terminal moraine of a small narrow glacier just east of the Whitney Glacier, and which may formerly have been an upper eastern branch of it. This, perhaps, is the Ash Creek Glacier, which lies on the northeast slope of the mountain, while the McCloud Glacier lies farther to the eastward.

The terminal moraines at the end of the Whitney Glacier, which are not, as in Swiss glaciers, clearly demarked from the end of the glaciers themselves, but form an exceedingly irregular and broken field of rocks and *débris* covering and burying the ice, with many sinks or basins and "kettles," enabled me to clearly understand the mode of formation of the "kettles" or deep holes, at times still filled with water, which are so marked in Massachusetts, near Salem and Marblehead, and also at the "Dumplings" on Canonicut Island near Newport, Rhode Island.

In his account of the McCloud Glacier of Mount Shasta in his entertaining Mountaineering in the Sierra Nevada, Mr. Clarence King states that for "at least a mile's width the whole lower zone is buried under accumulation of morainal matter. Instead of ending like most Swiss glaciers, this ice wastes chiefly in contact with the ground, and when considerable caverns are formed the overlying moraine crushes its way through the rotten roof, making the funnels we had seen."

These immense fields of morainal matter overlying and burying the melting edge of the glacier, here spreading out over the lower flanks of the mountain, were evident signs of the waning of the ice, the glacier having long since ceased to advance; and it enabled me, as never before, to understand that the peculiar hills and basins or kettles of the great terminal moraine of southern New England were formed by the irregular melting of the southern edge of the glacier, when through and under the mass of ice, perhaps not over from three to five hundred feet thick, ran subglacial streams and rivers, while here and there, owing to the uneven melting of the ice, immense masses of gravel and bowlders had fallen in, the material adjoining being rearranged into rounded kames, so characteristic of our New England scenery.

The rocks on the eastern side of the middle portion of the Whitney Glacier were rounded and polished, as much as such hard rock could well be, when the glacier was of greater volume than now. At present the ice has melted away from the sides of the rock overlooking it. So far as I could see from my point of view, the surface was not grooved or striated.

That the glacier was in motion was proved by the not infrequent distant explosions caused by the rupture of the ice near the head of the glacier. The general appearance of things indicated that the glacier was diminishing in size, and Sissons told me that the surface of the glacier was at least from seventy-five to one hundred feet lower than at the time of his last visit, four years previous.

We lunched on the rim of the crater, at 3 P. M. went down to where we had left our horses, and after a hard and fatiguing though glorious ride of four hours reached the hotel ranch.

We found that the crater cone is composed of a reddish lava, while the mother peak rising far above it is formed of a hard, bluish trachyte. Its moraines extend for ten to twelve miles down the western slope, passing beyond the west side of the stage road north of Sissons, where more or less rounded hillocks of this bluish trachyte abut on the hills of metamorphic rocks of the Trinity and Sacramento Mountains.

We also saw as we descended that the large moraine extending from the cone ending in the "Devil's Garden" is flanked by two lateral moraines, the median one, or the garden, extending from the base of the crater cone. What adds to the singularity and wildness of the scene at the upper end of this "garden," or rather playground of mountain imps, are the numerous parallel concentric ridges of lava rock, forming a succession of transverse terminal moraines, with benches of clear soil between them. These parallel curved rows of stones and angular gravel mark the rapid retreat and melting away of the glacier, which, with its neighbor, extended down on the western slope.

To my disappointment, I found no Alpine fauna or flora on the summit of the crater, and believe there is none on the main peak. The vegetation was very scanty where we camped, only grasses and plants which had straggled up from below, and, so far as I remember, nothing but lichens occurred on the bare rocks and moraines above. No Alpine or arctic butterflies or moths occurred, such as I was familiar with, and which abound on the summits of the Rocky Mountains. A few spiders, a small centipede (*Lithobius*), and a few ants' nests were to be seen, and under stones a bristle-tail (*Machilis*), but the only distinctive Alpine insect on the mountain was a wingless grasshopper (*Pezotettix*), though that occurred lower down, in the zone of firs. I saw a common *Pieris* butterfly at the top of the crater, but this was like one seen flying below.

This entire lack of any Alpine plants or animals indicates that Mount Shasta is too young and isolated a mountain to have been reached by any waifs from arctic or Alpine sources, and their absence suggests that the glaciers had at a very recent date melted away and disappeared from the western side of the mountain.

But that the whole *massif* or mountain mass had once been enshrouded by the ice of a late glacial epoch was proved by the existence among the farms of Strawberry Valley, some ten miles in a direct line from the summit, of two well-rounded hills or flattened domes of a supposed metamorphic rock which had evidently been regularly molded by ice.

This was further proved to our own satisfaction the next day after our descent, in riding on the stage from Berryvale to Butteville. Directly beyond the hotel is a remarkable terminal moraine evidently derived from the crater, as it is composed of small bowlders of reddish-brown lava; these are arranged in transverse, curved parallel rows on the plain, with clear grass-grown spaces between them, much as in the larger, higher ones in the "Devil's Garden" moraine, but the bowlders are very much smaller and less angular. This point is about twenty-five hundred feet above the sea, and about fifteen or twenty miles from the summit of the crater. Hence the ice seems to have extended from the snow fields of Shasta's summit down upon the plains, where it apparently abutted on the Trinity and Sacramento ranges, which were probably below the ice belt and not glaciated.

From Butteville the view of Mount Shasta is incomparably fine—one of the world's great views. Looking from this point, the cone is in line with the mother peak. The great cone or mountain mass rises as a unit from a broad, treeless plain dotted with scattered ranches and pierces the clouds. Above this plain, as the afternoon waned and the evening shades fell, the zone of black firs and pines merged into a region of dark purple, becoming more ruddy above, until the last beams of the setting sun tinged and flushed the snowy summit with an Alpine glow. As these pink and reddish tints faded away, the dark purple mass of color rose higher and higher until the darker shades of evening completely enshrouded it, and finally as the darkness fell the cone lost its height and distinctness.

No one knows when the oil fields of Yenangyaung in Burmah were first discovered; but the legend of their origin relates that in January, 1099, a king of Pagau, attracted by the accounts he had heard of the marvels of the region, especially of a wonderful spring of sweet-scented waters, visited the spot. Some of his courtiers who also visited the spring were so entranced by the exquisite odors exhaled from it that they forgot to return at night. The king, searching for them the next morning, found them thus enthralled, to the neglect of the duties they owed him, and in his anger ordered their immediate execution; while, exercising his miraculous powers, he changed the sweet odors to the repulsive smell of petroleum. From this the place came to be known by its present name, which means Stinking-water Creek.

NOTES ON BHILS, BURMESE, AND BATTAKS.

By Dr. R. W. SHUFELDT.

ABOUT a year ago the distinguished anthropologist of the University of Zürich, Dr. Rudolph Martin, presented the writer with a small but very valuable collection of photographs of certain peoples of India and the East Indies. Some of these are very rare, and, upon searching the ethnological works in the Government libraries in Washington, I have been unable to find examples of quite a number of them.

For instance, we have scarcely any literature upon the history of that truly interesting race of Indian peoples known as the Bhils. Two of my photographs (Figs. 1 and 2) are devoted to a Bhil beauty, the one giving her directly *en face*, and the other *en profile*. This is the true scientific method of photographing a subject of this kind, and it has been my experience among native races that it can usually be done. It practically very much enhances the value of either picture; for characters and objects of dress and ornament, seen upon front view, can often be only fully explained by the one taken upon lateral aspect, and *vice versa*.

Fig. 1.—A Bhil Beauty, India. Seen upon front view.

In this Bhil woman, for example, the central fastening of the chain ornament at the fore end of the hair-parting is distinctly seen when we regard her from in front, whereas the very peculiar perforated, circular ornament of metal in the wing of the nose is but partly made out. Taken upon side view, these conditions are exactly reversed, and with a lens of moderate power one can easily study in detail the several interesting ornaments with which she has bedecked her head and neck. Upon profile, too, we can appreciate the nature of her headdress behind, which is quite out of the question when the subject, in this case, is seen from in front. This is likewise the only method by means of which we can properly study the features of the individual whom we have photographed, and learn something of the facial angle and similar characters. It will be noted that this Bhil beauty wears as many as half a dozen heavy metal bracelets upon either wrist, and the collection of trinkets that hang over her ears is extremely curious. Her rather light attire permits us to form some opinion as to the physique of this woman, and it is not difficult to see that in such particulars she is remarkably well proportioned. She is evidently broad and deep-chested; has finely developed limbs, and a well-balanced head, upon rather square shoulders. The form of her face is nearly circular, with large mouth and nose, and the eyes are set far apart. Her complexion is dark, and she is somewhat small in stature. Bhils have the reputation of being very active and capable of enduring much fatigue with impunity. Twenty years ago, or less perhaps, this tribe occupied a British political agency—the Bhil agency, in central Asia—which covered an area of some eighty-one hundred and sixty square miles, and had a population of nearly a quarter of a million of people. This agency was established in 1825, at which time a Bhil corps was organized "with a view to utilizing the warlike instincts of the Bhil tribes. This brave body of men have done good service, and gradually put down the predatory habits of their countrymen. The Bhil tribes chiefly inhabit the rocky ranges of the Vindhya and Sátpurá Mountains, and the banks of the Narbadá and the Tapti. In common with other hill tribes, the Bhils are supposed to have been aborigines of India, and to have been driven to their present fastnesses at the time of the Hindu invasion."

FIG. 2.—A BHIL BEAUTY, INDIA. Photographed *en profile*. Same subject as shown in Fig. 1.

I understand that numerous efforts have been made to break up their plundering ways by the home Government, and that the official reports stated in 1869–'70 that "the Bhils of Mánpur are becoming reconciled to the life of cultivators, though not yet willing to take out leases." How this may be at the present date the writer is not informed.

Dr. Hunter, when Director-General of Statistics to the Government of India, wrote, in reference to the Scythic and non-Aryan influence in that country, that "proceeding inward to the North-western Provinces, we find traces of an early Buddhist civilization having been overturned by rude non-Aryan races. In Bareilly district, for example, the wild Ahírs from the north, the Bhils from the south, and the Bhars from the west seem to have expelled highly developed Aryan communities not long before 1000 A. D." Not a few works upon these Indian tribes have appeared in England, as well as elsewhere, and doubtless much more remains to be said about these wonderfully interesting people, that will prove to be of great importance to the science of ethnology.

A very different appearing people from the Bhils are the natives of Burmah, for in the Burmese we have the characteristics of the Mongoloid types, possessed in common with all the races of Indo-China, including those of the tribes of Tibet and the eastern extremities of the Himalayan range of mountains. As a rule, they possess a fine physique, and, as in the case of the Bhils, they, too, are notoriously active and hardy. In complexion they are usually dark, but never very decidedly so, the common shade of the skin being of a warm, rich brown. Burmans of the typical stock have black hair, that is rather coarse and very abundant, being straight as in the case of the Chinese. Some of the men are pretty well bearded, more distinctly so, indeed, than are their not distant neighbors the natives of Siam. The word "Burma" or "Burmah" is derived from their own name of their race, which is Mran-má, being pronounced Ba-má, in distinct monosyllabic tone, as their language usually is. In this respect it resembles the dialects of southern China, while in other particulars it exhibits evident Tibetan relations. Soft and flexible almost to a fault, the language of these people is written in letters of a subcircular form in most cases, and for nearly seven centu-

Fig. 3.—A Burmese Mother and her Child. From a photograph.

ries it has been the medium of recording their very interesting literature. Its alphabet is said to be of Indian origin, and was ushered in with the religion of Buddha. Burmese are not behindhand in the matter of some manufactures, though they are by no means up to the better races of India in these particulars. Upon crudely constructed looms, their women make a cloth of a very good quality, such as is worn by the child and its mother shown in Fig. 3. Gorgeous silk cloths, made from Chinese silk, are woven in other localities, and patterns of flowers are frequently embroidered (see Fig. 3). They also use numerous fabrics which they obtain through the medium of trade with the British, who have already conquered a considerable part of the Empire of Burma. As is the case with so many other peoples of the East, the women are fond of personal adornment. They wear from five to six bracelets around their wrists, a multiplicity of necklaces, and very frequently circular, worked ear ornaments of silver or gold on the lobes of the ears. In Fig. 3 the woman is smoking a large cigar. An authority at my hand says the Burmese are passionately fond of the drama, "which appears under the various forms of masquerades, puppet shows, ballet opera, and farces, as well as in the more dignified character of the regular tragedy. The moral character of the plays is often of the lowest kind, the utmost license both of speech and action being allowed on the stage. The scenery is of a very simple and purely suggestive kind, a single branch of a tree standing for a forest, and frequently the filling up of the dialogue is largely left to the ingenuity of the actors, little more than hints of the plot being contained in many of the librettos. The popular interest in the dramatic exhibitions is intense, and, as in Siam, the same piece often drags its slow length along for days together." Some of the young Burmese women have very intelligent features, and are far from being unprepossessing. The young girl shown in Fig. 4 is of this class, and it is seen that she

Fig. 4.—A Young Burmese Beauty.
From a photograph.

is endowed with a style of Oriental beauty by no means unattractive or to be despised. Their despotic king never allows any of his subjects to quit the country without his permission, and least of all, women. The British and others living in Burmah have not always had their eyes closed to the charms of the Burmese girls, and when they have had children by them they have experienced difficulties of the most extraordinary nature upon leaving the land in their attempts to take these and their mothers with them. Often fabulous fees have had to be paid to effect their removal. They are remarkably faithful to their masters, being affectionate, industrious, and extremely domestic. Those having these habits despise prostitution, for a prostitute among them is an outcast, while they in their own calling are not dishonored. In contrast with other parts of the East, the women of Burmah go about openly, and are not excluded from the sight of the men. They also have not a little to say in the community, even being able, with the proof of cruel treatment, to plead in court for a divorce, and this last, under such circumstances, is usually obtained without difficulty.

Leaving India now, and passing to the island of Sumatra, I desire to introduce an entirely different race of people; these are the Battaks,* and they are of great interest to the anthropologist from any point he may choose to consider them. Many books and descriptions have appeared about the Battaks, dating back before the middle of the present century. One writer tells us that it "is not known whether they were settled in Sumatra before the Hindu period. Their language contains words of Sanskrit origin, and others most readily referred to Javanese, Malay, Menangkabau, Macassar, Sundanese, Niasese, and Tagal influence." In 1866, when Prof. Albert S. Bickmore was traveling in Sumatra, he saw not a little of these people, and he believed then that the place where their aboriginal civilization sprang up was very likely on the shores of that famous Sumatran lake, Lake Toba, and upon the neighboring plateau of Silindong. From this locality they gradually occupied an extensive domain in the interior, which was extended upon either side to the seacoast. Eventually, however, the Malays spread along the coast line, and thus confined the Battaks once more to the interior.

Nearly twenty years later, Webster wrote that they occupied the country only to the southeast of Achin, the territory in the middle of which Lake Toba is situated. From all that I can gather upon the subject at the present time, it would appear that this curious race, although they are distinctly different from the typical Malay, these last-named people, together with the Achin

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* This word is also spelled "Batah" and "Batta."

population, are rapidly absorbing them. Webster, in describing the Battaks, says: "The average stature of the men is about five feet four inches; of the women, four feet eight inches. In general build they are rather thickset, with broad shoulders and fairly muscular limbs. The color of the skin ranges from dark brown to a yellowish tint, the darkness apparently quite independent of climatic influences or distinction of race. The skull is rather oval than round. In marked contrast to the Malay type are the large, black, long-shaped eyes, beneath heavy black or

Fig. 5.—A Group of Battaks.

dark-brown eyebrows. The cheek bones are somewhat prominent, but less so than among the Malays."

Neuman, in 1886, reckoned the population of the entire river basin occupied by the Battaks at fifty thousand, and Van der Tunk has given us a very good account of their language, and of the Toba dialect in particular. Battak poetry has been treated by Mr. C. A. Ophnijen in a very entertaining volume, and in it he describes "a curious leaf language used by Battak lovers, in which the name of some leaf or plant is substituted for the word with which it has greatest phonetic similarity."

The Battaks have invented an alphabetic language of their own, and the various shaped letters are sometimes quite intricate and difficult to decipher. Often they write it on narrow strips of tender bamboo about half a foot long, using for the purpose the point of a blunt needle. Their dialects differ but little in degree, and consequently the unification of their language is quite complete. Many of their superstitions, their myths, and their beliefs are most interesting, and when one comes to consider their advancement in certain directions it is certainly very remarkable, as Bickmore remarks, that "all of them, beyond the territory under the Dutch Government, are *cannibals.* Those living on this plain also feasted on human flesh until the Dutch conquered

Fig. 6.—Battak Girls. From a photograph.

them, and obliged them to give up such fiendish custom. The Rajah of Sipirok assured the Governor of Padang that he had eaten human flesh between thirty and forty times, and that he had never in all his life tasted anything that he relished half as well. This custom has prevailed among the Battas from time immemorial."

Marco Polo claims that the Battaks have been cannibals for a time extending at least as far back as the year 1290; and Sir Stamford Raffles, who was among them in 1820, found some of their laws to be very severe. For crimes for which we give but light penalties, or a few years in jail, the Battaks cut up their perpetrators alive, and I dare say ate them afterward; indeed, cases are on record where a Battak has been convicted of adultery, and his discoverers, members of his own tribe, have cut him up alive and then feasted upon his remains. A missionary once told Prof. Bickmore that he knew of a Battak who "had been guilty of stealing an article of only very little value according to their ideas of wealth, yet he was seized, his arms extended at full length and fastened to a bamboo, a sharpened prop placed under his chin, so that he could not move his head, and in this condition he was bound fast to a tree. The knife was then handed to the native who had lost the article, and he was ordered to step forward and cut out of the living man what piece he preferred. This he did promptly; the rajah took the second choice, and then the people finished the cold-blooded butchery, and thus their victim died.

"The parts that are esteemed the greatest delicacies are the palms of the hands, and after them the eyes. As soon as a piece is cut out it is dipped, still warm and steaming, in *sambal*, a common condiment, composed of red or Chili peppers and a few grains of coarse salt, ground up between two flat stones. Formerly it appears to have been the custom to broil the human flesh, for Mr. Marsden states that in December, 1780, a native of Nias, who stabbed a Batta at Batang Taroh, the river I crossed on the suspension bridge, was seized at six one morning, and, without any judicial process, was tied to a stake, cut in pieces with the utmost eagerness while yet alive, and eaten upon the spot, partly *broiled*, but mostly raw."

Such are some of the characters and habits of the people shown in Figs. 5 and 6 accompanying the present article. It will be seen that the members composing the group shown in Fig. 5 are but scantily clad, and they are each and all almost completely devoid of any ornament. The three elder boys wear turbanlike affairs upon their heads, while the old woman at the right-hand end of the line in the rear row has a peculiar kind of a headdress on. I have very carefully studied the faces of these individuals, and I am free to confess that, judging from their features, they seem to be capable of committing almost any species of barbarity.

The two girls shown in Fig. 6 are particularly interesting, especially the one sitting down, whom I understand the Battaks consider to be a great beauty. The one standing up, with the big earrings in her ears, has as veritable a face of a savage as I ever remember having seen anywhere. As in the case with the boys shown in Fig. 5, these girls likewise wear headdresses, but of somewhat though not a very different style. They, too, are but lightly attired, and possess the same set and wicked expression in their eyes. Yet, and notwithstanding this, and taking into consideration what I know of these two Battak girls, I must say I have not infrequently met with types of negroes, both in the South as well as in Washington, that possessed features nearly the counterpart of these Battaks. In this connection we must remember, however, that the negroes in this country need not trace back so very far before their arrival at an ancestral stock that can hardly be considered above suspicion in the matter of cannibalism, and that, too, without having been the inventors of an alphabet and a written language to redeem the fact.

THE ABUNDANCE OF ANIMAL LIFE.

By M. ALBERT GAUDRY.

WE find in studying the past epochs of the earth's history that they have been marked by an abundance of life, even exceeding any which prevails in the present. Comparing the existing state with the past, we are struck with the immensity of the part played by the inferior organisms. Life is everywhere; the number of microbes is infinite. Rocks which at first seem to belong only to the domain of mineralogy are found to appertain very largely to that of biology. One of the grandest spectacles, for example, is offered by the travertines of the Mammoth Hot Springs, in the Rocky Mountain National Park, which Mr. Weed declares are formed chiefly through the agency of algæ, withdrawing the excess of carbonic acid from the water, and forcing the precipitation of the limestone. Going from the hot springs to the geysers, we find deposits of silica which have been formed in the same way; and what is called gelatinous silica is largely vegetable matter. The lower animals are also so numerous in some places that they contribute to the formation of rocks. Plancus has calculated that three grammes of certain sands of the Caribbean Sea contain 180,000 shells of foraminifera. M. Schlumberger found 116,000 foraminifera shells in a cubic centimetre of the Atlantic mud which was brought up by the Travailleur expedition. Polyps construct atolls, barrier reefs, and islands; and if the bottoms of the oceans were uncovered we should doubtless see coralline rocks no less extended than the Secondary formation called the coral rag. It is said that the shells of the *Etheria* form such large beds in the Senegal that they are quarried to be made into lime, and that on the shores of Lake Pontchartrain, near New Orleans, the *Gnathodons* form a bed four miles and a half long, nearly two hundred feet wide, and sixteen feet thick. I have been informed by M. Sauvage, to whom we owe many important works on marine animals, that the year's crop of oysters as entered in the statistical tables of the Minister of the Marine reaches the prodigious figure of 1,407,390,400. In the same year there were returned 1,262,600 bushels of mussels and 620,000 bushels of other shellfish than oysters and mussels. The same authority estimates that 2,200,000 lobsters, 16,000,000,000 shrimps and prawns, 1,080,000,000 sardines, and 400,000,000 herrings are consumed in France in a single year. The cod, the mackerel, and the fresh fishes would also represent considerable quantities. The fishermen of the single port of Boulogne took 63,000,000 kilogrammes of fish during a period of nine years. Assuredly the statistics of such other countries as Great Britain, Norway, and Newfoundland would give not less considerable figures. These numbers illustrate the richness of the life that is concealed under the waves of existing seas.

Although the reptiles are much less various in our epoch than during the Secondary age, they are still numerous in some regions. According to Alcide d'Orbigny, caymans are numbered by thousands in the province of Moxos. The traveler Leguat, speaking of the extinct tortoises of the island of Rodriguez in 1708, wrote that they were seen sometimes in troops of two or three thousand, so that one could go more than two hundred paces on their backs without putting his foot on the ground. M. A. Milne-Edwards found reports in the office of the ministry according to which thirty thousand tortoises were taken from Rodriguez in a year and a half to supply Mauritius and Réunion. Venomous serpents are so common in India that M. Sauvage says that in comparison with them tigers and panthers are inoffensive beasts. According to official documents, more than nineteen thousand persons perished in India in one year from snake bites.

Warm-blooded animals have especially multiplied in our epoch. Livingstone met in the country of the Makololos more than thirty different species of birds; among them hundreds of ibis, files of three hundred pelicans, myriads of ducks, many geese, herons, kalas, crossbills, burgills, spoonbills, and flamingoes, and an enormous multitude of gulls and cranes. Delegorgue has also executed paintings showing the abundance of the birds. He speaks of having seen five hundred or a thousand vultures upon a single elephant's carcass. Nothing, he says, is more strange to the hunter than to see rising at his approach, circling in the air, that mass of feathered creatures which forms a kind of immense movable dais above him. Alcide d'Orbigny, in his travels in Bolivia, descending the Mamoré, found its banks animated with innumerable shore birds. The tantalus, in troops of several thousands, marched with slow steps upon the muddy parts in company with the red spoonbill or white egret, while the sand banks were covered with scissorbills and sea swallows, together with many goatsuckers. In the country of the Chiquitos, D'Orbigny met cardinal and cacique birds which "possessed the qualities rarely found together, of melodious song and brilliant plumage. Toucans made the woods resonant with their sharp accents, which were mingled with the disagreeable cries of paroquets of numerous species and of red and yellow aras. . . . The woods resounded with the cadenced cries of the penelope and the hoecos; by means of his cry at a fixed hour the kamichi serves the Indians instead of a clock."

The abundance of mammals is still more extraordinary than that of birds. Livingstone speaks of a band of more than ten thousand euchoris antelopes. Delegorgue says, describing a meeting he had with these animals: "The dust flew and formed thick clouds in a hundred directions. Sometimes it rose in whirling columns to the height of one hundred or two hundred feet. . . . Immediately I perceived the innumerable troops of springboks which were raising these clouds. . . . The vision astonished me so that I had to question myself in order to be sure that it was not a vision. There were bands of from three to ten thousand individuals each, crossing one another's course at all points at once." The same traveler speaks also of large herds of gnus and elands; and he speaks of bands of a thousand or fifteen hundred buffaloes.

Allen, in his admirable work on the bisons of America, gives some curious details on the importance their herds once had and on their extinction. The 2,500,000 bisons that were killed between 1870 and 1875 would represent 50,000,000 in a century.

The solipedes abound in our epoch. Delegorgue saw bands of four or five hundred quaggas in Africa. Mr. Blanford says that Dr. Aitchison met a troop of one thousand herniones in Afghanistan. Brehm estimates, following Youatt, that the number of horses in all Russia is near 20,000,000 head. The rapidity with which horses left loose multiply in America is well known. Wild elephants are destined to be annihilated by man, but they are still numerous in some regions. Speke relates that when he was on the banks of the Nile, he found himself in the midst of a drove of several hundred elephants. Delegorgue estimates the number of elephants which he saw on a space about ten thousand feet in diameter in the Amazulu country at six hundred.

The rodents have a surprising force of propagation and multiply with the most astonishing rapidity. In 1863 a Mr. Austin took some rabbits to Australia for stocking his hunting grounds. The introduction of them was a disaster. They have so multiplied that thousands and thousands of acres of land have been ravaged, and thousands of men ruined. According to a report made three years ago, there are 20,000,000 rabbits in southern Victoria and northern Queensland. Brehm relates that 1,500,000 of field mice (*Arvicola arvalis*) were destroyed in fifteen days in the canton of Saverne, and that a factory in Breslau having offered a centime (a quarter of a cent) a dozen for these animals, some peasants delivered fourteen hundred of them a day. Charles Martens has given some curious details concerning the immense troop of lemmings (*Myodes*) in Norway. I was struck with the multitude of squirrels in the Rocky Mountains. We met them at every step in passing through the wooded regions. Alcide d'Orbigny relates that when at Carmen de Moxos he was nearly suffocated by the odor of musk in his house. It came from the thousands of bats that hung from the roof during the day. Marine mammals were also very numerous before they were pursued by man. Buffon says that in 1704 the crew of an English ship met a school of more than a thousand morses near Cherry Island, in latitude 75°.

Notwithstanding the number of beings that disappeared in the various geological epochs, I believe that the sum of the appearances surpassed that of the extinctions till the end of the Miocene. I can not assert that there has not been some diminution since that period; but we can affirm that a prodigious fecundity prevails at the present time.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

The Cambodian doctors, according to M. Paul d'Enjoy, largely use vegetable poisons as medicines, and apply them with very great skill; and they are often possessors of recipes, the secret of which is carefully kept within the family. They pretend to be acquainted with the love philter, and sell at a very high price a colorless oil with which the young men impregnate their lips in hopes of winning the young women through its magical power. The Cambodian bonzes have established in the vicinity of their monasteries, and the Annamites near their pagodas and under their own direction, refuges where the sick are taken care of gratuitously. The institutions are sustained by public charity and by the generous gifts of patients. Many of the wealthy are not ashamed to have themselves taken to these asylums, hoping that their cure may be made more complete through the protection of the ministers of God, under whose care they place themselves.

Insect chrysalides seem totally inert, and to the ordinary observer suggest a mummy rather than anything else. Yet, when occasion arises, they are able to manifest their vitality and even to be active. M. G. de Rocquigny Adanson, studying some Saturnias, opened a few of the cocoons, and having examined the insects, put them in a box in which the place of their broken silken envelope was supplied by cotton wadding. Three weeks afterward he found that they had changed position, and, examining them more closely, that they had thrown out threads and fastened themselves to the cotton. Madame Elisée Reclus, studying natural history in Switzerland, had some Vanessas much shaken by the jolts in descending the mountain, and afterward more shaken on the railway train. Observing them after they had enjoyed a few hours of quiet at home, she found that they had changed position, and, having thrown out threads and cross threads, had fastened themselves firmly to the lid of the box in which they were kept.

SHELLS.

By MARGARET WENTWORTH LEIGHTON.

See what a lovely shell,
Small and pure as a pearl,
Lying close to my foot,
Frail, but a work divine,
Made so fairly well
With delicate spire and whorl,
How exquisitely minute,
A miracle of design!

Slight, to be crushed with a tap
Of my finger nail on the sand;
Small, but a work divine;
Frail, but of force to withstand,
Year upon year, the shock
Of cataract seas that snap
The three-decker's oaken spine
Athwart the ledges of rock
Here on the Breton strand!

—Tennyson.

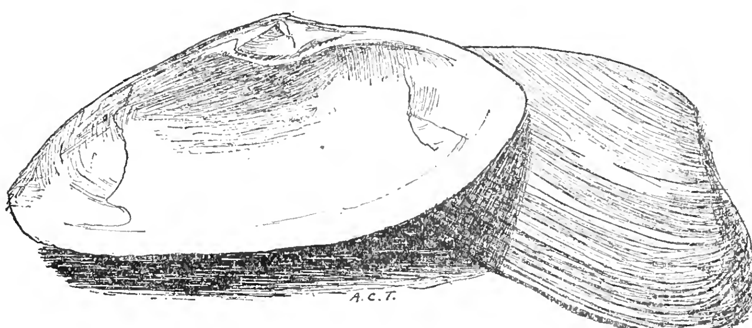
As we watch the little pools of water left among the rocks by the retreating tide the pearly luster or the violet or golden tint of some tiny shell catches our eye. How exquisite its form and coloring!

Shells have always, from the most ancient times, been greatly prized. Prehistoric men discovered in the burial caves of Auvergne have chaplets of shells which scientific men tell us they must have traveled long distances to gather. It is only of late years that their curious little occupants have been interviewed and some ideas obtained with regard to their characteristics and mode of living.

All shells with their inhabitants belong to the immense class known as *Mollusca*, or soft-footed animals. Shells are divided into two groups—univalve, those having but one valve, as the snail, whelks, cowries, etc.; and bivalve, as the oyster, clam, and mussel.

If we take the clam as a typical mollusk we shall see that each little line on the inside or outside of the shell reveals an interesting fact. On the outer surface of each valve are a number of concentric lines parallel to the edge and growing fainter toward the hinge part. These are called the lines of growth, and are made by the mantle. The clam's mantle is quite as useful to him as are our hands to us, and he uses it for similar purposes. The mantle surrounds the clam's body inside the shell, its edge protruding and looking like a row of little frills. This edge secretes carbonate of lime from the water and adds it to the shell all along the outer edge, forming a new line of growth. Thus, as the clam increases in size his house grows proportionately, so that it always exactly fits him. The two halves of the shell are joined by a curious hinge. In some kinds of shells the hinge is external and in some internal. It consists of teeth (two or more) with spaces between on either half. These lock together, and are held by a strong, elastic muscle. On the inside of the clam shell are two slight depressions, where the powerful adductor muscles of the body were fastened.

The clam's body is completely enshrouded in the mantle, except for two openings, through one of which the foot can be



CLAM SHELL. Exterior showing lines of growth; interior showing muscle scars.

pushed out. The other is for the siphon, or what is commonly known as the "neck" of the clam. In some respects the clam may be better off than we are, for he has a little brain in his foot and also a gland for secreting strong fibers. With this he spins a byssus by which he can attach himself to whatever he likes. He does not even have to search for his food, but waits for it to come to him. He makes a burrow in the mud or sand, attaching himself to the bottom by the byssus. Then he thrusts his siphon up through the mud and water until it reaches the surface. The siphon is made up of two tubes, the water flowing in through one and out through the other.

When the inflowing current, laden with minute plants and animals, reaches the gill chamber, some of these are sifted out and retained for food, while the water and waste matter flow out through the other tube.

The clam's eggs are carried by the mother on her gills. When there are fish in the water with them the mother clams discharge the eggs, which soon hatch, but if there are no fish they carry the eggs until they decay. The reason of this strange behavior is this: When the eggs are set free in the water they soon hatch, and the little ones swim about until they find some fish to which to attach themselves. They live for a time on the mucus of the fish and then drop off, sink to the bottom, and form burrows for themselves. This curious semiparasitic life is no doubt a reversion to the habit of some ancient ancestor.

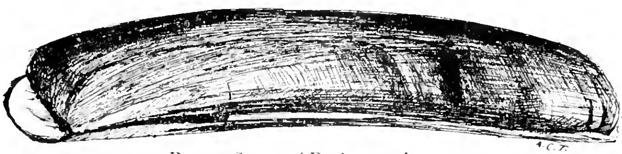
The white-shelled clams live in sand, the black-shelled in mud. Besides living on the seacoast, clams inhabit all United States fresh waters, and in some New York and Western rivers clams have been found which contained pearls of great beauty and considerable value. I have never seen anything more exquisite than the pink pearl lining of some river clam shells.

The razor shell, familiar to all on account of its universal distribution, belongs to the clam family. It has a powerful foot, with which it can scoop out a passage through the sand faster than a man can dig with his spade. One of the clams inhabiting warm inlets south of Boston is the quahog. The shells have a finely beaded edge and are partly lined with deep violet. It was from this that the New England Indians made their purple "wampum" (money), which was considered twice as valuable as the white "wampum." The old-time spelling of clam, *clamp,* was characteristic of one of its chief features, the two halves being so tightly clamped together.

The oyster, a close relation of the clam, is perhaps the most useful and valuable member of all the molluscan group to mankind. The left half of the shell is generally attached to some submerged object and is quite hollow, for it is in this half that the body lies, the upper or right half being almost flat. The oyster readily adapts its shell to surrounding objects, growing about them in most fantastic ways.

When a grain of sand or any minute particle gets in between the oyster's mantle and the shell it is very irritating, and causes a great excretion of matter to take place. This collects around the nucleus in concentric coats like those of an onion. If the lining of the shell be mother-of-pearl, these coats of matter which cover the little grain of sand will also be pearly, and perhaps form a gem of priceless value. Sometimes one of the oyster's own eggs lodges between mantle and shell and is transformed into a wonderful tear of rainbow hues. It is only those shells having a pearly or nacreous lining which can form these gems. For hundreds of years pearl fishing has been a lucrative industry. The most renowned fisheries are at Panama, Ceylon, and in the Red Sea. The pearl oysters are very large, live in from six to twelve fathoms of water, and are gathered by diving.

Pliny calls the scallops (*Pectinidæ*) butterflies of the sea. They are very shy and live in the midst of the eel grass, where the water is warm. The shells range in color from pure white, through all shades of yellow, to bright orange, and some are exquisitely banded and shaded with light and dark brown. The edge of the mantle is fringed with long and short tentacles, among which are thirty silver-blue eyes. As they are not as highly organized as our eyes, *Pecten* needs a much larger number of them. The scallops, unlike most of the mollusks, can swim through the water



RAZOR SHELL (*Ensis americana*).

by rapidly opening and shutting the valves. Closing them suddenly drives out the water in a powerful jet, which by reaction sends the shell forward. It must be a strange and beautiful sight to see a flock of these "butterflies" flying through the blue water on a fair summer day. Scallops used to be known in Europe as pilgrim shells, because they were used by the pilgrims of the middle ages as a badge.

A most remarkable family of shellfish are the piddocks, living in England, America, and Borneo. They are all borers. The shells of those which inhabit the English chalk cliffs are snow-white, to match their home. Some bore in rock, some in the red chalk, and the most wonderful of all, the East Indian species, lives in the trunks of dead trees. Their shells are covered with deep grooves crossing each other and forming a sort of rasp. The foot, which is covered with a hard dermal armor, is pressed against the sides and the shell turned about, thus easily scooping out a cavity in the soft chalk. The piddock continually floods his burrow with water to wash out the particles of chalk that collect as he works. The piddock has a little light of its own, so that it could travel safely about after dark were it necessary. This is a peculiarity of many of the creatures of the sea, and often on a summer night in the tropics the water is ablaze with their phosphorescence.

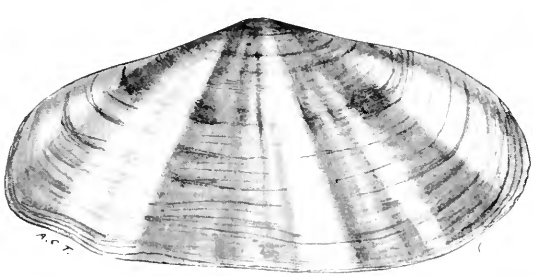
Mussels, living in both salt and fresh water, form a large class of mollusks. Some of them can climb about on the rocks by throwing out a byssus thread, pulling themselves up, then fastening another above that, and so on.

The horse mussel is one of the largest, and very interesting on account of a boarder which it often entertains. A tiny crustacean, the pea crab, lives inside its shell in peace and happiness. The crab is not a parasite, as it does not live on the mussel itself, but merely a messmate eating the refuse of its food.

The Noah's ark is a most oddly shaped shell, and was named by Linnæus from its resemblance to that primitive craft. One ark found in the Mediterranean sometimes contains violet-colored pearls, and one on our coasts is called the "bloody clam," from its fiery gills and the crimson fluid in its tissues. Some of the arks live in submerged clefts of the rocks, and are so busy eating and growing that before they know it they have grown too large to get out, and must remain prisoners for the rest of their lives.

The teredo, or ship worm, would hardly seem to belong with this group of animals, but it is a true bivalve, having a pair of tiny shells at one end of its wormlike body. It has been a most terrible pest ever since men began to traverse the ocean, for its favorite home is the bottom of a wooden ship. It belongs to a family of borers. Some bore in coral, some in rock, and others in wood. The baby teredo, when floating about in the water, comes across a vessel or piece of wood, and immediately begins to bore into it with the edges of a pair of pallets which it has for the purpose. As it proceeds, a calcareous lining is formed to the burrow, which increases in size as the teredo grows. It never leaves its hole again during life.

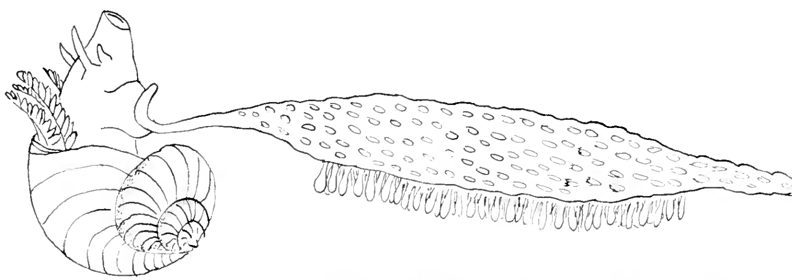
One very curious fact connected with the teredo is that the burrow of one never runs into nor crosses the burrow of another, even though the wood between is no thicker than a sheet of paper. These little fellows work very rapidly, as the following item from Quatrefages will show: A ship was sunk near St. Sebastian, Spain, and in four months, when it was raised, all the timbers and planks were so riddled with teredo burrows that they were entirely worthless.



SUNSET SHELL.

The most brilliant and withal attractive shells in my collection are from the West Indies. I call them sunset shells, because they look as the sky often does on a beautiful summer evening. They are somewhat like clam shells in shape, but narrower and flatter, and most delicately finished. Some are flushed with delicate pink, with rays of pale yellow, others are violet and white, still others green. All the colors of the rainbow are here blended and harmonized with the matchless perfection with which the Great Artist works.

The univalves are more highly developed than the bivalves. They are called *Gasteropods,* which means stomach-footed, because they have a long foot lying the whole length of the body. Unlike the bivalves, they have a distinct head, in which the brain is situated. Often there are tentacles or feelers, as in the snail, on the ends of which the eyes are placed. *Gasteropods* have a wonderful eating apparatus called the *odontophore* or tooth ribbon. It is covered with hooked teeth, pointing backward, and is in the lower side of the mouth, situated about the same as our tongues. On the upper side of the mouth is a hard plate or jaw, and the food is ground up by the toothed ribbon against this plate. The



VIOLET SNAIL AND EGG FLOAT (*Janthina fragilis*). Copied from the Riverside Natural History by kind permission of Houghton, Mifflin & Co.

odontophore wears out rapidly, but as the front part is used up it grows from behind, and these animals are so fortunate as to have a new set of teeth every little while.

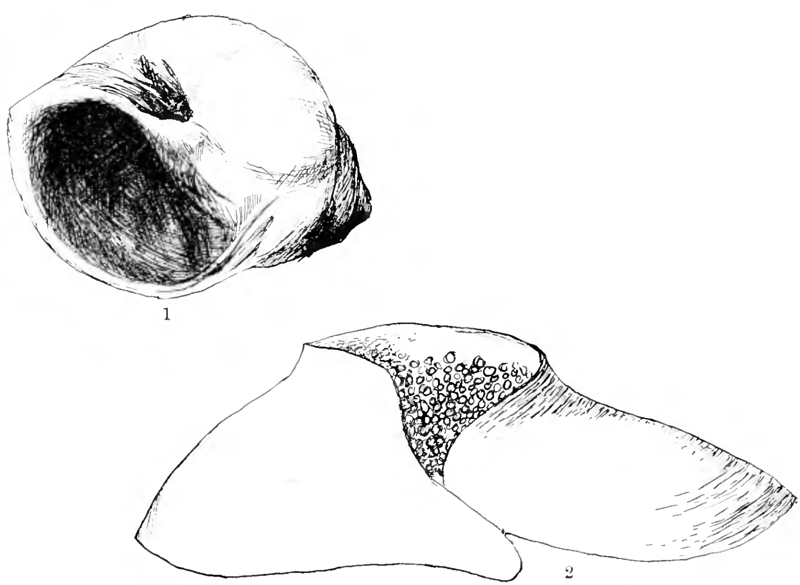
There is only one shell to take the place of two in the bivalves, so most of the univalves have an operculum. This is a little lid (either horny or calcareous) on the upper side of the foot which exactly fits the aperture in the shell. If a *Gasteropod* wishes for any reason to be alone and rest for a time, he only has to draw in his foot, pull to the door, and he is in complete seclusion from all the world.

The shells of the *Gasteropods*, like those of the bivalves, are often covered with a sort of horny membrane or epidermis which protects them from the eroding power of the water and other external injuries.

At the bottom of the *Gasteropod* group is a wonderful creature which we may call a multivalve, as its shell is made up of a number of plates (usually eight) which look like ancient armor. It is called the mail shell, or *chiton*, and is the only example in the world of a shell composed of more than two parts. It is common on the Atlantic coast, in some of the bays and inlets south of Boston, on the Pacific shores, in England, and other places. Chitons sometimes have as many as eight thousand eyes, their backs being covered with them.

The limpets range in shape from those which are almost flat to a perfect cone. Some of my prettiest from Sitka are snow-white, and look like little peaked nightcaps. One is the cup-and-saucer limpet, and indeed it might easily serve as such on the table of some water sprite. It is glistening brown in color and looks like porcelain. The slipper limpets or boat shells are very pretty, being shaped like little rowboats with one seat. The shallow-water boats are flat-bottomed and thin, while the deep-water ones are much stouter and round-bottomed. Limpets each have a particular spot on the rock to which they attach themselves, and when they wander off between the tides for their dinners of seaweed they always return to the same spot. If you should try to pull a limpet off of his stone you would find it very hard work, for his strong foot sucks the rock with great force, and as soon as he felt you pulling or prying he would redouble his energies to cling to his home and would probably succeed.

A king among shells is the *Haliotis*, or, as the Spaniards call it, *abalone*. It is found in all collections, and is extensively used for its pearly lining in the manufacture of buttons, buckles, and other ornaments. It is sometimes called the ear shell, on account



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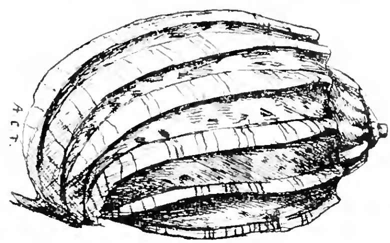
2

Natica heros (1) and egg mass (2), known as "sand-saucer."

of its resemblance to the outline of the human ear. In life the animal thrusts his tentacles out through the row of holes along the edge. On the outside the shell is rough, often closely resembling the rocks on which it lives. The animals are eaten in Europe and by the Chinese in California. While I was living in San Francisco a Chinaman went out on to the rocks at low tide to gather some. As he attempted to wrench one from its home his hand was caught between shell and rock, and so firmly held by the animal that he could not escape the rising tide, and was drowned.

The pearly lining of the abalone is richly shaded with all colors of the rainbow, an opalescent green often predominating. The mother-of-pearl is composed of undulating layers. The iridescence is caused by minute lines reflecting different spectra.



Harp Shell (*Harpa ventricosa*).

Some members of the snail family, with their world-wide reputation for slowness, have made amazing progress in the ascending scale. They have gone so far as to develep from the gills, with which they breathed in the water, lungs suitable for air-breathing, and have come to enjoy the pleasures which a life on *terra firma* affords. You can find them in the woods or in your garden, thrusting out their inquisitive little heads and investigating everything with their eye-tipped feelers. Some snails, after trying the experiment of a land life, have decided that on the whole a water life is preferable, and gone back to live there, where they have developed gills again, but of a different kind from the original ones.

There are sea snails, pond and river snails, as well as land snails. Many of them are carnivorous and can bore into other shells with their lingual ribbons. The hole usually strikes a muscle, when the shell gapes open, and his snailship enters and devours his prey.

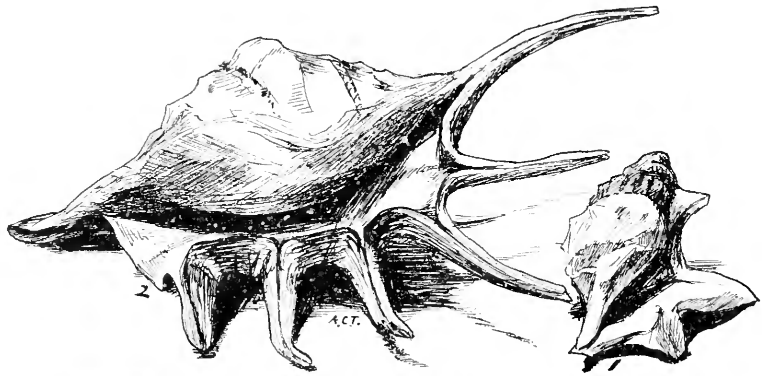
Some kinds of snails, especially the land group, can live for a great length of time without food. A snail was fastened to a card and put in the British Museum in 1846. Four years afterward a discoloration appeared on the card, showing that he had been moving about. He was taken out, immersed in warm water, and was soon quite lively.

In creeping about, the snails always leave a track of mucus, which glistens when it is dry. It is in this mucus that they immure themselves for their long winter's nap, sometimes making several layers or partitions over the opening to the shell.

In the middle ages snail shells were worn as amulets, protecting the wearer against certain diseases as well as witchcraft.

Prof. J. S. Kingsley says of one North American species (*Helix harpa*): "In motion it is exceedingly graceful, at times poising its beautiful shell above its body and twirling it around, . . . again hugging its pretty harp close to its body."

The shells of the common wood snails are quite transparent and pale brown, but some of the land snails have splendid houses. One in my cabinet is in broad bands of white and brown, lined with rose color. The violet sea snail is one of the most fascinating of all the group. Great herds of these bright, purple creatures are sometimes seen on the surface of the ocean feeding upon *Medusæ* (jellyfish). Each carries an enormous float, from the under side of which the eggs hang down. The float is formed



Pterocera lambis, showing prongs made by mantle.

PELICAN'S FOOT (*Aporrhaispes pelicani*).

by a secretion from the foot and is made up of a great many little bubbles. When storms occur the floats often become separated from the creatures to which they were attached, but the eggs develop just as well. The violet snail is never found on shore, except when cast up by violent storms, being a lover of the high seas.

The largest littoral (shore-inhabiting) univalve on the Massachusetts coast is a common globular snail (*Natica heros*). It lives on clams and other bivalves, and is interesting on account of its curious egg masses, known to the children who gather them on the beaches as "sand-saucers."

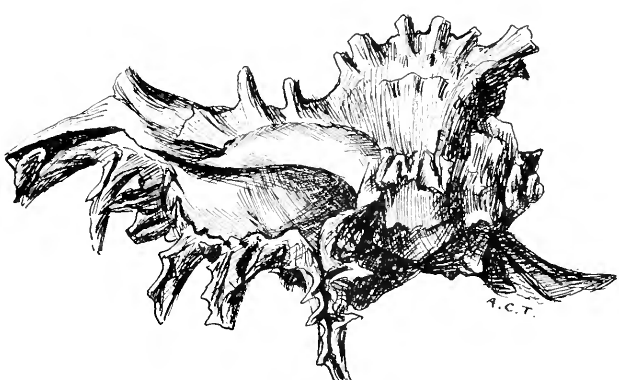
The olive shells are so called from their resemblance to that fruit. They are all pretty, being curiously marked with different shades of brown, but the most striking of the family is the East Indian harp shell, which is very beautiful, with its longitudinal ribs, representing the strings of the harp. The animal which lives in it is exceedingly shy, and if it is captured it draws itself into the shell as far as possible. The whole of the foot will not go in, however, and this is quickly drawn across the sharp edge of the aperture and cut off. If the animal is set free again in its native element it will redevelop its foot.

The miter shells are varied and brilliant in coloring. Some of mine are white with orange spots, others brown and purple, and all showy. They are named from their resemblance to the bishop's miter, and are found in the Philippine Islands. If an enemy approaches, their occupants throw out a purple fluid and escape under cover of the stained water.

Notice in the miter shell how the color spots correspond to the whorls, in the scallops how the shades and bands follow the lines of growth. Have you ever thought why this is so? The mantle which builds the shell has spots or bands of color scattered through it, and as it works, the impressions of these same pigment spots are left on the shell. If the pigment cells of the mantle be yellow, red, or violet, these colors will be left on the shell and preserved forever.

Another marvelous accomplishment of the mantle is the ornamentation of shells with prongs, flutings, etc. We have a good example of this in the lovely *Murex* shells. The mantle sometimes works without cessation until the shell is finished, then turns up, forming the lip (the edge of the aperture). Often it works for a time, turns up, forming a frill or row of points, and rests. Then it begins its labors anew, building an addition and ornamenting it in like manner. Sometimes the mantle turns up at the end in a number of fingerlike radiations, as in the *Pterocera lambis* and curious pelican's foot.

The cowries form an immense group, some species of which inhabit almost every shore. They are called porcelain shells, on



Murex ramosus.

account of their glossy, smooth texture. The little white cowries are used in some parts of Africa for money and to make girdles for the high chiefs. A stripe of a different shade from the body of the shell runs along the back, showing where the edges of the mantle met. In life it entirely covers the outside of the shell.

The helmet shells of warm seas are used for making exquisite cameos, the best being cut at Rome. The raised figure is chiseled out of the white layer and rests on a colored groundwork, blue, pale salmon, etc.

A very strange little fellow is *Rhizochilus antipatharum*. In his youth he has a well-formed shell, but as he grows older he cements about it bits of coral, other shells, and anything which he finds convenient, until the opening is entirely closed, and he can communicate with the outer world only by means of his siphon.

One of the largest shells found on the coasts of the northern and middle Atlantic States is *Scycotypus canaliculatus*. It is protected from injury by its coat of rough brown fur. The inhabitant comes ashore to lay her eggs, which are a great curiosity. There are hundreds of little leaflike sacs which contain the eggs, all joined together, forming a long chain.

Æons ago the shells had very different forms from those of to-day, but we have left a few members of the group which existed in countless millions. The nautilus of the present time is not a very distant relative of the ammonites, which we find so marvelously preserved in the Silurian deposit, every line and penciling absolutely perfect.

Note.—I am greatly indebted to Prof. J. S. Kingsley, who was my teacher of biology at Tufts College, for his assistance to me when I was studying the shells, and for material in this sketch taken from his article on Mollusca in the Standard Natural History.

THE EMPLOYMENT OF THE MOTOR ACTIVITIES IN TEACHING.

By Prof. EDWARD R. SHAW, Ph. D.,
DEAN OF THE FACULTY OF PEDAGOGY, NEW YORK UNIVERSITY.

THE recent development of our knowledge of the nervous mechanism in its relation to the processes of education leads us to appreciate the great worth of the ideas advanced by two educators of the last century, Basedow and Heusinger, and also to see quite clearly the great advantage which will result in the work of the school from the applications of the truths set forth by them.

When Basedow said that children were fond of noise and movement, that they hated to sit still for a long time, that a continued strain of attention and learning by rote were distasteful to them, and that only by force could they be trained to such vexatious employments, he apprehended a truth upon which the researches of recent years have given us more specific knowledge; and his warning that through the disregard of this principle not only the health of the pupils is weakened, but also their intellect and natural desire for knowledge, teachers are just becoming able to heed through the newer knowledge of child life and development.

Heusinger, a name little known, showed his great insight into this matter when he urged teachers to change and adapt their work so as to take advantage of the extreme impulse in children to be busy; for Heusinger maintained that, considering the great power given to this impulse by Nature, a prominent place in the development of man should be granted to it, and that it is the duty of teachers to give heed to this impulse in which an effective means of instruction is afforded. He set up this impulse to activity as the regulating principle in gaining knowledge, for he asserted that not only does it lead to a deeper knowledge of the thing itself, but also to a greater appreciation of all that is in connection with the thing, and also that it excludes those things which have no relation to the particular object of thought.

Froebel's apprehension of this truth is shown by his plays and games.

All these educators apprehended the fact that the most marked characteristic of the child and the youth is physical activity. This activity is due to an energy that must be expended through motor channels. It will perhaps make my contention the clearer if we consider briefly the young infant and examine the first manifestations of this energy and what results therefrom in mental development. The activity of a young infant must, I think, be conceded. Its arms and legs move vigorously. These movements are not determined by itself, are not controlled by itself. In various ways it often hurts itself by these uncontrolled motions, and in these movements there is at this period no will. These movements which all have recognized are impulsive in their nature—that is, they are set on not by any external stimulation, but by the accumulation of energy in the cells of the nervous system, and when the cells are filled with nerve force or energy the discharge of this energy is necessary for the growth and development of the system; and so the kickings and twistings and strikings and clutchings result. One suggestive point which may be noted here is the fact that when the cells become filled with energy they discharge. No demands are made on them before they are ready to act, for Mother Nature is the babe's wise teacher.

Closely following the impulsive movements, and indeed accompanying them, are what are termed reflex movements, which differ from impulsive movements in the fact that they are initiated or started by some external stimulation through some of the avenues of sense.

All impulsive and reflex movements occur without any premeditation on the part of the child. They do not enter into consciousness during their performance, but are often remembered after they have been performed. The images left in the memory after these movements have been executed are a very great factor in the development of the will, for the voluntary movements which develop later are based upon these impulsive and reflex movements.

Beginning somewhat later than the impulsive and reflex movements are the *instinctive* movements. We may say that the instinctive movements are an advance on the reflex movements, as they are more complex, they enter somewhat into consciousness, and there is a purpose in them, though the child does not know at the time he performs the movement the end that is to be attained.

The first movements of the child are impulsive and reflex, and no self-consciousness accompanies them. Yet every movement, whether impulsive or reflex, leaves some slight trace in the developing brain, and when the movement is hit upon again, and then again, and still many times again, this trace strengthens and associates itself with the particular movement, and there arises in the dawning consciousness an idea, the elements of which are very largely motor; and so numerous motor ideas arise. The three classes of movements which I have described are involuntary, and out of all these various involuntary movements spring up motor ideas. The pleasure or pain necessarily accompanying these gives rise in consciousness to desire to repeat these movements or to inhibit or stop them. Deliberative or voluntary movements are not possible without motor ideas. Through these motor ideas the child comes gradually to represent to himself some end to be attained or avoided. To say, then, that the will develops first through the motor side is warrantable.

I have indicated how motor ideas are involved at the start in the psychic or mental life, and how it is "only after a motion has taken place that the child acquires any knowledge of its own motor act." We must not, however, lose sight of the fact that there is blended or associated with the motor acts sensations coming from the eye and the ear and from other sensory avenues. Involved in all these motor acts is an extensive part of the cortex of the brain called the motor centers, because all muscular movements are controlled from these centers. Not only do these motor centers play a great part in the development of the psychic life and the rise of the will, but all other parts of the brain come to be developed in communication with them. Prof. Baldwin has expressed the idea that it is the motor which holds the sensory elements together, and Dr. Crichton Browne has said that an analysis of our ideas reveals to us that we have few if any of purely sensory characteristics. All our ideas, then, have important motor elements. Dr. Browne says further that "the muscles not only by the locomotion which they make possible enormously widen the field from which our sense impressions are gathered, but also, by the experience which their own activities involve, expand our mental resources a thousandfold."

How does this come about? it will be asked. Let one reach out his hand in any fashion, and he knows exactly what movement he has made. Does he know because he saw what he did? Then let him close his eyes and move his hand in any other fashion, and he knows just as well what the movement was as if the act were performed with eyes open. Did he know it because he had willed to move the hand thus? Not so. It must be granted that he willed to do it, and pictured in his mind previously the movement to be made; but that was the end of it in one particular. From that point it disappeared from his consciousness. The picturing of the movement with the intention to make it was the last thing he was conscious of so far as the movement is concerned. Because of that willing a discharge was set off from the motor centers, and the next thing in his consciousness was a perception coming from the sensations which arose from the movement. He then compared that perception with the previous image of the willed movement. They agreed, and he knew just the movement he had made.

But it will now be asked, How do sensations arise from the movement? Such a question is most pertinent at this point. Sensations arise from movement because there are distributed through the muscles, the joints, ligaments, and tendons, even the skin itself, sensory nerve ends which are affected by the movement and convey to the brain sensations of that movement. Out of these sensations the mind perceives what has been done. There is, then, connected with the motor or muscular side an important sensory side. We may go further than to say it is connected with the motor side; it is really imbedded in it. This important sensory side, it will therefore be seen, can not perform its function and carry information to the brain unless the motor side is used; and the more various the employment of the motor side, the larger the knowledge stored up in the brain from its sensory counterpart. The motor and the related sensory are developed *by* and *with* each other. The ideas resulting therefrom are sensory-motor ideas; and we have at last come to have some scientific appreciation of the far-reaching importance of these sensory-motor ideas as a part of the structure of the mind and as a means of producing fuller as well as higher mental development.

Ideas of time and place and position in their basic and most important elements are motor. Ideas of form involve more of motor impressions than of optical impressions. By the use of the motor side the child's judgments are enormously increased and are made more accurate. This is necessarily true because by the use of the motor side his opportunities for comparison and discrimination are multiplied. He is called upon, for instance, to form a judgment out of the ideas already in his possession. If now he stops with this judgment he has no new criteria with which to judge its correctness. On the other hand, if he can convert this judgment into motor terms a comparison is forthwith instituted and the judgment undergoes revision.

I have already spoken of the physical activity of youth as a marked characteristic, and have said that this activity is due to the discharge of energy into motor channels. It is a significant fact that the attention of the child can be held for a surprisingly long time provided he is so employed that this motor energy is expended in movement. Attention from the first is therefore closely related to the motor side. The reason seems to be that there are many groups of cells more or less isolated from each other, but each closely connected with the main branches of the nervous system. Each group has functions largely peculiar to itself; when the brain is fully developed these isolated groups of cells become more closely interrelated by means of filamentary outgrowths, called by some writers pathways of association and by others dynamic pathways, by which energy is more readily distributed to various groups. In other words, if I may use a bold metaphor, short circuits become at last established between the various centers, so that the energy is not discharged into the early isolated channels. If, therefore, we wish to hold the child's attention to any particular line of study, we must at the same time provide for the expenditure of the energy that is gathered in the other groups of cells whose connections of interrelation are not yet built up or established. If we do not provide for this, the natural discharge of the energy from the overfilled cells of those other groups swerves the child's attention from what we have in hand for him. Every mental act, it must be remembered, involves the complete arc of the sensory and the motor, and in the child the inherent stress is on the motor. Again I quote from Prof. Baldwin: "Just in as far as the motor ingredient of a mental content of any kind is large—that is, in so far as the sensory ingredient is intense—just to this degree also will the direction of attention be secured, and to this degree also will both the ingredients be intensified by this act of attention. Intensity draws attention, and attention increases intensity—the law of sensory-motor association—i. e., *every mental state is a complex of sensory and motor elements, and any influence which strengthens the one tends to strengthen the other also.*"

I have spoken of how the use of the motor side adds new avenues of perception, of how it increases the number of judgments and the accuracy of them. It enriches also in content our ideas of form, of time, of distance, of place, of resistance, etc.

Association, moreover, is very closely related to this side, and the employment of the motor activities in mental acquirement aids memory. Prof. Baldwin says very emphatically that association has a motor foundation from the first, and that the elements hold together in memory because they are used together in action, and as action becomes one, but yet complex, so the mental content tends to become one, yet complex. He says further: "We have to-day got beyond the view that memory is a faculty which takes up content and remembers it. It is, on the contrary, now known to be a function of the content remembered." In my view this function of the content depends upon the variety of association and also upon volition, and both of these are best built up by that which gives the fullest possible functioning of the nervous mechanism during its developing period—namely, the fullest and most varied use of the motor activities warrantable. This, bear in mind, means a much more prominent use of these activities than has yet been made in our schools.

In the act of teaching or learning, old elements are constantly revived through extrinsic stimulation and volition. But it is, after all, the motor which sets those processes going that revive the older mental elements, and it is through the motor that the older elements have placed beside them images and judgments containing a greater number of elements than they would otherwise have had. Thus arises a more varied association. The new impressions become blended with the old, but at the same time the new have more elements in them because of the development of the motor side. Accordingly, the new content is a fuller one—that is, it has more clews by which its revival may be produced. For Donaldson, in those two remarkable chapters which close his recent work, The Growth of the Brain, not only expressly says that "education consists in modifications of the central nervous system," but also that "the value of mental images appears also as dependent on the number and balance of the secondary sensations which accompany them. The greater the number of these, the more certain and precise is our thought," and "as the possibility of forming the extra images is curtailed, the conception becomes weaker, more special, and less reliable."

The reasons why we attribute such value to paper folding, drawing, coloring, clay modeling, of late so largely introduced into courses of study and with such profit both to pupil and to teacher, must now be very evident. On the same grounds manual training is appreciated to-day, and is winning wider adoption because of its employment of the motor activities. It may be said, however, in passing, that the various exercises now laid down in courses of manual training will all have to be examined in the light of the scientific methods already employed in studying the older practices in education, to determine not only what value these exercises have, but also their sequence, and doubtless to cast aside considerable that is at present recommended. Thirty-five years ago object lessons were strongly advocated in this country. They brought new life and spirit into the schools, and became widely adopted. But to-day, without object teaching, all that was then gained by it is secured and much more by Nature study or science work, that which object teaching has led up to. And through a similar process of evolution many of the formal exercises of manual training are destined to disappear and to be correlated with other kinds of work, so that a broader purpose will be subserved through the use of the motor side.

The reader will recall the statements already made that attention is strongest when the motor side is employed, and that association and memory seem more closely related to this side. There is, however, another ingredient entering into all this which we have not yet mentioned. It is that with the proper expenditure of motor energy there arise interest and pleasure—an emotional condition which of itself materially strengthens memory and association.

When we call to mind that the child's mental world is largely an unrelated world, we find another reason for urging a larger recognition of this principle in our teaching. The child is in an unrelated world, because he is in the midst of innumerable objects, manifestations of complex and varied phenomena, the succession of events and their occurrences simultaneously. The stimuli which constantly stream in produce very strong sensations, and innumerable sense judgments are formed more or less unrelated. One of the most difficult tasks of the teacher is to lead the child to relate these judgments, to reject the unessential and unrelated, and to arrange the ideas growing out of those judgments in series; in other words, to introduce coherence and unity into the child's mental life. But this mental unity can not be considered apart from the matter of physical growth. The child's brain at birth weighs about one fourth of what it weighs at maturity, and the proportionate increase of other tissue in the body during the period of growth is considerably greater than the proportionate increase in brain weight. That which helps the child to gain nervous control will accordingly help greatly in bringing unity into his mental life, and no other means at the teacher's command will contribute so much toward what Prof. Baldwin has so happily styled nervous and mental unity, as a large employment of motor activity in schoolroom work.

If, then, we go into our schools with this idea in mind and examine the methods of teaching we can not fail to discern what a disregard there is of this important principle. Better results would be obtained—incomparably better—could there be a change in this regard in the methods of the schoolroom.

I do not ask for license, but for orderly activity—educative activity. It was in 1797 that Johann Heinrich Gotlieb Heusinger, Docent in Philosophy and Pedagogics at the University of Jena, apprehended this important principle, and expressed his surprise that teachers had not heretofore recognized this impulse of children to activity and taken advantage of it in the work of instruction. It is not the first instance in which the truth of an idea has been recognized a century after its expression. And it is a source of much pleasure to me to offer some of my pedagogical worship at the shrine of Heusinger.

In the different branches of study, then, which pupils pursue in our schools, and which they try to master in order to acquire a fair education, there are numerous places and many topics that admit of the employment of the motor side, if teachers had but the versatility and inventive talent to make the application. Time would be economized, broader mental development would be given to the child, and discipline would take care of itself, for it is undirected motor energy that produces so much trouble in the matter of discipline, and unused motor energy that produces so much fatigue in pupils during school hours.

In order that this article may not seem to be too largely theoretical, and also to show, if possible, more clearly what has already been set forth, I shall endeavor to point out some applications of the employment of the motor side in actual school work. A moment's thought will lead one to see that there are some studies where the employment of the motor activities is much more difficult than in others. Perhaps the most difficult of all subjects is in teaching reading to a class of beginners. In this particular I got my first suggestion from a visit to a little *Dorf* school in Germany. What I saw appealed to me as a simple and at the same time a remarkable application of the principle I have tried to give exposition to here. I doubt whether the kind, genial schoolmaster had ever read Heusinger's essay or had ever heard his name. I do not think he himself appreciated how scientific, how in accord with the best knowledge of to-day, the lesson he gave in reading to the lowest class really was. The spirit of that little village school, the work and the relations between teacher and pupils, were most beautiful and ideal. In three visits to Germany I never saw any other school comparable with it. Instruction by means of orderly activity, and much of it, were the aim. Activity was not suppressed; it was directed and controlled and made to help powerfully in securing that equipment of knowledge for which schools are established. The reading lesson I have referred to was given to the lowest class, with one little boy in it not yet five, which the master had allowed to enter.

The reader will assent, I have no doubt, when I say that learning to read makes a severe demand upon the attention, and there is perhaps no other subject, when we consider the way it is usually taught, that tires the pupil so quickly, simply because we do not provide for the employment of the energy that must be discharged into other channels. The act of recognizing and learning new words uses only a small part of the energy which the various groups of nerve cells are constantly accumulating in the healthy and growing child. Now this gentle, sunny German schoolmaster, who was every whit a man, focused the attention of his little class upon the words he wished that day to teach them, and added interest and delight to the exercise because he made other demands than those upon the eye and the voice and the ear. There were five words in the lesson, and the lesson lasted just five minutes, after which the little class went to a table in another part of the room and took up number work. The words of the reading lesson were Hut, Rad, Fisch, Topf, Sichel. The letters were printed on pieces of cardboard about two inches and a half square, and these were placed in the shallow trough of the blackboard in the order demanded by the words. Each pupil when called upon made a vigorous striking gesture as he pointed to each letter, giving at the same time the sound of the letter. When he had sounded each letter of the word in this manner he made another gesture, this time from left to right as if to blend all the sounds, pronouncing the word as he made the gesture. Then the little group in concert spelled and pronounced the word in the same fashion. The next pupil went through the same exercise with the second word, and so on for each pupil. Sometimes the master would tip the letters of a word over on to the floor and direct one of the pupils to pick them up and put them back in proper order; or he would take the letter cards, mix them up, and direct a pupil to put them back in the trough in their proper order.

In the Heusinger School, lately organized to give application to these principles, this plan of letting children point singly and then together to the letters of words written on the board has been used as one way of providing motor activity while teaching beginners to read. But variety is necessary, and as another way of securing this the pupil, when he has read his sentence, goes to the blackboard and writes it, then to the table, picks out the printed or script letters according as he has been directed, and forms on a tablet these letters into the sentence, and then takes this to the teacher for her approval. If it seems necessary to have the child write the same sentence several times, the mere matter of directing him to write the sentence on one board, then to go to the next board and write it, and then back to the first to write it a third time, gives him pleasure, enhances his interest, and strengthens his power to make effort. And thus much orderly activity is combined with all reading exercises. I may remark in passing that during the child's first year at school he is kept in his seat less than one fourth of the time. The desk, if the matter is not closely watched, proves a fatal obstacle to the employment of the child's motor energy, not only in the first year but in the succeeding years.

Arithmetic is a subject which presents large opportunities for the employment of the motor activities in teaching it, and the advocates of manual training ought to have shown us long ago how nearly the whole of arithmetic can be taught through manual-training exercises. Such a correlation is possible. But those schools which have stood for manual training from the first, and which possess to-day magnificent equipments, seem not to have apprehended that these two subjects of their curriculum can be made to go hand in hand. Because of their opportunities they should have worked out for the benefit of the educational world a method of teaching arithmetic and at the same time manual training in wood and metals.

But more convenient materials than wood or metal are at our command for the ordinary schoolroom. Paper and cardboard admit of tridimensional constructions in great variety, and by the folding and cutting of paper all necessary space-forms of two dimensions are easily made. Then, too, the floor, and even the conventional blackboard, can be brought into much larger requisition for the drawing of plans and diagrams. Scales and weights, measures of capacity, and other concrete objects and appliances can be brought into service. Moreover, buying, measuring, and selling should have a place. By the use of all these accessories, in graded exercises throughout the whole course of arithmetic from the class of beginners to the class completing the study, large employment can be given to the motor activities. Such procedure would render the instruction in arithmetic less formal and more informing, and would incite a greater degree of interest in pupils.

Inventional geometry is a subject which is regarded by all who have had experience in teaching it as a most interesting and educative study.*

The series of problems devised by William George Spencer

* See Popular Science Monthly, January, 1889.

stand pre-eminently above any other series yet published. The little book exemplifies most thoroughly the principle of apperception. Its exercises are very carefully graded. The steps are for the most part just difficult enough, so that the pupil is able, by using the ideas he has already gained, and the power he has acquired in gaining those ideas, to solve the next step. The book is based upon the heuristic or inventive method of teaching, and is a remarkable example of this. These factors unquestionably contribute much to the delight which pupils find in this study. But these factors, valuable as they are, are not sufficient to account for the command which pupils possess over the knowledge gained and their power to revive that knowledge and use it, as well as to find interest in it long after they have passed their examinations and have laid the study aside. There is another potent factor assisting these. The exercises call into use a very important part of the motor side. The pupil is continually busy with his hands as he brings into requisition ruler, compasses, pencil, pen, etc. The hands and the eye work in harmonious conjunction, and thus important motor elements become constituent parts of the notions and judgments acquired. An augmented power of perception, and consequently greater stimulation, results, and because of this the pupil produces forms which would not be produced if he studied printed diagrams and tried to build these up in imagination. Accordingly, his judgments of the relations of lines, angles, surfaces, planes, solids, and areas are multiplied to an enormous extent.

The last application I shall point out is in a branch of study where the employment of the motor side would be least thought of, and where it would lessen the burdens of pupils and preclude the discomfiture of teachers. The branch of study referred to is that of modern languages. Books are the repositories of knowledge, we have been told, but that is no reason why the pupil should begin and end his acquirement of a modern language by closely adhering to the pages of a text-book. I trust the reader will not misinterpret me. I do not wish to abolish text-books. I would not, however, by their use hold the child down to one narrow avenue of acquirement. The printed page is greatly like a photograph—it gives but one point of view. It must, however, be conceded in this connection that there are a few, a very small percentage, of those who enter upon the study of a foreign language that apparently get on easily with acquirement from the printed page. Most teachers of the languages doubtless belong to this class, but that is no reason why the method by which they learned should hold sway. The fact is that a large majority of students do find this way of acquirement very hard, and many become discouraged and give up effort. I think it will be conceded that the principal factor in learning a foreign language is manifold association. The vocabularies in text-books are printed with the English equivalent after each word. The pupil is required to learn and recite those vocabularies and then to apply the knowledge in reading and writing sentences. It must be apparent that this method affords but a narrow ground of association, and difficult recollection is, of course, inevitable. It has been shown that when foreign words are printed and are followed by a picture of the object instead of the equivalent word in the vernacular, memory is largely aided.

Excellent as is this plan, however, it can not be used in connection with all the parts of speech, but must be confined principally to one class of words. When, however, we make use of the motor side, first creating through this means the idea in the mind of the pupil and afterward giving, in the foreign tongue, the expression of this idea without the employment of English as an intermediary, we are not only taking the most direct way to lead the pupil to understand and think according to the idiom of the language he wishes to learn, but we are also economizing mental effort on his part, because the largest acquirement results from the effort expended. In a future article I purpose to discuss more fully this particular topic, and to describe some experiments now being made for the purpose of developing a method of teaching German according to this principle.

DOUBLE PERSONALITY.

By Prof. WILLIAM ROMAINE NEWBOLD.

BEFORE discussing the conception of double personality, it may be as well briefly to review the conceptions of which I have so far made use. I have held that the human mind must be conceived as a complex system of elements which is capable of greater or less degrees of disruption or disordination without the total destruction of its component elements. Disordination often takes place normally while falling asleep; it can be artificially produced by the use of certain drugs, and, in some persons, by concentration of attention; it is also found in some diseases, notably epilepsy and hysteria. In disordination the dissociated elements which remain work out their normal results with more fatal precision than usual; from this fact spring the phenomena of suggestibility, trance, and ecstasy, and some forms of hallucination and automatism. Frequently the dissociated elements recombine in new forms, some of the constituents of the former consciousness being omitted and new ones appearing; this gives rise to secondary states of all kinds, such as somnambulisms and successive modifications of the self.

The very conception of disordination involves the notion that mind may exist in forms very different from those with which we are familiar. For the present I shall limit the word "consciousness" to such an orderly system as yours or mine. The disordinated condition I would describe as "amorphous mind"—what I mean by that I will try to show a little further on.

In my last paper I discussed three typical cases in which the elements of personality seemed to have recombined in new forms, but throughout that discussion I tacitly assumed that the elements which were peculiar to one system became extinct upon the formation of another. From our present point of view this is the most natural assumption, and there was, in those cases, no evidence to the contrary. But that assumption is not essential to the theory, and often seems inconsistent with the facts.

Apparent evidence for the existence of mind in connection with a body of which the consciousness belonging to that body has no knowledge is not unusual, and I have given some illustrations of it in my recent papers. But the interpretation of such phenomena is not easy.

Since our first-hand knowledge of mind is nearly always in the form of a personal consciousness or self, one is at first inclined to ascribe such manifestations to a self. But since they are denied by the normal self, it would then be necessary to assume the existence of a second self in order to account for them, and this second self is conceived by some as existing beneath the level of the normal self and as having its own memories, interests, hopes, and fears, as acquainted with the existence of the upper self, and as bearing to it a relation sometimes hostile, sometimes benignant.

Of this theory and its congeners I shall have more to say at another time; for the present I must confine myself to that which I am developing. According to it the evidence which is sufficient to establish the existence of a mental event may be and usually is wholly insufficient to establish that of a personality or self. When an automatic hand writes a message of which the upper consciousness knows nothing—a point, by the way, very hard to prove—we have evidence for the existence of a mental event; but if we ascribe it to a person of any sort, we are practically adding to it, without evidence, a multitude of mental events combined in definite ways.

Yet if a personality is no more than a system of mental states organized in a certain way, why should not the elements dissociated from the upper consciousness recombine and form a secondary self which may exist simultaneously with the upper self, and in a way beneath it as above described?

There is good reason for thinking that they do, to some extent—to what extent is a question more easily asked than answered. In the first place, if the two groups are to be entirely distinct, there scarcely seems to be enough mental material to go around. The primary system would be so maimed and the secondary so incomplete that one could scarcely regard either as a full-fledged personality. If certain elements are to be simultaneously held in common by both groups the case would be different, but, so far as I know, there is no good evidence for this. In the second place, the will, or sense of effort, which I believe to be the essence of the self, raises a serious difficulty. We practically know nothing of its nature. The rival theories may be regarded as falling under two heads—those that make will but a name for the control exerted by the more complex ideas over the more simple, and those that make it something absolutely unique in mental life, and in no respect analogous to the control exerted by ideas, whether complex or simple. If we adopt the first, it is hard to believe that the secondary system could attain the degree of complexity necessary to the manifestation of will without destroying the complexity of the primary; if we adopt the second, it is as hard to believe that two of these unique phenomena should appear in one body. If the secondary system manifested a will of its own, we should expect to find that the primary had lost it, and then we would not have two simultaneous selves, but merely successive modifications of the original self, as in the cases discussed in my last paper.

Turning now from the abstract to the concrete, I shall give some of the facts upon which these conceptions are based. First I shall take up the case of Prof. Pierre Janet's famous patient Lucie, and show how he tried to prove in her the existence of subconscious states, and how he apparently succeeded in organizing them into a sort of dream self which existed only in his presence, faded away when he departed, and finally vanished when Lucie recovered her health. Then I shall try to throw a little light upon the actual character of this "amorphous mind" and the relations which may exist between secondary states and the primary system.

When Lucie fell into Prof. Janet's hands,* she was about nineteen years of age. She was intelligent, quick-witted, hot-tempered, and had a strong will of her own. She had wholly lost her sensa-

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The most detailed accounts of Lucie's case are in Prof. Janet's articles in the *Revue Philosophique*, vol. xxii, pp. 577–592; vol. xxiii, pp. 449–572. More facts are to be found in his work *L'Automatisme Psychologique* and in his other writings.

tions of touch, pain and temperature and all those sensations from the muscles and joints which make one aware of the position of one's limbs, so that, as she herself said, she "lost her legs in bed." Her other sensations were normal. She was subject to frightful hystero-epileptic convulsions which came on every day and lasted about five hours. During them she seemed delirious and talked constantly about men hidden behind curtains, but could not make intelligible what it was that troubled her. Her memory was good on the whole, but she never recalled anything that happened during these attacks, nor could she remember ever having had the sensations which she had lost.

When hypnotized, she was extremely suggestible, performed posthypnotic suggestions with fatal precision, but *never seemed conscious of what she was doing*. For example, she would carry her hands above her head in obedience to such a suggestion and yet stoutly maintain that they were in her lap. The same results could be got without hypnotizing her by simply distracting her attention. Some one would engage her in lively conversation while Prof. Janet whispered a command in her ear; the command would be obeyed, but Lucie would profess ignorance both of the command and of its execution. After a while the mere tone of command produced the same effect. Lucie would hear all that Prof. Janet said to her before and after the command, but the command itself was unheard by her, although invariably obeyed.

The significant feature of these experiments is that commands not heard by Lucie were obeyed by her body. In like manner, suggestions given through the sense of touch, which Lucie had wholly lost, were obeyed. If Prof. Janet clinched her fist, it would strike out and her face would assume an angry expression; if he carried her fingers to her lips, the lips smiled and the fingers threw kisses. Signals of the most complex kind were obeyed in the same way. She was told to perform a posthypnotic suggestion when Prof. Janet had clapped his hands twelve times. He then clapped his hands five times gently and at a distance from her while she was talking with some one else; he asked her what he had been doing and she could not tell him. He clapped his hands again and asked what that was. A handclap, she said. After waiting until her attention was again distracted he clapped them six times more, and the suggestion was obeyed. Lucie could remember having heard only one of the claps, but all twelve were in some way counted. He varied this experiment in many ways, but always with the same result.

Believing, then, that mental states really existed in Lucie's head, so to speak, of which she knew nothing, Prof. Janet next endeavored to get them more fully expressed than was possible in gestures and obedience. Since all talking was done by Lucie, he tried writing, and found, to his delight, that when her anæsthetic hand was hidden from her sight by a screen he could get answers to his questions in writing without Lucie's knowing that it was writing at all, much less what it said. At first it showed little or no spontaneity, and unless the content of the writing was determined by his suggestions it was limited to "Yes," "No," and "I don't know." He asked for a letter, and it wrote an apologetic refusal of an invitation; he asked it to solve little arithmetical problems, and if they were not very difficult it did so correctly while Lucie was talking or reading aloud or otherwise occupied. But there was never a sign of a self-conscious personality in the narrower sense of the word. The writer did not claim to be anybody in particular, and volunteered no information about herself.

One day Prof. Janet undertook to inquire into this point, as follows: "Do you hear me?" "No." "But you must, to answer." "Of course." "Then how do you do it?" "I do not know." "There must be some one who hears me?" "Yes." "Who, then?" "Some other person than Lucie." "Ah, some one else. Shall we name her Blanche?" "Yes, Blanche." But Lucie abhorred the name Blanche, and when the writing was shown to her she flew into a rage and tried to tear it up. So the name was changed. "What will you have?" asked Prof. Janet. "No name." "But it will be more convenient." "Very well, Adrienne." "Well, Adrienne, do you hear me?" "Yes."

It seems probable that the notion of being a person was first suggested by Prof. Janet. However that may be, thenceforward all these automatic phenomena seemed to become crystallized about the name Adrienne and the voice and touch of Prof. Janet, and were readily evoked by him but by no one else.

Having thus got access to the secondary system, the next point was to determine what it comprised. In brief, it was found that all Lucie had lost, whether spontaneously or by suggestion, Adrienne had, and, *vice versa*, whatever Adrienne got, whether spontaneously or by suggestion, Lucie lost.

Lucie had lost her sense of touch, but Adrienne's was perfect. Suggestions given through the sense of touch were executed, but made no impression upon Lucie's consciousness; Adrienne claimed to experience the corresponding mental states. Prof. Janet clinched the left fist, and it struck out; he then asked the right hand, "What are you doing?" "I am furious." "With whom?" "With F——." "Why?" "I do not know, but I am angry." Then he unclasped the fist and put the fingers to the lips—the lips smile and the fingers throw kisses. "Adrienne, are you still angry?" "No, it is gone." "And now?" "I am in a good humor." "And Lucie?" "She knows nothing—she is asleep."

Lucie remembered nothing of her hypnotic states and the suggestions given in them, but Adrienne could tell all about both. Lucie knew nothing about her convulsive attacks. When Adrienne was questioned during a convulsion she could only write, "I am afraid, I am afraid," but afterward she gave an account of them which was intelligible enough, although a little incoherent. "I see a curtain first, and then hidden men, who frighten me. In the country once, at grandmother's house during the holidays, two men came; then in the garden a big curtain, which they put on the trees and went behind it, which frightened us, and since then I have always been afraid." Lucie knew she had had a fright when about seven years old, but never could tell what it was. Prof. Janet does not say whether he verified this story or not, but seems to regard it as true.

So of states artificially dissociated from Lucie by suggestion. Bits of paper were put in Lucie's lap, some of which were marked, and she was told that she could not see those that were marked. If Adrienne were asked what was in Lucie's lap, she would describe those only which Lucie could not see. In this way Adrienne was proved capable of distinguishing odd numbers from even and of performing other simple judgments. Whenever a suggestion was given to Adrienne, it and all that it involved were withdrawn from Lucie. While Adrienne was writing the numbers Lucie could not count, and while Adrienne was writing the alphabet Lucie "had forgotten it." In such cases as these the fact might easily escape notice, but when the elements thus subtracted from Lucie's consciousness were such as she would be likely to miss, she supplied their place by a sort of dream of her own. Thus, when Adrienne was told to put her arms above her head, Lucie lost all consciousness of their true position and said they were in her lap. When Prof. Janet established this fact, it supplied the explanation of an occurrence which had puzzled him not a little at the time it happened. Adrienne was told to come to Dr. Povilevitch's house at a certain time, and Lucie's body came. But Lucie believed herself still to be at home, and mistook the furniture for her own, while Adrienne knew perfectly where she was.

Prof. Janet desired to reverse the relative positions of the two systems so as to make Adrienne speak and Lucie write, and, finding that his suggestions to this end were unavailing, he put Lucie into a deep sleep to make her more suggestible. After sleeping a half hour she awoke, and to his surprise he found that he had neither Lucie nor Adrienne, but a new personality derived from the coalescence of both. This personality called herself Adrienne, but had all Lucie's memories and sensations in addition to those of Adrienne. She was more vivacious and intelligent than Lucie, could not be distracted, and only laughed at Prof. Janet's attempts to give her suggestions. This new synthesis lasted only about twenty minutes; it was followed by a deep sleep of about fifteen minutes, and then Lucie awoke in her former condition.

At first, as I have said, Adrienne showed little spontaneity, but as time went on she acquired memories and developed more character. Once she got angry with Prof. Janet, and for some time all the tokens that showed her presence—automatic writing, catalepsy, and suggestibility—disappeared. When she was reconciled they came back again.

Adrienne existed after her first creation about six weeks. Then Prof. Janet undertook to cure Lucie by suggesting against her hysterical symptoms; little by little they disappeared, and with them Adrienne faded out of existence. "At last," says Prof. Janet, "one day I called upon Adrienne—it was Lucie that replied, laughing a good deal and asking whom I called Adrienne. A few days later the hypnotic sleep, which had ceased to be interesting, entirely disappeared, and it was found impossible to get Lucie asleep by any means."

For eight months Lucie was quite well. Then she had a relapse and Adrienne reappeared. For five days she remained evocable and then disappeared for the last time.

Since that time Prof. Janet has verified with many other patients the conclusions which he reached in the case of Lucie, and most of them have been confirmed in greater or less degree by other investigators in France, Austria, England, and America. But Lucie remains the best illustration of apparently simultaneous "double personality" that has yet been described.

We can not be too cautious in trying to picture to ourselves what the condition of this secondary system which called itself Adrienne really was, just as we can not be too cautious in trying to picture to ourselves the minds of the lower animals. It is much easier to say what Adrienne was not than what she was.

She was not a continuously existing, self-conscious being. She did not exist, in all probability, before Prof. Janet questioned the hand about the writer's name. She did not exist after Prof. Janet had left Lucie. No one but he could evoke Adrienne. Whenever he came into Lucie's presence a marked change came over her—she lost her vivacity, appeared subdued, almost timid, and then Adrienne could be elicited. It would seem that Prof. Janet was like a great magnet about which these dissociated subconscious elements gathered in a sort of dream self, but in his absence they again relapsed into their former incoherent condition.

What were they, then? Can we form any conception of what this "amorphous mind" is like?

I think we can to some degree and in some cases. In our own familiar dream life we have precisely those conditions realized which we suppose obtain in the subconscious realm of a hysteric. Nearly all sensations and most memories and ideas are withdrawn and the fragments remaining work out their own bizarre results free from the control of the organized system. We shall not be far wrong, I think, if we conceive of these subconscious states as a mere aggregation of very incoherent dreams. They are probably very much more incoherent than most of the dreams which we remember, although not more so than those that we forget. Under the guidance of a hypnotic suggestion, and under some other circumstances into which I can not now enter, they may become coherent to almost any degree.

There is a good deal of direct evidence for this. Prof. Janet found that he could sometimes, by awaking Lucie in the midst of a hallucination which he had suggested to her, get her to recall it, and she always spoke of it as a dream. Prof. Janet once tried * some experiments upon a patient whom he had not seen for some months. To his surprise she did not seem to understand him. When he asked why, she told him that she was too far away to understand; that M. X—— had sent her a month ago to Algiers, and he must bring her back before she could understand. This was found to be true: M. X—— had told her she was in Algiers, and had forgotten to remove the suggestion.

Another case will serve both to illustrate this point and also to introduce the question as to the relation between the primary and secondary systems. They need not be entirely distinct. Sometimes, as in this next case, the mere existence of the one may seem to disturb the other in some vague fashion, at other times scraps or fragments or consequences of either may appear in the other without their origin being recognized, and in still other cases the two appear to coalesce sufficiently for the one to recall the other while yet they remain dynamically distinct.

One of Mr. Gurney's patients † was told to write automatically while reading aloud. The result was that both reading and writing were imperfect and confused. He was then hypnotized again and asked what he had been trying to do. He said, "Trying to write, 'It has left off snowing.'" Then he was asked if he had been reading, and said: "Reading? No, I haven't been reading. Something seemed to disturb me; something seemed to move about in front of me, so that I got back into bed again." "Did not Mr. Gurney hold a book and make you read aloud?" "No. Somebody kept moving about. I did not like the looks of them.

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* *L'Automatisme Psychologique*, second edition, p. 328.

† Proceedings of the Society for Psychical Research, vol. iv, p. 319.

Kept wandering to and fro. Horrible, awful. I thought to myself, 'I'll get into bed.' It looked so savage it quite unnerved me." Here the reciprocal interference seems quite clear, and the subconscious state, instead of evolving on the lines laid down by the suggestion, has been perturbed and developed into a vague dream.

Another good case of interference is given by Prof. Janet:* "M—— came to me one evening complaining of sundry troubles, and after putting her into her second state I talked to her and gave her some advice, then wakened her without thinking of repeating the same advice in her waking state. Some days later she wrote me the following letter: 'I can not make out what is the matter with me. I must be very queer. I understand with difficulty, and it seems to me that everybody is looking at me, perhaps because I express myself badly. I feel absolutely nothing, and I let nearly everything fall, which makes me seem very stupid. I can not work, and if any one in the house should notice it I should be the loser. I may be wrong, but I have a dim idea that I ought to do something. For two days I have tried in every way to discover what it can be.'" All this annoyance was easily removed by destroying the subconscious suggestion.

Upon this conception of the interference between the two states without coalescence and without the formation of a memory bond, Prof. Janet has based a most interesting and important theory as to the origin of the hysterical and nervous troubles which so often follow a severe accident or fright where no actual injury can be detected. It is well known that such an experience often becomes a conscious fixed idea, and "haunts" one. But sometimes where there is no conscious "haunting," and even where the experience is forgotten, the same results are traceable. In these cases he believes that the fixed idea exists subconsciously as a continuous or frequently recurring dream.

Thus, Vel—— is a young man of twenty-four.† About every five minutes while awake and often while asleep he expels his breath violently through the left nostril and the muscles of the right cheek are contracted. He has had this spasm for eight years and can not explain why. He thinks it may be connected with a severe hæmorrhage from the nose which he had as a child. He is easily hypnotized and then affirms most positively that there is an obstruction in his nose which he must get rid of. "No matter when he is put to sleep, he makes the same statement; it is probable that this idea has existed more or less clearly in the patient's mind, and in any case unknown to him, for eight years. This dream was modified and suppressed very easily in the somnambulic state."

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* *Les Accidents Mentaux*, p. 137. † Ibid., p. 102.

"A subconscious dream,* in which the movement of a limb is represented, tends to some extent to invade the primary consciousness and deprive it of control over that limb. Le —— dreams that he is fighting with a thief, and keeps off his assailant with his right hand; the thief puts his knee on his left side and clutches his neck with his hand. Upon awaking, Le —— has a hyperæsthetic point on the left side, pressure upon which is sufficient to bring on the complete hallucination of the scene, and has, further, an anæsthetic spot upon the neck with complete insensibility and almost complete paralysis of the right arm. Why do we find these two symptoms? Because these sensations of pressure on the neck and movement of the arm form, so to speak, part of the dream, are absorbed by it, and are no longer at the disposal of the self."

Sometimes we meet with cases in which the secondary system is not subconscious, but blends sufficiently with the primary system to be recalled, and at the same time retains its independent character. The experiences of Dr. Cocke and of Anna Katharina Emmerich, to which I allude in my paper on Hypnotic States, Trance, and Ecstasy, are of this type. Similar cases are not infrequent in insanity. One of the best accounts from normal life that I have seen is given by the late Robert Louis Stevenson in a letter to Mr. F. W. H. Myers, dated July 14, 1892: †

"During an illness at Nice I lay awake a whole night in extreme pain. From the beginning of the evening *one part of my mind* became possessed of a notion so grotesque and shapeless that it may best be described as a form of words. I thought the pain was, or was connected with, a wisp or coil of some sort; I knew not of what it consisted, nor yet where it was, and cared not; only I thought if the two ends were brought together the pain would cease. Now all the time, with *another part of my mind,* which I venture to think was *myself,* I was fully alive to the absurdity of this idea, knew it to be a mark of impaired sanity, and was engaged with *my other self* in perpetual conflict. *Myself* had nothing more at heart than to keep from my wife, who was nursing me, any hint of this ridiculous hallucination; the *other* was bound that she should be told of it and ordered to effect the cure. I believe it must have been well on in the morning before the fever (or *the other fellow*) triumphed, and I called my wife to my bedside, seized her savagely by the wrist, and looking on her with a face of fury, cried, 'Why do you not put the two ends together and put me out of pain?'"

In another illness, at Sydney, "*the other fellow* had an explana-

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* *Op. cit.*, p. 132.

† Proceedings of the Society for Psychical Research, vol. ix, p. 9.

tion ready for my sufferings, of which I can only say that it had something to do with the navy, that it was sheer undiluted nonsense, had neither end nor beginning, and was insusceptible of being expressed in words. *Myself* knew this; yet I gave way, and my watcher was favored with some reference to the navy. Nor only that: *the other fellow* was annoyed—or I was annoyed—on two inconsistent accounts; first, because he had failed to make his meaning comprehensible, and, second, because the nurse displayed no interest. *The other fellow* would have liked to explain further, but *myself* was much hurt at having been got into this false position, and would be led no further."

Now, when such a disordinated system obtains complete control of the body, the patient is wholly insane. Not, of course, that every case of insanity belongs to this type, but that every case of this type belongs to insanity. The normal consciousness is then supposed to be wholly extinct, but there is no reason for believing that it necessarily must be. Take for example a case observed by the late Dr. Ira Barrows, of Providence, R. I., and printed by Prof. James.* The patient was a girl of nineteen. I make only a few extracts from Dr. Barrows's notes.

"*September 17, 1860.*—Wild with delirium. Tears her hair, pillowcases, bedclothes, both sheets, night dress, all to pieces. Her right hand prevents her left hand, by seizing and holding it, from tearing out her hair, but she tears her clothes with her left hand and teeth.

"*29th.*—Complains of great pain in right arm, more and more intense, when suddenly it falls down by her side. She looks at it in amazement. Thinks it belongs to some one else; is positive it is not hers. . . . She bites it, pounds it, pricks it, and in many ways seeks to drive it from her. She calls it 'Stump, old Stump!'

"*January 10, 1862.*—When her delirium is at its height, as well as at all other times, her right hand is rational, asking and answering questions in writing; giving directions; trying to prevent her tearing her clothes; when she pulls out her hair, it seizes and holds her left hand; when she is asleep, it carries on conversation the same; writes poetry; never sleeps; acts the part of the nurse as far as it can; pulls the bedclothes over the patient, if it can reach them, while uncovered; raps on the headboard to awaken her mother (who always sleeps in the room) if anything occurs, as spasms, etc."

"Old Stump" made no statements, so far as the account goes, about its own identity. It always spoke of the patient in the third person as "Anna," but that is common in changes of personality.

* Proceedings of the American Society for Psychical Research, vol. i, p. 552.

Dr. Barrows himself believed that "Old Stump" possessed more intelligence and knowledge than the patient ever had, but the record is not extensive enough to pronounce on that point. It seems most probable that "Old Stump" expressed what remained of the patient's sane self, which still existed, although the incoherent mass had control of the rest of her body.

In the case of successive personalities, if no memory is retained, each synthesis has to learn of the existence of the others as of third persons, and may cherish friendly or unfriendly feelings toward them. When memory is retained, if the change is not very great, the patient often expresses it by saying that he is "asleep," which is doubtless a phrase borrowed from the hypnotizer. According to Prof. Janet,* the more intelligent often say: "But I am not asleep, it is absurd to say that; only I am changed, I am queer; what have you done to me?" Rose, who has four or five states, says, "It is always I, but not always the same thing."

When the change is more extensive, the patient often hesitates or refuses to claim identity with her own past self. Leonie, another of Prof. Janet's patients, has two other states which can be evoked successively and which possibly exist simultaneously. The third, which calls itself Leonore, says of the first: "A good woman, but pretty stupid; she is not I"; while of the second state—Leontine—she says: "How can you think me like that madcap? Happily, I am nothing to her." Leontine several times wrote letters while Leonie's attention was distracted. One of these ran as follows: † "My dear good sir: I must tell you that Leonie really, really makes me suffer a great deal. She can not sleep, she gives me much trouble; I shall destroy her; she makes me dull, I am also sick and very tired. This is from your most devoted Leontine." When Leonie discovered these missives she always destroyed them, so the writer adopted the further plan of concealing them—with Leonie's own hands, of course—in a photograph album, into which Leonie never dared look, because it had once contained the portrait of Dr. Gibert, who used to hypnotize her. In short, whenever Leonie fell into a fit of abstraction, she, or at least her body, was apt to do things which bore evidence of intelligent purpose and often of wishes very much at variance with Leonie's.

Subconscious states, which exist at the same time as the upper consciousness, may cause it many perplexities. Said one patient: ‡ "'I can not in the least understand what is going on. For some

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* *L'Automatisme Psychologique*, second edition, p. 130. † *Op. cit.*, p. 321.

‡ Quoted from Prof. Janet, by Mr. F. W. H. Myers, in the Proceedings of the Society for Psychical Research, vol. ix, p. 21.

time past I have been working in an odd way; it is no longer I who am working, but only my hands. They get on pretty well, but I have no part in what they do. When it is over I do not recognize my work at all. I see that it is all right; but I feel that I am quite incapable of having accomplished it. If any one said, It is not *you* who did that! I would answer, True enough, it is not I. When I want to sing, it is impossible to me; yet at other times I hear my voice singing the song very well. It is certainly not I who walk; I feel like a balloon that jumps up and down of itself. When I want to write I find nothing to say; my head is empty, and I must let my hand write what it chooses, and it fills four pages, and if the stuff is silly I can not help it.' The curious point is that in this fashion she produces some really good things. If she makes up a dress or writes a letter, she sometimes shows real talent, but it is all done in a bizarre way. She looks absorbed in her work, but yet is unconscious of it; when she lifts her head she seems dazed, as if she were coming out of a dream, and does not recollect what she has been doing. . . . Although she still has activity, she has no longer the personal consciousness of this activity, and her acts therefore can no longer be called voluntary."

I have now briefly analyzed the leading types of what is known as double or multiple personality. Successive changes of personality are demonstrated facts. That subconscious states of some sort exist is also exceedingly probable. For the existence of simultaneous personalities there is also good evidence, and in some cases I am inclined to admit it. Yet I believe that we can not be too careful in making use of these conceptions. While the evidence upon which they are based is stong, it must not be forgotten that it is largely selected evidence, that multitudes of cases remain for which these theories afford no adequate explanation, and that the metaphysical basis upon which the theory itself rests is far from finally established. While formulating theories, we must not become theorists.

RAISING bacteria for the general market is an entirely new business which a large German firm of color manufacturers has recently engaged in. They advertise that they will deliver, under the name of nitrazin, cultures of bacteria with which to inoculate various leguminous crops, to the increase of their yield and improvement of their quality. Their stock includes pure cultivations of nodule organisms suitable to the growth of seventeen varieties of beans, clover, and other crops of the family mentioned. Each bottle is labeled according to the crop for which it is intended, of which the botanical and the German name are given. Sixty-three cents will procure enough bacteria to inoculate half an acre of land.

TWO SCIENTIFIC WORTHIES.*

By HARRISON ALLEN, M. D.

WE can estimate the popularity of any branch of knowledge by the interest taken by the public in the lives of the men who are identified with it. We read with avidity the lightest details in the careers of military leaders for the glamour which is attached to war; but the victories and defeats of students of Nature pass unregarded.

The mediæval naturalist was artist and naturalist, or priest and naturalist. Permit me to quote a passage from Edward Forbes's Naked-Eyed Medusa: "The genus *Sarsia* was instituted by Lesson for a very remarkable Medusa discovered by the eminent naturalist of Norway, whose name it bears; a philosopher who, pursuing his researches far away from the world, buried among the grand solitudes of his magnificent country, where the pursuit of science is his recreation, and the holy offices of religion his sacred duty, has nevertheless gained name and fame wherever the study of Nature is followed. The unpretending writings of this parish priest have become models for the essays of learned professors in foreign lands, and his discoveries the texts of long commentaries by experienced physiologists." Father Sars, a priest and naturalist, appears to have been a representative of the mediæval type projected into the nineteenth century. While the conflict between science and religion is going on, the amenities of science and religion as exemplified by such a career should be acknowledged.

I shall sketch briefly the careers of two scientific worthies, one standing on the threshold of modern times, and the other well within. I allude to the naturalist and physician in the person of Sir Thomas Browne, and the naturalist and administrator in that of Sir Thomas Stamford Raffles. I shall present their claims as scientists, for these have been largely ignored.

Sir Thomas Browne was an English provincial physician of the time of Charles II. He was born in 1605 and died in 1682. We are informed that modern readers without special preparation can understand the spirit of this time. But we must acknowledge Browne is something of a puzzle. It is true we can dip into his mental life as we can read of an Owen. He is one of us. He thought and worked as we do. At other times he appears as a Rosicrucian in his physics—an Aldrovandus in his natural history.

* An address delivered before the Academy of Natural Sciences of Philadelphia, December 7, 1894.

How pregnant his inquiries! How trenchant his comments! A phrase suggests the beginnings of new sciences. His phraseology is cumbersome and pedantic, yet in startling ways he will use poetical expressions in the midst of learned comments that carry the mind along vistas of the imagination. He was a physician, and, while giving only his leisure to science and literature, he became a leading authority in the zoölogy and botany of Great Britain. He introduced the word "commensality," now in com-

THOMAS BROWNE.

mon use, to express a state of many living together, as it were, at the same table. This word is mentioned by Johnson as an example of a useful term which if rejected must be supplied by circumlocution. Browne was a pioneer in the scientific study of graves and their contents. He appreciated the value of fossils. He was also a comparative anatomist, and constantly engaged in such topics as the anatomy of the horse, the pigeon, the beaver, the badger, the whale. In a note on an autopsy of a spermaceti whale the following passage occurs: "It contained no less than sixty feet in length, the head somewhat peculiar, with a large prominence over the mouth; teeth only in the lower jaw, received into fleshy sockets in the upper. The weight of the largest about two pounds; no gristly substance in the mouth, commonly called whalebones; only two short fins . . . on the back; the eyes but small." This is a very good note, we think, and written in a scientific spirit.

He studied animal mechanism, especially the gaits of quadrupeds and the acts of swimming and floating; the problems of right and left handedness; and the erect figure of man. He tells us that "tempermental dignotions" can be detected by studying spots on the finger nails. Physicians even in our own day have not formulated knowledge on this curious subject. He discovered the animal soap now called adipocere. "He would have made a very extraordinary man for the Privy Council," we are told by his biographer.

A letter of advice to a young physician from Browne gives an estimate of the reading held to be essential to a medical course in his day. "Lay your foundation in anatomy." Among authors he recommends Vesalius, Spigelius, Bartholinus; and enjoins his friend to "master Dr. Harvey's piece, the Circulation of the Blood; also, to read with care and diligence Sennertus's Institutes. This done, to see how Institutes are applicable to practice." It must be remembered that in Browne's day "institutes" included physiology. This is all very modern in spirit.

What were the contents of a scientist's mind of the seventeenth century? The queries are taken from Sir Thomas's commonplace book. "Why little lap-dogs have a hole in their heads and often other little holes out of the place of the sutures?" "Why a pig's eyes drop out in roasting rather than other animals?" "Why a pig held up by the tail leaves squeaking?"* "What is the use of dew claws in dogs?" "To make trial of this, whether live crawfish put into spirits of wine will presently turn red, as though they had been boiled, and taken out walk about in that color." Such an experiment reminds us of the famous distich of Peter Pindar.

Here is another modern touch! Browne remarks of one of his writings: "It is done by snatches of time, as medical vacations, and the fruitless importunity of uroscopy would permit us. And therefore also, perhaps it hath not found that regular and constant style, those infallible experiments, and those assured determinations, which the subject some time requireth, and might be expected of others, whose quiet doors and unmolested hours afford no such distractions." The "importunity of uroscopy" is per-

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* Charles Waterton asks, "What is the use of classification, when no one can tell us why most birds drink, by alternately sipping and raising the head between the sips, and others like the pigeon by prolonged immersion of the bill?"

haps less "fruitless" than it was in Sir Thomas's time, but physicians who chance to have scientific tastes will repeat the plaint of envy for those favored ones "whose quiet doors and unmolested hours afford no distractions."

Browne wrote in addition to scientific work two remarkable general treatises—the Religio Medici and Christian Morals; and indeed on these accounts he has been absolutely appropriated by the literary critic. It is necessary, as we have said, to secure a true point of observation in judging of the science of Sir Thomas Browne so as not to be unfair to him. It is equally necessary to resist the claim of professional authors that Browne is simply a man of letters. Mr. Simon Wilkins, in speaking of the early death of Thomas, the second son of Sir Thomas Browne, says that if he had not been cut off early, his character and talents would have secured to him in the profession he had chosen a distinction not inferior to that his father had attained in the more quiet paths of philosophy and science. But this is a single voice. It is likely that many who hear these words will learn for the first time that Sir Thomas Browne was a *savant* as well as a literary man. Because Browne took no interest in the theological and political controversies of his time, the writer of the biographical notice in the Encyclopædia Britannica calls him a psychological curiosity. Allibone in his Dictionary of Authors does not allude to his science. In Johnson's celebrated life of Browne (it is strange that with such lack of sympathy he should have written at all) occurs this passage in reference to the Hydrotophia or Urn Burial: "It is indeed like other treatises of antiquity rather for curiosity than use, for it is of small importance to know which nation buried their dead in the ground, which threw them into the sea, or which gave them to the birds and beasts; when the practice of cremation began, or when it was disused; whether the bones of different persons were mingled in the same urn; what oblations were thrown into the pyre or how the ashes of the body were distinguished from those of other substances." We are properly instructed to bow before the great moralist and thinker, Samuel Johnson; but for such an estimate as the above (and it is by no means an isolated one in which Johnson held all knowledge of the exact sciences) we can not be alone in confessing to some impatience!

No more striking figure is met with in modern biography than that of Sir Thomas Stamford Raffles. He was the first to give the learned world knowledge of the mysterious East as expressed in Java and Sumatra. He, like Sir Thomas Browne, has been strangely misjudged by the literary critic.

Raffles was born in Jamaica in 1781, but was educated in England. He was the only surviving son of Benjamin Raffles, one of the oldest captains in the West Indian trade at Port London. His school education ceased at the early age of fourteen years, when he was removed from the seminary and placed as extra clerk in the East India House. He never overcame the deficiencies arising from imperfect early education. The habit of study which in after years made him remarkable for his attainments was due to utilizing the moments which he described as "stolen" either before office hours or after them in the evening.

Thomas Stamford Raffles.

In 1805 the Court of Directors determined to make an establishment at Penang, a small island on the west coast of the Malacca Peninsula. Raffles was appointed assistant secretary to Sir Hugh Inglis, the representative of the Court of Directors in the East India Board. He was at this time but twenty-four years of age. In 1811—namely, when he was thirty years of age—he was appointed by the directors agent to the governor-general. He suggested to the Indian Government the conquest of Java, and after this was accomplished in 1811 he was appointed lieutenant-governor.

The Spice Islands, so called because they yielded cloves, nutmeg, coriander, mace, ginger, pepper, and cinnamon, were so important to Europe that their possession was eagerly sought for by the maritime powers. As condiments the demand for many of the spices is much less now than formerly was the case. The esteem in which ginger and pepper especially are yet held is low in comparison with that entertained in the period from the fifteenth to the beginning of the present century. Are the relatively few dishes into which these spices enter to be regarded as survivals of the diet of a Charles V? Is the art of cooking so far advanced that we are no longer obliged to cover up taint with aromatics? But after answering such questions, and after making allowance for changes in taste, it is a striking fact that spices should at any time have entered into questions of state policies.

As an antithesis to an active life Herrick says of a rustic hero:

> Thou never plow'st the ocean's foam
> To seek and bring rough pepper home,
> Nor to the Eastern Ind dost rove
> To bring from thence the scorchèd clove.

Was not the zest to control spice due to its use, not as a condiment as it is with us, but as a preservative? Ice appears to have had a small place in preserving perishable articles. Salt is a coarse agent and impairs both the flavor and digestibility of food when used in sufficient quantity to arrest decomposition, and with the exception of the olive is not applicable to fruits. Spices are highly antiseptic. Oil of cloves is used by microscopists in preserving sections of tissue. Oil of cinnamon is one of the most valuable antiseptics in the modern materia medica. Spices increase the preservative power of sugar, an article of luxury in the middle ages and far out of the reach of the masses. If this view of the importance of spices be conceded, we can understand their value as something over and above their use to improve a defective *cuisine*, increase flavor, and add variety to diet. We must also remember that while the attempts to find new routes to the Spice Islands by sailing west failed, the early voyagers discovered in the American tropics vast tracts of arable land which were adapted to the growing of many of the spices; they also succeeded in bringing to the European market new condiments in capsicum and allspice. Besides this, rapid transportation places fresh fruit early in the market, and the discoveries of chemistry have done away with the necessity of resorting to spices for preservatives, benzoic acid alone supplanting most of them in the keeping of vegetable products. Thus geographical and chemical sciences have brought about changes in national policy.

While no future administrator is likely to repeat the experience of a Raffles in giving excuse for European control of the Spice Islands, the rôle that he played was one but little less in importance to the East (especially in Java) than that of the Dutch administrators who preceded and followed him.

Raffles secured Singapore in 1818, and thus transferred to British interests the waters by which the best passage from the Indian seas to the Pacific Ocean is possible. His opportunity came with the Napoleonic wars, by which the loss of Holland to the French threw the Eastern possessions of the Dutch as fruits of conquest into the hands of the English.*

Raffles encouraged missionary work, and in 1821 endeavored to suppress slavery in the island of Pulo Nias. The circumstances attending this traffic were no less revolting than those that marked it on the coast of Africa. But the East India Company was an association of traders, and prudently repressed whatever sentiments its members may have held on the subject of slavery. The Court of Directors disapproved of Raffles's acts, and went so far as to assert officially that his proceedings were deserving of their reprehension. He always insisted that it was folly to assume that the exposure of the evils of the slave-system in any way affected the Company. However, he came near being dismissed from the service, and in a little while after the transfer of the islands to the Dutch the slave trade was resumed with greater vigor than ever. I mention this circumstance in order to show how differently Raffles interpreted his duties from those of a mere agent of a trading company. He held science, literature, and practical benevolence as primary motives to action.

But, by the redistribution of lands agreed on at the Congress of Vienna in 1815, Java ("another India!" cries a despairing critic) was returned to the Dutch; and the Raffles administration (and to a great extent the reforms he established), after a brilliant term of five years, came to an end.

After his recall from Java, he visited England. The Prince Regent showed his appreciation as opposed to that of the East India Company by knighting Raffles, and in a short time thereafter appointing him Lieutenant-Governor of Sumatra.

Any sketch of Raffles would be incomplete that did not include an account of his domestic life. He married in 1805, but lost his wife in 1815. He remarried in 1816. Lady Raffles, in 1830, wrote a life of her husband in the form of a large quarto of exactly eight hundred and twenty-three pages.† Judged by the standard of the taste of to-day, such an achievement defeats in great measure its own object, though it must be said in behalf of the author that she intended the volume to be a defense of her husband's services, and the records of his private life are subordinated.

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* A study of the influences of the Raffles administration over Philadelphia would be found interesting. The founding of Penang and Singapore gave increased security to our vessels trading in the China seas. The Raffles and, later on, the Brookes policy tended to suppress piracy. The large trade of Philadelphia with the East in the early part of this century, that built up the fortunes of a Girard and a Wagner, has been of incalculable advantage to Philadelphia.

† Memoir of the Life and Public Services of Sir Thomas Stamford Raffles, F. R. S. London, John Murray, 1830.

Raffles's domestic life and his zeal for natural history are inextricably mixed. His residence and the yard attached thereto were a museum and laboratory. "I have thrown politics far away," he writes, "and, since I must have nothing more to do with men, have taken to the wilder but less sophisticated animals of our woods. Our house is on one side a perfect menagerie; on another, a perfect flora; here, a pile of stones; there, a collection of sea-weeds, shells, etc."

When he was in Bencoolen he rose early, and delighted in driving into villages, inspecting the plantations and encouraging the industry of the people. At nine the family assembled at breakfast; afterward he wrote, read; studied natural history, chemistry, and geology; superintended the draughtsmen (of whom he had constantly five or six employed), and always had his children with him as he went from one pursuit to another. At four he dined, and seldom alone. After the party had dispersed, he was fond of walking out with the editor (Lady Raffles always alluded to herself as the editor), and enjoying "the delicious coolness of the night land-wind." "I believe people generally think I shall remain longer," says he in a letter to a friend, "as they hardly suppose in such times, and with an increasing family, a man will be inclined to forego the advantages of the field before me; but they know me not. I have seen enough of power and wealth to know that, however agreeable to the propensities of our nature, there is more real happiness in domestic quiet and repose, when blessed with a competence, than all fancied enjoyments of the great and the rich" (page 497). His oldest son Leopold "has the spirit of a lion, and is absolutely beautiful." His daughter Charlotte "is of all creatures the most angelic I have ever beheld." There are two other younger children, Harry and Ella. But Sumatra, as indeed all tropical Asia, excepting favored localities in Java, is fatal to children of European parents. Raffles entertained a scheme of removing his family to a colder climate, but he lingered too long, and all his children, save the youngest, Ella, died within one year. From these blows he never recovered. His health rapidly failed. He asked to be relieved from duty, and after a foreign service of twenty years he prepared to return for good to England.

His collections included objects of natural history in every department, a living tapir and many birds, and upward of two thousand drawings, notes, observations, together with memoirs, vocabularies, dictionaries and grammars of native languages. Just as he is about to sail, all his collections being carefully stored in the hold, the vessel, through the carelessness of the steward, takes fire and everything is lost. How unutterable the dismal sense of failure that thus often awaits the explorer! Rafinesque, Wallace, Schweinfurth, all lose the result of years of toil and privation. Humboldt makes three collections, travels with one, never losing sight of it, ships the other two, and both through the fortunes of war are in great part lost. Raffles staggered to his feet after this crushing blow and obtained a second collection with which he sailed to England. Upon his arrival he was not idle. He interested himself in establishing the Zoölogical Society of London and became its first president. He founded the Museum Rafflesianium, which is composed of specimens of natural history from the Malayan Archipelago. He died suddenly in 1826, at the comparatively early age of forty-five years.

The career of Raffles is thus briefly outlined. If any one is interested in the subject and looks it up in the Biographical Dictionary, the encyclopædias, or in articles on Java, he will find nothing, or next to nothing, on Raffles's scientific labors. The interesting chapter in Chambers' Miscellany entitled Sir Stamford Raffles and the Spice Islands relates almost entirely to his work as a philanthropist and administrator. Yet his influence on the subject of topography, botany, zoölogy, ethnology, and archæology of the East is as great as are his political ideas. He undertook systematic investigations of Java, Sumatra, and the neighboring islands. He encouraged collections to be made by competent explorers,* instituted special expeditions for collecting antiquities by which the Hindu influence on the Javanese mythology, history, and literature was established. He wrote an elaborate history of the island. Some idea of the comprehensive plan of his labors and of its rich results can be obtained by the estimate of the cargo with which he stored his ship on his departure for England.

We acknowledge the justness of the tribute to Raffles as ex-

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* The Americans who have made impressions in European affairs are naturally very few. The mind in this connection reverts to Ledyard and Count Rumford among scientists; to West, Copley, and Leslie among painters. I infer that few Philadelphians recall that a man trained in their city and a native of Bethlehem, Pa., should be added to the list. I allude to Dr. Thomas Horsfield, the most prominent of the naturalists encouraged by Raffles in the exploration of the Malayan Islands under his administration. Horsfield was born in 1773; he studied medicine at the University of Pennsylvania, where he was graduated in 1798, writing on Rhus Poisoning, which appears as one of the Medical Theses, edited by Charles Caldwell, Philadelphia, 1805. In no other publication is there to be found so excellent an account of the properties of the American poison vine and poison oak. Immediately after graduation Horsfield went to Java, where he remained for twenty years in the service of the East India Company. At the end of this time he was recalled to London, where he spent the rest of his life as the curator of the museum of the company in Leadenhall Street. He was elected a correspondent of the Academy of Natural Sciences of Philadelphia in 1826. He was the author of the classical work on Zoölogical Researches in Java, a separate volume on the rare plants of Java, as well as a special report on the annelids of the same general region. Dr. Horsfield died in 1859.

pressed in the epitaph on a tablet in Westminster Abbey. It reads as follows: "He was ardently attached to science; he labored to add to the knowledge and enrich the museums of his native land."

A DOG'S LAUGH.

By M. le Vicomte d'Aiglun.

ALPHONSE KARR has said: "Man is the gayest of animals; much more, he is the only gay one, the only one that laughs." Toussenel is equally explicit: "Laughter is a characteristic faculty of man." Gratiolet observes that "when man freely breathes a pure air, fresh and uncontaminated, his mouth dilates slightly, his upper lip reveals more or less of his upper front teeth, and the corners of the mouth gracefully elevate themselves; the muscles that determine this movement act at the same time upon his cheeks and raise them, slightly lifting the outer angles of his eyes, which become a little oblique. This movement of easy respiration is called the smile; and the smile of the lips is distinguished in language from the smile of the eyes. The smile of the eyes is in man, however, consecutive to the service of the mouth, and does not depend upon any special muscle. No mammalian animal has the smile of the mouth; but the smile of the eyes exists in the carnivorous animals, and, as it can not depend upon the buccal smile, its determining cause resides in a small muscle that acts on the outer angle of the eye. Dogs, it is known, have this smile of the eyes in a superior degree."* Further, he says: "The real and simple smile—that is, the movement that lifts the angle of the mouth—is exclusively peculiar to the human species. There is nothing like it even in the highest monkeys. Among the carnivores, animals of the genera *Ursus* (bear), *Canis* (dog), and

Fig. 1.—Fox Terrier Laughing.
From a photograph.

* Gratiolet. De la Physionomie, p. 25.

Hyæna have some movements that resemble the smile, but can not be really compared with it. Below the mammalian animals there is no longer mobility in the face, and consequently no longer a possible smile." *

Darwin also admits a sort of smile in dogs,† but regards it as a simple grimace: "A pleasurable and excitable state of mind, associated with affection, is exhibited by some dogs in a very peculiar manner; namely, by grinning. This was noticed long ago by Somerville, who says:

> "And with a courtly grin the fawning hound
> Salutes thee cow'ring, his wide op'ning nose
> Upward he curls, and his large sloe-black eyes
> Melt in soft blandishments and humble joy.
>
> —*The Chase*, Book I.

Sir W. Scott's famous Scotch greyhound, Maida, had this habit, and it is common with terriers. I have also seen it in a Spitz and in a sheep dog. Mr. Rivière, who has particularly attended to this expression, informs me that it is rarely displayed in a perfect manner, but is quite common in a lesser degree. The upper lip during the act of grinning is retracted as in snarling, so that the canines are exposed, and the ears are drawn backwards; but the general appearance of the animal clearly shows that anger is not felt. Sir Charles Bell ‡ remarks: 'Dogs, in their expression of fondness, have a slight eversion of the lips, and grin and sniff amid their gambols in a way that resembles laughter.' Some persons speak of this grin as a smile, but if it had been really a smile we should see a similar though more pronounced movement of the lips and ears when dogs utter their bark of joy; but this is not the case, although the bark of joy often follows a grin."

Notwithstanding my profound respect for the names of Darwin and the other authors from whom I have quoted, I take the liberty of remarking that it is hard to laugh and bark at the same time, and that some dogs employ laughter to express their joy while at the same time wagging their tails and exhibiting all the other signs peculiar to their kind.

We must not push the analysis too far, for fear of going beyond the truth. Laughter to everybody is nothing else than a joyous expression of the face given by the movement of the mouth. No one certainly would take the trouble to find, in order to know it, by what muscles it is produced.

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* Gratiolet. De la Physionomie, p. 169.

† The Expression of the Emotions in Man and Animals, p. 120.

‡ The Anatomy of Expression, 1844, p. 140.

Now, is not that a good laugh, quite free and affectionate, that is represented in the picture, Fig. 1, taken from the instantaneous photograph of a little fox-terrier bitch in my possession, which puts on this expression very prettily every time it would manifest pleasure or a great joy? Fig. 2 gives also the expression of a dog laughing all over. It is the portrait of a collie bitch. The animal has a very pleasant physiognomy. The French language has an expression, *canin*, for canine laughter, which the dictionaries define by saying that it is produced by the contraction of the canine muscle, or the muscle that lifts the angle of the lips; and they give it as the synonym of *sardonic* laughter, because it is produced on only one side of the mouth. Fig. 1 shows that this synonymy is not always just.

FIG. 2.—A COLLIE "LAUGHING ALL OVER."
From a photograph.

A friend of mine has a terrier which also laughs, and which has after a few months taught a spaniel, its habitual companion, to laugh.

This education of one animal by another is not so rare as might be supposed. I knew a little dog in Havana, a great friend of the cat of the house, that took from it the habit of moistening its paws with its tongue and washing its face with them.—*Translated for the Popular Science Monthly from La Nature.*

THERE is a good deal of human nature in the reason which General Sir Thomas Gordon gives in his Persia Revisited as having been assigned by a mollah of that country for opposing education. "They will read the Koran for themselves," he said, "and what will be left for us to do?"

POPULAR SUPERSTITIONS.

By WALTER JAMES HOFFMAN, M. D.

PRIMITIVE man fills his world with innumerable spirits, both good and bad, and much of his time is spent in devising means whereby he may invoke the aid of one class to assist him in averting the malignant influence of the other. The dread and wonder excited by the phenomena of the elements, or the discovery of anything abnormal, either animate or inanimate, suggest to his mind the existence and manifestation of deities. As the burrowing of the mole is observed to cause ridges upon the turf, so a mythic gigantic mole traverses beneath the earth to form the mountain range. The storm is caused by a monster bird, the movements of whose wings produce the winds and whose voice is heard in the muttering thunder and lightning flash. So, in everything, he recognizes the presence of some one or more beings, the pretended explanations of whose functions and exploits form the basis of his mythology. The emotions with which these deities are regarded, the dread or reverence in which they are held, and the impressions resulting therefrom, give rise among different peoples to various religious beliefs or cults.

Among civilized nations we perceive evidence of an inherent tendency to regard with partiality anything strange or unusual, the soil of the mind being prolific in the cultivation of morbid fancies which, if given serious thought, become difficult to eradicate.

The survival in America of Old-World customs, beliefs, and superstitions is naturally to be expected because of the continuity of the peoples with whom they originated. This is illustrated by the occurrence of African demonology among the negroes of the South, of Gallic folklore among the creoles of Louisiana, of some vestiges of quaint old English customs and superstitions in New England, and particularly in the survival of Teutonic folklore among the descendants of the early German colonists.

It is not surprising, then, at this late day, that the folklore and superstition of one part of the country may have been transported into another, and there taken root and become incorporated as original. No matter how little or how much change may have occurred in its transmission, or to what extent a new environment may have influenced it, the nationality of such belief or superstition may still be ascertained with tolerable certainty, as the collection and classification of such data have been reduced to a science.

As pertains to the status of the early cults of northern and western Europe, Germany holds a middle place. Our knowledge of the religion and heathen doctrines of the Greeks and Romans rests upon writings which existed previous to the rise of Christianity. The Teutonic races forsook their ancestral faith slowly, the transition lasting from the fourth to the eleventh century. Christianity was not popular; the faith was clothed in a new language, and it aimed at supplanting the time-honored indigenous gods, and their worship was an important part of the people's traditions, customs, and constitution.*

One of the most conspicuous characteristics of the Teutonic race is a devout attachment to ancestral customs and beliefs, a trait which among the less intelligent and truly illiterate becomes proportionately intensified. It is more than probable that to this trait may be attributed the preservation of fragments of myths and folklore, as well as remarkable adherence to old-world formulæ relating to witchcraft and folk medicine, relics of customs and superstitions which are probably contemporary with the birth of the human race itself.

We are all familiar with the custom of having eggs served at Easter breakfast, and also that of children receiving presents of dyed eggs; sometimes toy rabbits or hares, made of soft, fluffy goods and stuffed with cotton or sawdust, were also given as presents. Children were told that the hare laid the eggs, and nests were prepared for the hare to lay them in. The custom obtains as well in South Germany. The figure of a hare is placed among the Easter eggs when given as a present.

The association of the hare with Easter observances was much more common in former times, and in England it was customary for the hare to be eaten at such times. Hare-hunting as an Easter custom began to fall into disuse about the middle of the last century.

The use of eggs as a sacred emblem of the renovation of mankind after the Flood was held by the Egyptians, and the Jews adopted it to suit the circumstances of their history as a type of their departure from the land of Pharaoh. The egg suggests a resurrection to life of a vital principle which may for an indefinite period have lain dormant. Hutchinson, in his History of Northumberland, says:

"It was used in the feast of the Passover as part of the furniture of the table with the Paschal Lamb. The Christians have certainly used it on this day as retaining the elements of future life for an emblem of the resurrection. It seems as if the egg was thus decorated for a religious trophy after the days of mortification and abstinence were over and festivity had taken place; and as an emblem of the resurrection of life, certified to us by the

* Grimm. Teutonic Mythology.

resurrection from the regions of death and the grave."* "The Church of Rome, also, in the time of Pope Paul V, considered eggs emblematical of the resurrection." †

Germans to this day term April *Ostermonat*, or Easter month, an old form of the word *óstarmânoth* occurring as early as the time of Charlemagne. The Old High German name was *óstarâ*, the plural form being retained, as two days were usually kept at Easter. The association of the hare with eggs is curious, and the explanation is found in the belief that originally the hare seems to have been a bird which the ancient Teutonic goddess Ostara turned into a quadruped. For this reason the hare, in grateful recognition of its former quality as a bird and swift messenger of the Spring Goddess, is able to lay eggs on her festival at Easter time. ‡

The practice of nailing a horseshoe against the lintel of a door is familiar to almost everybody; and it is thought particularly efficacious in warding off bad luck if the shoe be one that was found upon the highway.

Although this custom obtains more extensively among the negroes, it is not of African origin. I am inclined to believe that it originated at a time more remote than the superstitions relating to "thirteen at a table," or "the spilling of salt," both of which are generally conceded to have originated at or with the Lord's Supper and consequent events.

The Romans drove nails into the walls of cottages as an antidote against the plague; for this reason L. Manlius, A. U. C. 390, was named dictator to drive the nail.# In Jerusalem, a rough representation of a hand is marked by the natives on the wall of every house while in building. ‖ The Moors generally, and especially the Arabs of Kairwân, employ the marks on their houses as prophylactics, and similar handprints are found in El Baird, Petra. General Houtum-Schindler, of Teheran, informs me that a similar custom exists in Persia, as well as in parts of northern India.

That these practices and the later use of the horseshoe originated with the rite of the Passover is probable. The blood upon the doorposts and upon the lintel (Exodus, xii, 7) formed, as it were, an arch, and when the horseshoe was subsequently observed as resembling, conventionally, a similar arch, it may naturally have been adopted, and in time become a symbol of luck, or "safety," to those residing under its protection.

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* Quoted by Brand. Observations on Popular Antiquities. London, 1877, pp. 90, 91.

† Ritual of Pope Paul V, for the Use of England, Ireland, and Scotland; quoted by Brand, *op. cit.*, p. 91, note.

‡ Folklore Journal. London, vol. i, 1883, p. 123.

\# Lieutenant Condors. Palestine Exploration Fund, January, 1873, p. 16.

‖ Brand. Antiquities. London, vol. iii, 1882, p. 18.

Beliefs and superstitions relating to snakes are exceedingly common. These reptiles, by their graceful and sinuous movements and the terror of their bite, appear at once to command reverence and awe. The worship of the tree and the serpent was a cult of aborigines of India, the Turanians; and evidences of ophilolatry, or snake worship, appear in other parts of the world. Kneph, the grand serpent of Egypt, is the father of Hephæstus, the god of metals; and Hi, the serpent god of Chaldea, the master of all wisdom, is also guardian of treasures.* In the mythology of several peoples of the Old World the serpent is associated with the guardianship of golden treasures and mines. The god serpent of Greece, Cadmus, was regarded as the first miner, and he was, according to Pliny, the first workman in gold.†

Stories are extant of an exchange of form between human beings and snakes, an interesting example of which was at one time currently reported in South Whitehall, Lehigh County, Pennsylvania. Further reference to this will be made presently.

A very common belief is to the effect that if one kills the first snake met with in the spring, no others will be observed during the remainder of the year. In Swabia, tales are still told of home snakes which appear to bring good luck, but which must under no circumstances be killed. These snakes come to the children and sip milk with them out of their bowls. Tales of this class were common a score of years ago, and I remember hearing of a child eating bread and milk from a saucer, while a huge black snake drank freely from the same dish, but at short intervals the child would playfully tap its spoon upon the snake's head, saying, "Du musht me[n] mŏk'ka fres'sa," to cause it to drink less milk and to eat more of the bread.

Occasionally we hear of black snakes found in pastures where they suckle cows, so that these animals daily resort to certain localities to secure relief from a painful abundance of milk.

Some of these house and farm snakes wear crowns, and are then termed king snakes. Such were reported from several localities in Lehigh County, one of which was said to abide in a large pile of rocks near Macungie. It was seldom, however, that this golden-crowned serpent was seen; still, the greater number of residents thereabout were firm believers in the truth of the report.

As an illustration of the belief in the transformation of human beings into serpents, I will relate a circumstance said to have occurred during the first half of the present century. Near Trexlertown, Lehigh County, dwelt a farmer named Weiler. His wife and three daughters had, by some means or other, incurred the

* Jones. Credulities Past and Present. London, 1880, pp. 120, 121.

† Jones. *Op. cit.*, 121.

enmity of a witch who lived but a short distance away, when the latter, it is supposed, took her revenge in the following manner: Whenever visitors came to the Weiler residence, the girls, without any premonition whatever, would suddenly be changed into snakes, and after crawling back and forth along the top ridge of the wainscoting for several minutes they were restored to their natural form. This curious transformation occurred quite frequently, and the circumstance soon attained widespread notoriety. About the end of the third month the spell was broken and everything went on as before.

Another popular fallacy is the existence of the hoop snake. This creature is usually reported as capable of grasping the tip of its tail with its mouth, and like a hoop running swiftly along in pursuit of an unwelcome intruder. This snake is believed, furthermore, to have upon its tail a short, poisonous horn, like a cock's spur, and that if it should strike any living creature death would result. The stories concerning this marvelous snake usually end with the statement that the person pursued barely escapes, and that the snake strikes a tree instead, causing it to wither and die.

The rattlesnake, because of its venomous bite, is universally dreaded, and numerous curious beliefs are current respecting this reptile, also the use to which various parts may be put, and the treatment of its bite.

The rattle, if tied to a string and suspended from the neck of an infant, will serve to prevent convulsions; if carried by an adult, it will guard against rheumatism. The oil is employed as a remedy for deafness; and the venom, diluted, mixed with bread, and made into pills, has been administered internally to cure rheumatism. Another curious superstition, held by young men, is that if one places a snake's tongue upon the palm of his hand—beneath the glove—it will cause any girl, regardless of her previous indifference, to ardently return his passion if he be enabled but once to take her hand within his own. This resembles to a certain extent the former use, in Germany, of a dove's tongue, which was similarly employed; and furthermore, if one became aware that the choice of his heart failed to respond to his affection, he had only to place a dove's tongue within his mouth and snatch a kiss, when the girl's objection or indifference to him would instantly vanish.

There are numerous popular methods of treating snake bites, from the internal use of alcoholic liquors to the external application of warm, raw flesh obtained by cutting a live chicken in two.

I ascertained a short time since the secret of alleged success claimed by various mountain powwows both in Pennsylvania and in Maryland. The remedy is termed the *Meisterwurzel*, or "master root," commonly known as the *sanicle*, or *Sanicula marylandica.* The roots of the plant are crushed, one part being made into a poultice and applied to the wound, while the remainder is boiled in milk, which is freely administered internally.

The following procedure was formerly practiced in northern Lehigh County, and obtains even at this day in Cumberland County. The operator recites the following words:

> Gott hott alles ärshaffa, und alles wâr gūt;
> Als dū alle^{n}', shlañg, bisht ferflucht,
> Ferflucht solsht du sai^{n} und dai^{n} gift.
>
> God created everything, and it was good,
> Except thou alone, snake, art cursed;
> Cursed shalt thou be and thy poison.

The speaker then with the extended index finger makes the sign of the cross three times over the wound, each time pronouncing the word *tsing*.

In connection with the extraction of serpent venom may be mentioned the use of the snake stone or mad stone, the latter without doubt having originally been employed in snake bites.

The earliest notice of stones used in extracting or expelling poisons occurs about the middle of the thirteenth century, though the knowledge of them and their use by the superstitions of Asia Minor appears to antedate that period. They are called bezoar stones, from the Persian *pad-zahr*, signifying to expel poison. This substance is a calculus or concretion found in the intestines of the wild goat of northern India known as the *pazan*. Various other ruminants also possess similar concretions, but the Oriental variety seems always to have been the more highly prized and entered largely into various therapeutic remedies two centuries ago.

In addition to the fact that the fable of poison-extracting stones may be traced back to the middle ages, and that they had been used long anterior to that time in Asia Minor, it is more than probable that a knowledge of their reputed properties and possibly specimens were brought back to Europe by crusaders on their return from the Holy Land.

Several objects found in 1863 at Florence, on the site of the old church of the Templars, dedicated to St. Paul, may be briefly noticed. One of these was a vase and another a medal. Among other figures upon the vase is one of St. Paul bitten by a serpent, and the Latin inscription signifying, "In the name of St. Paul, and by this stone, thou shalt drive out poison." On the other side is engraved in relief the cross of the temple between a sword and a serpent. On the medal is represented a dragon with an Italian legend signifying, "The grace of St. Paul is proof against any poison."

That St. Paul is the one appealed to in the above instances may be attributed to the fact that he was not affected by the bite of a serpent when almost instant death was the result expected by his associates (Acts, xxviii, 3–6).

It would appear that the Old-World custom of employing calculi or stones for the extraction of serpent venom gradually led to the practice in modern times of applying similar substances to wounds made by the bite of rabid dogs. These calculi are of a cretaceous or chalky nature, and anything of a cretaceous character may, if dry, possess absorbent properties; and it is probable that to this property may be attributed the first employment of the Oriental bezoar stones as capable of extracting or expelling poisons.

The prescription for the use of the so-called mad stone is generally as follows: Place it against the wound until it becomes saturated with the poison, when it will of its own accord fall off. Then boil it in milk to remove the poison, and repeat the application until the stone refuses to adhere.

A short time since I examined a celebrated North Carolina mad stone, one that had widespread reputation. This stone was of the size and form of an ordinary horse-chestnut, white in color, and consisted of feldspar, a hard mineral usually found in granite. It possessed no absorbent properties whatever, and its reputed ability to extract poison or any other liquid was utterly unworthy of a second thought.

We are all familiar with the frequently circulated reports of the cures performed by mad stones, reports pretending to emanate from reputable physicians and others, but when we attempt to trace the source from which they emanate they are found to be of questionable authority.

To illustrate the esteem in which these substances are held, I will only add that in 1879 a mad stone was sold to a druggist in Texas for two hundred and fifty dollars. The specimen was found in the stomach of a deer.*

It may be of interest to refer to a famous specimen, known as the "Lee" stone or penny,† which consisted of a small, heart-shaped pebble of carnelian or agate, set in a silver coin about one inch in diameter. The specimen was traditionally asserted to have been brought from the Holy Land, and it is said to have suggested to Sir Walter Scott the design of his Talisman. According to the legend, Robert Bruce wished that after his death his heart should be carried to the Holy Land by Sir James Douglas; and in 1329 the latter, accompanied by Simon Lochart, of the Lee, proceeded on the mission. In Spain the Scots were

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* Journal of Chemistry, Boston, 1879.

† Jones. *Op. cit.*, p. 330.

drawn into a combat with the Moors. Douglas was killed, and Lochart, who now commanded the party, turned homeward with Bruce's heart, which was eventually buried in the Abbey of Dunfermline. Lochart (changing his name into Lockhart, to commemorate the event) had taken prisoner a Moorish chieftain, and the wife of the prisoner when she bargained for the husband's ransom, while counting the gold from her purse, let drop this gem, and appeared so anxious to recover it that Lockhart insisted upon its being made a part of the ransom. The woman unwillingly consented, and informed the greedy Scot that its value consisted in its power of healing cattle, and that it was also a sovereign remedy against the bite of a mad dog. So great was the popular faith in this talisman in Scotland that the Lee penny was exempted from anathema in the clerical war against superstitions after the Reformation, and the clergy went so far as to extol its virtues, in which implicit faith was placed until a comparatively recent period. The mode of using this amulet was to hold it by the chain, and then plunge it three times in water, and once round—*three dips and a swell*, as the country people expressed it; the cattle drinking the water were cured. In the reign of Charles I, the people of Newcastle being afflicted with the plague, sent for and obtained the loan of the Lee penny, leaving the sum of six thousand pounds sterling in its place as a pledge. For this sum the Laird of Lee, the owner, would not part with it. It is reported also that about the beginning of the last century Lady Baird, of Saughton Hall, having been bitten by a mad dog, and exhibiting all the symptoms of hydrophobia, her husband obtained a loan of the amulet, and she having drunk and bathed in the water in which it was immersed, was cured of her malady.

Many other interesting examples of superstitious practices might be given, some of which have been handed down from remote antiquity, while others are of comparatively modern date and probably the result of circumstances and environment. The use of the staff and rod in divination was known to the ancient Jews, and Hosea reproached them for adhering to the superstition. Tacitus mentions this sort of divination as a custom of the ancient Germans.

We are all aware of the frequency with which the divining rod is used in the search for water, ores, and hidden treasure; and we learn occasionally of certain individuals claiming to possess the power of curing sickness and healing wounds by the mere laying-on of hands; of exorcising evil spirits, and combating the spells of rival witches; laying ghosts and giving charms and amulets, and pretending, in fact, to be able to accomplish almost anything that may be desired.

Who has not heard of carrying a potato, or a horse-chestnut, to ward off rheumatism; having secreted somewhere about the person the left hind foot of a graveyard rabbit for luck; or placing within the purse the dried heart of a bat for success in gambling?

Many mothers believe that amber beads possess signal properties in curing their children of sore eyes, ears, or throat; while the flannel band to be worn about the neck to cure tonsilitis or an inflamed throat must be red, as that color corresponds to the color of the malady. In like manner the carrot is held in esteem in the cure of jaundice, yellow being the characteristic color of both. The carrot is suspended in the room occupied by the sufferer, and as the root shrivels and dries up the affection is removed. Warts, it is believed, may be removed by rubbing upon them a piece of meat which is then buried; as the meat decays the warts go away. They may also be transferred to another by rubbing upon them a piece of bone, and putting this upon the spot where found; whoever picks up the bone will have the warts transferred to his own hands.

We are all more or less uncomfortably impressed at hearing unaccountable noises; many persons dread going upon a journey or cutting out a garment on Friday. Thus we perceive that the mere reference to the trifles which are apt to control our actions brings to our minds such a startling array of superstitions, observed by us in others, or perhaps even entertained by ourselves, that it becomes impracticable to continue further entering so prolific a subject at this moment.

I may say, in conclusion, that it is only by exposing such fallacies that we can hope for their extinction; but this is no easy matter, remembering the axiom that "there is no truth, however pure and sacred, upon which falsehood can not fasten and ingraft itself therein."

The birth of a child among the Bondei people of Africa is attended, according to the account of the Rev. G. Dale, missionary, by many great perils, for if a single condition regarded as unfavorable occurs, the infant is strangled at once. Its life is in danger again at the time of teething, for it may be so incautious as to let its upper teeth protrude first, and if this is the case it is held unlucky, and will almost certainly be killed. Even if it is allowed to live it will be in perpetual danger, and any disaster that happens to its parents will be attributed to it. If, however, the under teeth protrude first, the child's moral character is established. The boy can not, however, enter the house in which the unmarried men sleep till he has been publicly welcomed. For this ceremony all the boys and girls assemble, and the father brings the child out to show them that the lower teeth have protruded first. Then every house contributes Indian corn, and the children pound and eat it, after which the boy is regarded as one of them.

SCIENCE IN WHEAT-GROWING.

By M. P. P. DEHÉRAIN.

THE chlorophyll cells and the leaves of the plant may be regarded as little laboratories elaborating vegetable matter; they work upon the carbonic acid, which the enormous quantity of water they contain enables them to extract from the atmosphere, reduce it, and form with the residue from its decomposition, after the elimination of oxygen, sugars and cellulose, straw-gum, vasculose, and all the ternary matters composed of carbon, oxygen, and hydrogen; these cells likewise reduce the nitrates which are brought to them at the same time with phosphoric acid, potash, and silica, by the water which constantly traverses the plant, entering it at the root and being exhaled from the leaves.

If rain is frequent and the soil well moistened, the cells will continue their work for a long time; they will elaborate much vegetable matter, and the plant will grow. But the course is not the same if rain is scarce and the soil is parsimonious in providing for the enormous expenditure of water which the wheat makes. I have found that a leaf of wheat exhales, under one hour of insolation, a weight of water equal to its own. When the earth, insufficiently watered by rain, becomes incapable of supplying this prodigious consumption, desiccation of the organs is produced, and it is always the oldest leaves which dry up and perish first. A May rarely passes without one seeing the little leaves fixed at the base of the stem soft, flabby, and withered. If we submit them to analysis, we find that they have let escape some nitrogenized matter, phosphoric acid, and potash, which they contained while they were living, green, and turgescent. It is well to lay stress upon this death of the leaves, and on the departure of the materials they contain; when the leaf dies, one of the small agglomerations of working cells is closed, the quantity of matter elaborated is then less than if it had continued its task, and as the closure of these little laboratories is determined by their desiccation, we conclude that the quantity of vegetable matter formed during dry years is limited, and that the stems are shortened and there is little straw.

At the moment when desiccation begins the nitrogenized matter which forms the protoplasm, the living part of the cell, is metamorphosed, and takes an itinerant property that permits it to pass through the membranes and migrate toward the new leaves, carrying with it its usual accompaniment of phosphoric acid and potash. This transportation of some of the elaborated material from the lower leaves toward the upper leaves goes on through the whole duration of vegetation, and continues at the time of flowering, which, without doubt, by a mechanism of which we do not know the method of operation, takes place only when the quantity of materials elaborated is sufficient to nourish the seeds which are about to appear.

The wheat begins to head, in our latitude, early in June. On pressing lightly between the fingers the upper part of the stem, at the place where it appears a little swollen, we meet a slight resistance, due to the head, which is entirely formed before it emerges. It is composed of a stem; the rhachis, which bears the flowers, formed of little green leaflets; and the glumes, one of which terminates, in some varieties, in the long appendage characteristic of bearded wheat. If, at the moment when the head emerges outside of the stem, we gently lay open the glumes, we shall discover the essential organs of the flower within. On a little greenish swelling, the rudiment of the corn, are fixed two little aigrettes of plumes, slightly divergent. These are the pistils, the female organs. Around them, fixed at the extremity of fine peduncles, are the anthers, as yet closed. They contain the pollen, the yellow fecundating dust. At the moment of maturity the anthers open and the pollen falls on the little plumes of pistils, well constructed to hold it. It germinates there, sends out a long tube—the pollinical branch—into the ovule, to which the plumous pistils are attached. Fecundation is accomplished, and the corn is formed.

All these delicate operations, which it is so interesting to follow, take place in the formed flower. When the stamens, emerging between the glumelles, appear without, or, to use the common expression, the wheat is in flower, everything is really done. So, when we try to create hybrids—that is, new varieties—endowed with qualities wanting in one of the parents, we must take the anthers from the flowers before the plumes are open and the anthers have shed their pollen.

The operation exacts much care. When the flower is half opened, we cut off the anthers it contains and drop in the pollen of the variety which we have chosen to give the one we operated upon the qualities which it lacks. One of the most widely distributed varieties around Paris, the Dattel, was created in this way by M. H. de Vilmerin by fecundating the pistils of the English Chiddam wheat, which had fine qualities but a short straw, with the pollen of the Prince Albert wheat. The operation was perfectly successful; the straw of the Dattel is thicker and longer by at least five inches than that of the Chiddam, from which it is derived. The variety is quite fixed; it reproduces itself with well-defined characteristics; and the experiment has now been of long enough duration to make it certain that the seed sown is not derived from plants reverting to the parental characteristics, as sometimes happens in imperfectly fixed hybrids.

When flowering takes place in good weather, fecundation goes on regularly, and the chances increase of obtaining a good crop. These chances, on the contrary, diminish when the earing occurs in a rainy time. Probably water gets within the involucre, and the wet pistils imperfectly retain the pollen grains, or their germination is irregular, the pollinic branch not reaching the micropyle, and the ovules not being fecundated; and the ears bear many sterile flowers in which the corn is not formed.

The production of the corn, of the seed which assures the perpetuity of the species, is the ultimate end of the herbaceous plant; it is essential that the reserve stores necessary for its development be accumulated around the embryo inclosed in this seed, and that it find everything near by: the starch which it will liquefy and then transform into cellulose; the gluten, the nitrogenized matter, with which it will form the protoplasm of its cells. These reserves must be abundant, so that a part of them may be burned, producing by their slow combustion the heat which favors these transformations. The whole life of the herbaceous plant tends toward this end of accumulating in the seeds the principles elaborated during its short existence; and it is precisely this accumulation in the seed of the glüten and the starch, both excellent food-stuffs, for which men have cultivated wheat from the most remote antiquity; or, if they live in different climates from ours, sow other corn plants—rice in the extreme East, maize in America—in order to find in their seeds the association of nitrogenized matter and starch which gives the grain so pronounced an alimentary value that it forms an essential part of the food of a large proportion of the inhabitants of the globe.

It is easy to follow the migration of the nitrogenized matter, phosphorus, and potash from the lower to the upper leaves, and from these to the end of the stem and the seed. The transportation of these principles has been studied for more than thirty years by a distinguished agronomist, Isidore Pierre, professor in the Faculty of Sciences at Caen. We are less well informed concerning the formation of starch. It can not be seen accumulating in the leaves of wheat as in those of a large number of other species, nor are reserves of saccharine matters found in these leaves. The formation of starch is very late, as it does not take place till during the last stage of vegetation. It thus happens that the quantities of starch contained in the grain vary greatly from one year to another.

The phenomenon of transportation and migration of nitrogenous substances from the leaves and the stem to the grain and the later production of starch takes place only when the plant conserves a considerable quantity of water. If the radiations of a burning sun strike upon a field of wheat the roots of which find nothing to drink in a dry soil, the plant dries up, everything stops, and the last phase of the life of the wheat is abruptly terminated; the grains remain empty, and the crop fails.

Persistent rain is no less to be feared. The wheat continues to grow indefinitely, and the migration of the principles is not brought about. I witnessed a very curious example of this in England twenty years ago. I was visiting a farm near London, where cultivation was assisted by irrigation with sewer water. The farm was slightly undulating, and the sewer water was carried over the depressions in troughs sustained a few yards above by wooden supports. One of these troughs, being in bad condition, let the liquid fall constantly in a fine rain upon several square yards of a field of wheat. It was July, and, while all the rest of the field was yellow and ready for the harvest, the stools thus watered were still green and continuing to grow, exceeding all their neighbors in height, and giving no signs of maturity.

A mild temperature and a slightly clouded sky are the favorable conditions for a good ripening. When the land has been well dug, the seeding regular, and the manure judiciously distributed, all the individual plants in the field will have expanded together, all will have passed simultaneously through all the phases of their development, and in the warm hours of the day, when all is motionless, the surface of the field, the English say, will appear as horizontal as a table.

There are no great inconveniences in harvesting a little early. The ripening, if not yet complete, will proceed very well when the sheaves are stood up against one another into those "shocks" which are much in use where severe rains are common. On the other hand, there is much advantage in not leaving the wheat standing after it has ripened. Every plant that has matured its seed tends to shed it, and sometimes the seed has powerful organs of dissemination. This is not the case with wheat; but, although it does not fly off to a distance, it escapes from overripe heads, falls, and is lost. Further, all the organs of plants respire by the aid of the oxygen of the air consuming some of their principles. In the seed the combustion chiefly affects the starch, and a crop which remains standing long diminishes in weight both by the loss of the seeds that fall and by the slow combustion which continues as long as desiccation is not produced. As soon as a field of wheat is ripe it should, therefore, be harvested, and here is where the reapers, that have been brought to such great perfection in America and England, are found to be very useful in making the farmer independent of the scarcity or the exactions of laborers.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

EVOLUTION OF INSECT INSTINCT.

By M. CH. PERTON.

I WAS a witness in 1887 of a combat between a halictus bee and its sphœcode parasite, a "cuckoo bee," which took place in the open air, outside of the nest. The nests of the *Halictus malachurus* (Kirby), which are found excavated in the compact soil of garden walks, are narrower at the entrance than below, and here the sentinel bee closes access with its head.

The sphœcode, *Sphœcodus hispanicus* (Wesmäel), twice as large as its victims, had to enlarge this entrance to effect its passage. I saw it cut up the sentinel, whose quarters came out with the digging. Very near, a halictus was assisting a dying sister whose pollen-loaded feet were still moving. She had without doubt been killed by the sphœcode. Another harvester still survived, and attacked the parasite, biting its legs and wings. The bandit, obliged to stop its task frequently, established itself near the nest and tried to seize the enemy with its sharp mandibles. The halictus at last threw itself upon him, and the two were locked in combat. In an instant the halictus was no more.

The sphœcode labored for nearly four hours to open a passage, and would perhaps have succeeded if I had not judged it prudent to capture it. It had worked till dark without having advanced more than an eighth of an inch.

Besides the deductions which other authors have drawn from the observation of insects under similar conditions to these, I found a no less important feature toward the study of instinct in the apparent development at the same time with sociability of a courage which impels the individual to devotion of itself to the common cause. The persistent struggle which my halictus maintained is, I believe, unexampled in the annals of other *Hymenoptera* than ants, wasps, honeybees, and bumblebees. It was not a rush of a moment upon the thief, or a struggle in a narrow corridor where escape was impossible after the fight had begun; but it was a foot-to-foot battle that lasted nearly a quarter of an hour, in the open field, where the halictus could run away at any moment. The assault was made vigorously, of determined purpose, the contestants fighting in close embrace, and ended in the death of one of them.

We remark that this devotion to the public weal is like society in its beginning. It is less developed here than among the wasps and the honeybees. Near the one who died so bravely on the field of honor, I saw a new halictus alight in front of the enemy at the first attack to go take care of the dying. Honeybees do not hesitate when their city is to be defended, and bumblebees, Hoffer says, often precipitate themselves upon the man who is destroying their nest; but their civilization, if I may use the word, is much more advanced than that of the halictus. Courage and abnegation are therefore not only the appanage of mankind or of rich societies of honeybees and ants; they belong to every association—to all those, whether beasts or people, who bind their hearts together in the struggle for existence.

The tenacity of the sphœcodes on the field of battle is not less surprising; it is, so far as I know, the only example of a parasite issuing from the peaceful progeny of the apiaries that gives battle for the acquisition of spoil.

Have we here a species of parasite in course of formation? I do not know. There is a great distance between the sphœcode and the halictus. The variation of the genus or species sphœcodes is very great, it is true; but that of the bumblebees is of the same order, and there are fossil bumble bees. The hazardous life of the parasite should teach us reserve concerning the cause of its variations.

I believe we may observe a nascent parasitism in another family of *Hymenoptera*. I mean among those insects which honestly gain life for their young most of the time, but which also do not disdain to rob a neighbor, to play the parasite, and that not fortuitously, but almost every time an occasion presents itself. I have found such insects in the spider-killing family of the *Pompilidæ*.

The pompiledes are those little black wasps, with a somewhat party-colored abdomen, which may be seen lingering on sunny talus or walls, with their antennæ and wings in febrile vibration. Those that I have observed in France and Algeria chase spiders. They pursue them, keeping in touch with the ground like a dog following game. The manner of attack varies with the species of the hunters. Nearly all those that I have seen light directly upon the enemy, which rolls over, and stab it. The spider is generally put in a safe place on top of a tuft or a stone, while the pompilus digs a hole in which it deposits the anæsthetized head, after gluing its egg upon the abdomen. The pompilides are not all diggers—some choose or prepare the most singular places for their progeny; but the general rule is as I have described it.

My observations have been made chiefly upon the *Pompilus viaticus* (Latreille) and on the *Pompilus rufipes* (Vanderlinden).

If we throw a spider that has been stung by a fellow-wasp at one of these, it will nearly always be taken without hesitation, and will often be stung again. The depositing and the laying of the egg are done as if by habit; and I may add that the hunter is not dainty as to the freshness of his game. I have seen spiders of eight days' standing accepted, and have repeated the experiment so often that I can not suppose that the fact is accidental. It is not a case of one opening a cell to deposit an egg because its own has been stolen, or of digging into the partitions at the end of its labors; but what I relate happens almost regularly whenever occasion offers. It may be said that the insect is obliged to deposit its egg. Perhaps, but the necessity for ovipositing is singularly elastic with my pompili, and is associated with the faculty they have of stealing the game of their neighbor.

A *Pompilus viaticus* has just drawn its spider into the cell. It has deposited its egg and stopped up its hole. I offer it a new spider, killed; it is not the time for ovipositing, but the victim is accepted and placed carefully by the side of the nest, the closing of which is arrested. A new cell is dug out, the booty is drawn into it, and receives an egg in its turn.

I have often repeated this experiment with *Pompilus viaticus* and *pectinipes*. I broke open the half-closed nest, and unfastened the egg, and I have several times seen the spider taken up, carried a little farther on, and the ovipositing begun again.

So far I have told of experiments; now I come to pure observation. Let us go at the beginning of September into a warm gravelly quarry. We see many hymenoptera there, but the pompilides dominate. They have chosen the most agreeable quarter, the most sunny one in the city. Those which I observed were the *Pompilus rufipes*. They are a colony of crafty fellows, constantly in motion, ferreting everywhere, sometimes on the quest for a neighbor's spider, going into the holes which they find to their taste to drive the proprietors from them. When they have succeeded in stealing, they bury their spoil, if some other thief does not interfere, and deposit an egg upon it. These thefts are often the occasion of lively combats. I chanced to see two of the largest of the band disputing over a spider. Hunters and victim rolled like a ball along the gravel for four or five yards. The contestants, which had not let go, tugged at their prey like dogs wrangling over a bone. After a few minutes the beaten one—generally the less corpulent—gave up the struggle. The species, however, is not parasitic. The spider is in the beginning the legitimate prey of one of the two, and I have, besides, seen them hunting and ovipositing honestly in the same quarry.

Not only in the capture of the prey, but in the choice of the nest, too, a very great adaptation of instinct to conditions exists among the pompilides. They turn everything to profit.

Taschenberg* says that the *Pogonius* nest in the sand. I have found *Pogonius bifasciatus* nesting in a hedge at Châtellerault in abandoned snail shells. Some shells contained as many as three cocoons. This year, at Algiers, I found bulimus containing cocoons which have not hatched at this writing, but which strongly resemble the cocoons of my pogonius. If Taschenberg has not made a mistake, the insect is a digger that does not always dig. I have long observed a little pompilus at Châtellerault which I have not been able to identify. I have seen it nesting almost everywhere—in snail shells, in the rotten mortar of old walls, and in worm-eaten wood, digging when it had no other way. One day it even had the audacity, while we were at lunch, to bring its spider to my sister's hair.

We are therefore, it seems to me, contemplating an eminently variable instinct, which, joined to the tendencies to parasitism of which I have just spoken, suggests that a parasitical branch may be even now detaching itself from the pompilus type.

The pompilides, or some among them, have possibly been showing these tendencies for many centuries. The walks of the garden near Algiers are crowded in October with small spiders which pass the day hidden in holes closed by a stone or a clod. I have observed that a little *Salius* knew very well how to open this retreat, go in, and kill the inmate. Prof. Pérez, in his contributions to the apian fauna of France, has studied the parasites of bees in a masterly manner, but he has almost omitted the study of instinct in the formation of parasitism. I have no more than suggested the question, but I believe we might easily give an acceptable answer to it with the help of the pompilides. If we succeed in this, we shall perhaps have answered the challenge sent out in his Souvenirs by the entomologist of Sérignan: "Let them show me a species in the course of transformation."—*Translated for the Popular Science Monthly from the Revue Scientifique.*

A curious experiment is recorded in *La Nature* by M. F. Crestin, in which, by the application of a magnet, he extracted a needle from a woman's hand, in which it had been imbedded two months. The hand was placed upon one of the poles of an electro-magnet, and a current giving an attractive force of three grammes was applied for about two hours at a time. After nine sittings, or about twenty hours of magnetic action, the needle, with the point broken off, came out and adhered to the magnet, the whole operation having been performed without pain or loss of blood.

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* *Die Hymenoptera Deutschland*, etc.

"DEAF AND DUMB."

By MABEL ELLERY ADAMS.

THE average man has no idea of the real meaning of the common adjective phrase "deaf and dumb." He occasionally sees a group in some public place conversing by means of signs or the manual alphabet, and he says to himself, "Deaf and dumb." Less often he comes in contact with an orally taught deaf person, and either talks with him or hears others talk with him, and goes away and says: "I met a deaf and dumb man to-day and heard him talk; it's wonderful, wonderful!" quite unconscious meantime that his way of expressing what he saw is also wonderful.

Sometimes this same average man hears that a friend's child has been born deaf, and if he is a little conservative he says: "Oh, well, the child can be educated at the Deaf and Dumb Asylum; they teach them everything there. Many deaf and dumb people are able to make a good living nowadays." If, however, our average man is fully up to the times, he says: "Oh, the child can be taught to talk just like other folks; they have got a way of teaching the deaf and dumb children to speak and to understand other people by looking at the motions of the lips; so they get along just about as well as though they could hear."

All this is very crude, no doubt, but it is safe to say that nine out of every ten people in ordinary life, whom circumstances have never brought in contact with the deaf, have very much the same ideas. To be deaf is to be unable to hear, and to be dumb is to be unable to talk. The lack of hearing is remedied by teaching the child to use his eyes and understand either signs or the motions of the lips, and the lack of speech is remedied by teaching the child to use his vocal organs or his hands to make others understand, and behold! the task is accomplished, and he is "just like other folks." Not one thought is given to language, to the wonderful medium of exchange by means of which the business of life is carried on, that is supposed to come by Nature, or instinct, or miracle, but never by teaching. A cultured lady, a literary woman, said to me once, after seeing some deaf children and hearing them go through certain vocal exercises which included every elementary sound in the English language: "Now, if these children can make all these sounds correctly, why don't they go right on and *talk?* What hinders them?" She was a bright woman, and when a very short explanation had been given her, the reason flashed upon her, and she said: "Why, what a fool I am! I see, they've got something to say, and the mechanical ability to say it, but no language to say it in," and in that one sentence she expressed the reason for being of all the institutions and schools for the deaf in the country. "No language to say it in," that expresses the condition of a deaf child's mind before he is taught very well, but perhaps "and no language to *think* it in" should be added. Let the reader try for himself and see how much consecutive thought he can accomplish without words; and if, with his mind trained by years of intelligent thinking, he can do little until the words come, let him imagine, if he can, the state of a mind cut off from language.

By way of example, let us take the seemingly simple fact of similarity or likeness between two objects. Your three-year-old baby says, "I want a woolly baa-lamb like that one," or "Dose two kitties is dust alike," or "Mamma, you didn't give me the same as brother"—all expressions of the same idea of likeness. Now, an ordinary deaf child is eight or nine years old before he has acquired language enough to express either in speech or writing what the baby just learning to talk has said so easily—namely, the idea of similarity. Not but what he *knows* the things are similar; in this case it is simply the language that is wanting.

Language is a growth. A hearing child begins to absorb language from the very day of his birth. When he gets to be thirteen or fourteen months old, sometimes when he is younger, he begins to give back a word or two of the thousands of words which have been given to him over and over again every waking hour since he was born. It must be remembered that words spoken in a child's hearing are just as much given to him as words spoken directly to him. From the single words with which a baby begins he goes on to phrases and sentences, constantly learning to use more words or to use already familiar words in new ways, until at seven or eight or nine he is able to talk about common things just as intelligently as do his father and mother. In other words, he has *learned* to talk. His language has grown with his growth, nourished by the daily gifts of those about him, unconsciously given and unconsciously received, no doubt, but none the less contributing their share toward the future structure—i. e., the ordinary vocabulary of man.

Now let us see how the deaf child fares during these impressible years while his hearing brother is absorbing so much. He sees just as much as do the people around him, but it is all unexplained. If you were set down suddenly in utterly strange surroundings, you would be dazed until some explanation was made to you, but the deaf child must go without explanation for years. Life is one long pantomime to him until he goes to school, and the pantomime often means one thing to the person who uses it and another to the person who sees it. While the hearing child is acquiring the language of home, of play, of the street, of time and place and weather, of buying and selling, loving and praying, the deaf child is gaining only crude ideas of all these subjects.

Let me illustrate, if I can. Take the matter of buying and selling, for instance. A hearing child wants to go to the store and buy five cents' worth of candy. Think how much language he uses in talking about it! He says: "Mother, I want five cents to go to the store and buy some candy. Will you give me five cents? May I go to the store? Please let me go. If I am good, may I go?" When he gets to the store he says: "I will have one stick of that, and one stick of that, and a cent's worth of this," etc., and when he comes out he says: "I bought some candy. I like to trade at that store. The woman gives good measure"; and when asked, "Who sold it to you?" he says, "Oh, the woman herself." Now look back, if you please, and observe the amount of language used in connection with this one very simple transaction. See the different moods and tenses, and the different constructions introduced. If an uneducated deaf child wanted to go to the store and buy some candy, he would hold up five fingers to his mother, put his hand to his mouth to indicate candy, and then make some sign for store, perhaps a gesture to represent the act of paying; and after he had been to the store and bought his candy, he would go through just the same pantomime to indicate the finished action as he used to indicate his unaccomplished wish, for he can not distinguish between time past and time to come by natural pantomime.

If this illustration seems tedious in its details, it must be pardoned, for its object is to make the average man see the great gulf which exists between the deaf child who knows how to buy some candy and the hearing child who knows how to buy it and talk about it, to express his desire for it, and to relate the facts concerning the purchase. There is but one bridge for this gulf, the bridge of language, and all the teachers of the deaf in this or any other country are at work building this bridge. They differ in their tools and in their methods of building, but their aim is always the same. Language, be it spoken or written, is what the deaf child must have if he is to understand the world about him as his hearing brother understands it, and all the discussion of the educators of the deaf to-day is as to how it can best be given to him.

The builders who have this task to accomplish work in two ways. Some—and they are among the oldest and the wisest of the master builders—lay their foundation and make the base of their structure of a material different from the bridge itself, while others use but one material from deepest-driven pile to topmost guard-rail. Each party of workers claims that its structure is the stronger and furnishes an easier highway whereby the deaf may pass from the isolation of their wordless state to companionship with the hearing, speaking world.

Is the figure too complicated? A large number of the teachers of the deaf either teach, or allow the children to acquire from their schoolmates, a language of conventional signs. This language has a grammar and construction of its own, and an order differing from that of the English language; it is very comprehensive and flexible, and by means of it deaf children soon begin to enlarge their mental horizon. They find it tolerably easy to acquire, too, because many of the simpler signs are almost identical with the natural signs which they have learned or invented at home. By means of this sign language these teachers of the deaf impart ideas to their pupils, and these ideas they put into English, written English usually, and then spelled English (English spelled by the fingers), teaching the pupils to reproduce the English. To the children who show an aptitude for it they teach spoken English as well, and a comprehension of the spoken English of others, known as lip-reading. The deaf so taught usually converse among themselves by means of signs, and also use the sign language with such hearing persons as understand it. With such as do not understand signs they use the manual alphabet or writing, unless they are able to use speech intelligibly. The less intelligent think in signs; the more intelligent think in either written or spelled English, and, where they use speech, mentally translate. The method thus roughly outlined is known as the combined method. Nearly all the large institutions in the country use the combined method. The amount of speech, however, which is "combined" with the signs and written and spelled English varies greatly in the different States.

Two or three institutions, several day schools, some private schools, and many private teachers use another method, which differs radically from the one imperfectly described above. This method is the oral, or pure oral. Every child who enters an oral school is taught by speech, supplemented by writing. The sounds which make up the English language are taught to him—sometimes separately, sometimes in short words. He is made conscious of his own voice by feeling the vibration which it produces at the throat, under the chin, or at the point of the chin. His attention is called to the mouths of those about him moving in the motions of articulate speech on the first day of his school life, and, from that day until the last, he sees his teachers use only, as a method of communication with each other or the pupils, the English language, in either its spoken or written form. An atmosphere of English is created about him, and, as his vocabulary grows, he shapes his thoughts by means of words. His range of thought as he grows older is widened by means of the ordinary studies of the ordinary schools—stories, geography, history, physiology, biography, etc. What he does not understand is explained to him by means of what he does understand; simple language is used to make complex language more clear; but whatever is done is done by means of language, either spoken or written, so that what he writes or speaks is his own thought unhindered by mental translation.

There are cases which both these methods fail to teach, very moderate successes under both methods, and, besides, some very brilliant examples of highly educated, cultured, deaf ladies and gentlemen who have so far mastered the difficulties which beset them that they are able to take their places in life almost as though one sense were not lacking. The representatives of this last class who are personally known to me were all but one educated by the oral method. This one exception is a very warm advocate of the oral method, in spite of the fact that he was educated under the combined system.

The large number of average cases—the deaf people who are neither brilliant scholars nor apparent failures—are generally advocates of the system under which they were educated. The combined-method pupil claims that he enjoys life better because he has his signs by means of which he can take pleasure in the company of his deaf friends, and the oral-method pupil claims that with his speech and lip-reading he can accommodate himself to his environment in the speaking world; and that, if his speech is not understood, his written English is just as good as his brother's of the combined method.

And so it goes. Each thinks his own way the best.

A WRITER in Blackwood's Magazine, on the philosophy of blunders committed by persons under examination, assumes that the questions asked by the examiner are intended to awaken a recollection or to develop a kind of process of reasoning in the candidate. If the reasoning fails at any point or from any cause, a blunder appears in the answer. Some of the blunders cited by the writer, particularly in the scientific examinations, betray great confusion of mind, and are hardly accountable except on the supposition of inexact teaching or too hasty cramming. What did the pupil mean who answered that during summer "the weather is getting gradually warmer, caused by the rotation of the sun"; or that one who said that "the Tropic of Cancer is the meridian which passes round the earth midway between the equator and the Tropic of Capricorn"? Various pupils answered questions about the tides by saying that they were "caused by evaporation," "by prevailing winds," "by different oceans meeting each other," "by the undercurrents meeting," "by the waves of the Atlantic pushing the surface waters westward," or other phrases, all betraying a confused recollection of some of the words they have read in the text-books, without the most remote conception of their meaning or their relation to the subject. Such obvious illustrations of the faults of defective teaching bear their own comments.

SKETCH OF WILLIAM C. REDFIELD.

THE life of WILLIAM C. REDFIELD, said Prof. Denison Olmsted, in a memorial address delivered at the time of his death, "affords an interesting and instructive theme for contemplation in a threefold point of view—as affording a marked example of the successful pursuit of knowledge under difficulties, as happily illustrating the union in the same individual of the man of science with the man of business, and as exhibiting a philosopher whose researches have extended the boundaries of knowledge and greatly augmented the sum of human happiness."

Mr. Redfield was born near Middletown, Conn., March 26, 1789, and died in New York city, February 12, 1857. His father followed the seas as a profession from early youth to the time of his death. His early training was therefore derived from his mother. He was given such instruction as the common schools afforded. Having removed to Upper Middletown, now Cromwell, he was apprenticed to a saddler. He gave all the time he could afford, which was only a part of his evenings, to study, preferably of science, having most of the time only the light of the wood fire to read by. But before he was twenty-one years old "he had acquired no ordinary amount and variety of useful knowledge." With other young men of the village he formed a debating society, which was called the "Friendly Association," and which collected a library. Dr. William Tully having settled in the village, young Redfield applied to him for the loan of some books, and engaged his interest. No particular book was asked for, and the cases were opened for him to choose. He selected Sir Humphry Davy's Elements of Chemistry.

His mother removed to Ohio during his apprenticeship, and in 1810 he set out to visit her, going, with two companions, on foot. He regularly took notes of what he observed and experienced in a tramp through the country of western New York and northern Ohio, which was then very primitive; returning in the spring, again on foot, he took a more southerly route. His notes were afterward turned to good account in making the sketches of the railroads he projected. After this journey he engaged in business in Middletown, following his trade and keeping a small country store. He assumed the initial C. when he had come of age. In 1827 he removed to New York city.

A violent storm had swept the Eastern States, September 3, 1821, which became memorable as the "Great September Gale." Shortly after it occurred Mr. Redfield traveled through a part of the region over which it had passed, and was surprised to observe that in one part of his route the trees lay with their heads pointing toward the northwest, and in another part in the opposite direction or toward the southeast, and to learn that while the wind had been blowing violently from the southeast at Middletown, it had been blowing just as violently less than seventy miles away from the northwest. These facts and his reflections upon them led him to certain conclusions which business engagements prevented his developing at the time, but which he published, fortified by the citation of numerous observations and with illustrations drawn from other storms, in an article in the American Journal of Science for January, 1832, on The Prevailing Storms of the Atlantic Coast. His conclusions were, in short, that the storm was a great advancing whirlwind, and that tornadoes generally revolve on an axis of rotation and move with the main currents, exhibiting, consequently, retrograde motion on one side of the axis and progressive motion on the other side. In a subsequent article in the same journal he discussed the hurricane of August, 1831, as illustrating the position that storms and hurricanes are gyratory in action, and move with the general current of the region in which they occur. These views are now in the main accepted facts in meteorology.

Prof. Olmsted gives, in his memorial address, a very interesting account of the way the first article came to be published. In it we have a picture of the man Redfield. "I chanced at this period," he says, "to meet him for the first time on board a steamboat on the way from New York to New Haven. A stranger accosted me, and modestly asked leave to make a few inquiries respecting some observations I had recently published in the American Journal of Science on the subject of hailstorms. I was soon made sensible that the humble inquirer was himself a proficient in meteorology. In the course of the conversation he incidentally brought out his theory of the laws of our Atlantic gales, at the same time stating the facts on which his conclusions were founded. This doctrine was quite new to me, but it impressed me so favorably that I urged him to communicate it to the world through the medium of the American Journal of Science. He manifested much diffidence at appearing as an author before the scientific world, professing to be only a practical man, little versed in scientific discussions, and unaccustomed to write for the press. At length, however, he said he would commit his thoughts to paper and send them to me on condition that I would revise the manuscript and superintend the press. Accordingly, I received the first of a long series of articles on the law of storms and hastened to procure its insertion in the Journal of Science. Some few of the statements made in the earliest development of his theory he afterward found reason for modifying, but the great features of that theory appear there in bold relief."

Other articles confirming the position first taken followed, among them one on the hurricanes and storms of the West Indies and the coast of the United States, and the uniformity of their general character, in which the storms of the China Sea were shown to be similar to those of the West Indies, and the gyrations in the southern hemisphere to be opposite to those in the northern; one presenting a general view of the atmosphere and its currents, and a classification of storm winds, predicating the identity of whirlwinds and water spouts, and discussing the great aërial currents; and articles on tidal movements, climate as connected with atmospheric and oceanic currents, the Gulf Stream, and polar currents.

The main features of Mr. Redfield's theory of storms, as stated by Prof. Olmsted, are:

"That all violent gales or hurricanes are great whirlwinds, in which the wind blows in circuits around an axis either vertical or inclined; that the winds do not move in horizontal circles, but rather in spirals toward the axis—a descending spiral movement externally and ascending internally.

"That the direction of revolution is always uniform, being from right to left or against the sun on the north side of the equator, and from left to right or with the sun on the south side.

"That the velocity of rotation increases from the margin toward the center of the storm.

"That the whole body of air subjected to this spiral rotation is, at the same time, moving forward in a path at a variable rate, but always with a velocity much less than the velocity of rotation, being at the minimum, hitherto observed, as low as four miles, and at the maximum forty-three miles, but more commonly about thirty miles an hour, while the motion of rotation may be not less than from one hundred to three hundred miles per hour.

"That in storms of a particular region, as the gales of the Atlantic or the typhoons of the China Sea, great uniformity exists in respect to the path pursued; those of the Atlantic, for example, usually issuing from the equatorial regions eastward of the West India Islands, pursuing at first a course toward the northwest as far as the latitude of 30°, and then gradually wheeling to the northeast and following a path nearly parallel to the American coast, to the east of Newfoundland, until they are lost in mid-ocean, the entire path when delineated resembling a parabolic curve whose apex is near the latitude of 30°.

"That their dimensions are sometimes very great, being not less than one thousand miles in diameter, while their path across the ocean can sometimes be traced for three thousand miles.

"That the barometer, at any given place, falls with increasing rapidity as the center of the whirlwind approaches, but rises at a corresponding rate after the center has passed by; and, finally,

"That the phenomena are more uniform in large than in small storms, and more uniform on the ocean than on the land."

"These laws Mr. Redfield claimed as so many facts independent of all hypothesis—as facts deduced from the most rigorous induction, which will ever hold true, whatever views may be entertained respecting the origin and cause of storms."

Mr. Redfield's conclusions were reached after the collection and collation of as many records as possible of observations of the storms investigated, particularly of vessels which had been caught in them, the independent accounts of one storm having been one hundred and sixty-four in number; the charting of them; and the tabulation of the various data of them.

The next step was the suggestion of the methods by which vessels might avoid storms or escape them by sailing out of them.

Views like those of Mr. Redfield were reached about the same time by Dove, but Redfield knew nothing of his work. Colonel Reid, of the Royal English Engineers, at Barbadoes, who was also studying the subject, was struck with Redfield's articles, and entered into correspondence with him, which was continued to their mutual advantage. Mr. Redfield further speculated on the causes of storms—a subject which he was not able to solve, and which is still in large part a mystery.

In 1820 Mr. Redfield became interested in steamboat navigation, and ultimately associated with enterprises for carrying it on. The public had become alarmed about boiler explosions, to the detriment of the passenger traffic. To overcome their objections, Mr. Redfield devised a system of "safety barges," to be towed upon the Hudson by steamboats placed at such a distance that the passengers should be out of reach of the danger of explosions. These barges, which were in use from 1825 to 1829, attained a speed of between eight and nine miles an hour, and were in favor while the terror of explosions continued. But there came a lull in the explosions, the size and speed of the steamboats were increased, and conveyance by barges was discontinued, "to the regret," Mr. Redfield observed in a paper on the subject published in the American Journal of Science, "of those who love quiet enjoyment and whose nerves have not been inured to composure by frequent proximity with the moving power." In the same article Mr. Redfield undertook to show that the exposure to fatal accidents on board of steamboats was much less than attended the use of the ordinary means of conveyance by either land or water, and even than that from lightning. The towing system, originated by Mr. Redfield, though it lost favor as a means of conveying passengers, was extensively applied to the conveyance of freight, and is still an increasingly important method of transportation in that department. Mr. Redfield, associated professionally with the "Steam Navigation Company," continued to apply himself to the improvement of the art, devising better forms of apparatus, seeking for the best methods of regulating steam navigation, which he did not find in legal enactments, inquiring into the causes of boiler explosions and suggesting means of safety, and calling attention to the value of steam in national defense.

While railroads were still an experiment in this country—the Albany and Schenectady Railroad having been completed only in 1826—Mr. Redfield, in 1829, published a pamphlet outlining a project for one system of railroads connecting the Atlantic with the Mississippi, in which he made useful the knowledge of the country which he had gained in his walk to Ohio. The route he indicated was substantially, as far as to the lakes, the one afterward followed by the New York and Erie Railroad. The Erie Canal was then popular, and seemed to respond to the public demand for quick transportation; and so the author set forth, under nineteen distinct heads, the superiority of railroads to canals—a principle which was only a theory then, and to which men had to be won by argument. "He even anticipated," Prof. Olmsted observes, "that after the construction of the proposed great trunk railway connecting the Hudson and Mississippi, many lateral railways and canals would be built, which would bind in one vast network the whole great West to the Atlantic States. 'This great plateau, says he, will indeed one day be intersected by thousands of miles of railroad communications; and so rapid will be the increase of its population and resources that many persons now living will probably see most or all of it accomplished.'"

In 1832 Mr. Redfield was associated in the examination of the country through which the Harlem Railroad runs, with a view to establishing a road to Albany. He assisted in procuring a charter for the road, and published a pamphlet concerning it. He further assisted in the survey of a railroad route from New Haven to Hartford. He also showed his faith in street railroads, having as early as 1829 petitioned the Common Council of the City of New York for permission to lay an experimental track in Canal Street. At a later period he was a member of the Board of Directors under whom the Hudson River Railroad was completed.

While Mr. Redfield's fame rests mainly on his studies in meteorology, his contributions to geology were likewise important. Even as early as his journey to Ohio in 1810 he made geological observations. He was always much interested in the geological papers in the American Association, and took part in the discussions of them. The phenomena of the drift period and the signs of glacial action attracted his attention; but, living in the heart of the new red sandstone region of Connecticut, his closest studies were directed to that formation, and the fruits of them appear in several papers in the American Journal of Science. In these papers he described the allied sandstones of New Jersey as well as those of Connecticut, with their fossils, ripple marks, and evidences of the fall of raindrops. His son, John H. Redfield, having, in a description of the fossil fishes of the Portland quarry near Middletown, showed that their structural affinities pointed to a higher position for the sandstone than had previously been assigned to it, he continued the study and published descriptions of several new species of ichthyolites. The last paper he read before the American Association was on the Geological Age of the Sandstones of Connecticut and New Jersey, and the Contemporaneous Deposits of Virginia and North Carolina. He proposed for them the name of the Newark group, and showed that the ichthyolites contained in them pointed unerringly to the Jurassic group. The collection of fossil fishes which he formed in the course of this study, with special reference to a monograph upon them, was regarded by Prof. Olmsted as having been probably unequaled in this country.

Mr. Redfield was an active member of the American Association of Naturalists and Geologists, and was the originator of its enlargement into the American Association for the Advancement of Science—"the first," Prof. Olmsted says, "to suggest the idea of the American Association on its present plan."

Prof. Olmsted gives a list of sixty-two scientific papers in meteorology, physics of the globe, and geology, on steamboats, etc., published by Mr. Redfield. Forty-five of these are to be found in the first fifty volumes of the American Journal of Science, and twenty-eight of them are registered in the catalogue of the Astor Library.

Seeking to determine what attracted insects to flowers—whether the color, shape, or odor—M. Félix Plateau experimented with single dahlias trained against the wall. He disguised the flowers in a variety of ways, covering them all over with variously colored papers, leaving the yellowish centers of tubular flowers, giving different shapes to the papers, covering with green leaves, and so going through the changes. It seemed all the same to the insects: they found the flowers and enjoyed themselves with them in their usual way. M. Plateau concludes that the attractions of the flowers are not in their form or color, but that the insects are drawn to them by some other sense than that of sight, probably by the smell.

Editor's Table.

"THE NEW WOMAN" AND THE PROBLEMS OF THE DAY.

AS there is a new everything in these days, we suppose it was inevitable that there should be a "new woman"; though why a new woman more than a new man it might not be easy to explain. For our part we believe but faintly in "new" woman; we believe in woman. We believe in progress; we believe that new times call for new measures; we believe that these are new times, and that it behooves both men and women to prepare themselves to meet the demands which the age is making on them.

What is really new in the world is knowledge. We see the practical outcome of the new knowledge in the transformation that has taken place in the arrangements under which the life of society to-day is carried on. With the new knowledge there has come a vast enlargement of human power in all directions and a vast development of human individuality. Custom, though still powerful, is no longer such a ruler of men's lives as it used to be. Men and women everywhere have been roused, we might almost say stung, into a sense of individual existence; and, looking round on their changing environment, they are asking a thousand questions to which as yet no very certain answers can be vouchsafed. Woman is awake because man is awake; the keenness of the times has roused them both; and from both we seem to hear the inquiry made by the jailer at Philippi, when startled from slumber by the trembling of the earth and the flashing of a strange light: "What must I do to be saved?" The difference between the so-called "new woman" and woman without that qualification is that the latter would wish to be saved with man and the former apparently without him. The new variety emphasizes the fact that she is a woman, and in that capacity is going to do wonderful things; whereas woman without the "new" is content to know herself a woman and to feel that with her it rests to accomplish her equal part in all the best work of the future.

The great change, as we have said, is that there is more knowledge in the world and that the rule of custom is to a large extent broken. Things that once had all the authority that convention and routine could give them are now open to every one's criticism. Morality no longer rests in absolute security upon dogma. The time has come which Voltaire predicted would be the end of all things, when *the people* have taken to reasoning. Fortunately, there is no need to agree with Voltaire; but it is necessary to recognize that something is needed to give wise direction to the emancipated thought and action of our time. The dogmatic morality of the past was in the main sound; and the problem of to-day is to secure a sufficient sanction for whatever rules of conduct are necessary to the well-being of individuals and of society. That much in the way of wise counsel and true inspiration may be expected from the increased reflectiveness of women we most gladly recognize; but we do not feel disposed to call a woman who thus responds to the needs of the time a "new" woman, seeing that for generations past, and particularly in times of emergency, women have more or less fulfilled the same rôle.

The two principal questions which to-day confront society relate to the future relations of men and women and the education of the rising generation. The allegation is freely made in many quarters that marriage is a failure ; and no doubt frequently it is. None the less, however, is it the case that no scheme that has ever been proposed as a substitute for marriage merits a moment's consideration. It is easy to provide theoretically for the gratification of passion and impulse, but not so easy by any means to show how by any union less solemn and abiding than marriage the higher natures of men and women can be duly developed and their lower propensities kept in check. We do not look to any new woman for light on this question ; but we do look to the best women of to-day, those who to purity and soundness of instinct add a trained capacity for independent and intelligent judgment, to join with the best men in indicating the higher path which the generations of the future may tread. We may be sure of this, that the path is one not of less but of greater self-control, and that redemption from the miseries which attach, in too many cases, to marriage as it is will be found in an elevation and purification of the whole idea of marriage. Not that the idea has not been held in its highest purity by many in different ages ; not that the world has ever lacked examples of ideal marriage, but that there has never been a sufficiently wide recognition of its true nature and possibilities. There is a gospel on the subject which has to be preached and, so far as individual action can do it, enforced—the gospel that the true happiness of a man and woman united in marriage bonds consists in learning, as years go on, to love and respect one another more and more, and in aiding and stimulating one another more and more to right and noble action, each gaining strength through the other, each finding in the other the means of achieving a true individual completeness. The true gospel is that there is *more* in marriage than for the most part poets have sung or romancers dreamed, and that the failures of which we hear so much have been, in the main, failures to grasp the true conception of it and to make a right preparation for the duties which it involves.

Does not all this mean, it may be asked, that many are unfit through defect of character, and others through ignorance and general inferiority of thought and sentiment, to make the best of marriage ? It certainly does, and here the no less important problem of education comes in. In these days we look too much to the state to solve our problems for us. There are some problems which the state can not solve, and one, we do not hesitate to say, is the problem of a true education. The state can levy taxes and employ agents and make regulations; but it can not speak with the voice of father or mother; it can not speak confidentially to the young of their deepest interests. It can enjoin rules of conduct, but it can not guide aspiration; it can not meet what, in a broad sense, we may speak of as spiritual needs. If the rising generation is to be adequately educated, the best men and women of the day must come together and consider how it is to be done—how the work of the state is to be supplemented by individual endeavor, so that growth in character may keep pace with growth in knowledge and intelligence. There are two main ways in which, at first sight, it seems possible this might be done, or at least more or less hopefully attempted: first, by an improvement of the home, and, secondly, by the action of a higher public opinion on the schools. We quoted, some months ago, an eminent French writer of our own day as saying that it was necessary to put more "soul" in the public schools. That is precisely what they want, as all the best teachers are fully aware. But you can not make an appropriation for "soul." It is not quoted in the catalogues of school supplies; it is not among the prescribed subjects in teachers' examinations. It is a very real if not a very tangible thing; and it is a communicable thing. There are those who have it and can impart it; indeed, those who have it can hardly fail to impart it. If there is enough of it outside the schools, it will leak in; and our hope is that the best men and the best women of the day will so join forces as to create, especially around the public schools, an atmosphere of higher sentiment that shall affect for good the working of the state machine, and greatly strengthen the hands of all who, within the schools, have set for themselves a certain standard of spiritual as distinct from merely intellectual accomplishment.

Then as to the home. Here is where we want women with new knowledge, but not—we speak with all due fear and trembling—"new" women. The "new woman" would set every one discussing rights; but the *true* woman with adequate knowledge would see what the best women have always seen, that the home requires a principle of unity and not a system of scientific frontiers or an elaborately arranged balance of power. Home life and home influence have, we fear, been suffering in our day through a variety of causes; but the home, like marriage, is an institution which only needs to have its possibilities developed in order to stand forth more than justified. Without entering into the question as to whether the wisest methods are being followed to-day in the education of women, it is beyond all doubt that women have gained a vast enlargement of their intellectual horizon, and that in many cases women are not only the peers but the superiors of men in the same station in life as themselves in knowledge and culture. Such knowledge and culture can nowhere be better employed than in the home, where the physical, mental, and moral development of children has to be watched over. The question is, How far will it be employed in this way, and how far made a means of mere personal self-assertion? The true woman will use it for the good of others, and, if possible, will make it available for the improvement of the home; while others—the new type—will use it to make themselves conspicuous in the world, and, as they vainly fancy, add glory to the female sex.

The hope of the future lies mainly in well-ordered homes—homes in which children are trained to be just, reasonable, and humane, in which they are taught to look with an intelligent eye upon the phenomena alike of Nature and of society, in which they learn lessons of industry and self-reliance, of honor, purity, and self-respect, and are guarded against the vulgar worship of wealth and worldly success. It is for the wise and noble women of our time to help to make such homes, and it is for men to see to it that they are worthy of partnership in so sacred a cause. It is no time for any silly rivalry or futile opposition between men and women, who are as necessary to one another now as at any previous age in the world's history—nay, more necessary. On the contrary, it is a time for earnest counsel and vigorous co-operation on the part of all who have the interest of the present and future generations at heart; and the less we hear of the separate and conflicting claims of men and women the better. There is ample scope to-day for the efforts of all, and if any stand idle in the vineyard it must be from lack of will, not from lack of opportunity.

AN ALMOST TOO SUCCESSFUL JOKE.

When a valued contributor and prominent man of science offered us for publication recently an article over his own signature intended to cast not undeserved ridicule upon the insatiable craving which so many have for marvels, and particularly for marvels that seem to possess the crowning merit (in their eyes) of casting uncertainty upon the methods and conclusions of physical science, we decided to publish it; and it appeared in our last number, under the title of The Sympsychograph. The result, to speak frankly, has almost caused us to doubt the wisdom of the step. Nothing, we know, was further from the intention of the writer, Prof. D. S. Jordan, than to hoax or mislead intelligent readers; and we need hardly say that no such purpose could possibly have commended itself to our approval. There is reason to believe, however, that the great weight attaching to Prof. Jordan's name threw many persons off their guard who would otherwise have scanned the article with sufficient closeness to perceive not only its lack of scientific coherence, but the mischievously sportive intent underlying it. To such, we feel like offering an apology: they read in good faith, as a serious article, what was written as a burlesque, and, doubtless in some cases, puzzled very unnecessarily over the incoherences and obscurities which naturally entered largely into its composition. Many a one doubtless said: "This does not read like an article by Prof. Jordan, yet his name is signed to it; it must be his, and there must be something in it." Well, there was nothing in it except a burlesque; and if any of our friends feel that they were unfairly entrapped into taking it seriously, we can only express our sincere regret.

It is worth while, however, for those who took it seriously to reflect for a few moments over *what it was* that they thus gave credence to. The statement was that photographs were produced in absolute darkness; that in the darkness a photographic plate became sensitive to thought; and finally, that the thought of a cat in the mind could so decompose the film on a prepared plate as to produce thereon the image of a cat. This was a feast of absurdities which our contributor doubtless supposed, and which, we must confess, we ourselves supposed would prove too rich for all but the most credulous; and if, on a review of the case, those who were taken in are led to draw the inference that a certain independent exercise of judgment is always in order, and that no name should be accepted as sufficient voucher for stark absurdity, the annoyance to which the incident has given rise will not be unmixed with benefit.

If any reader should perchance ask whether there is anything more incredible in the alleged performances of the "Astral Camera Club" than in what we have learned this year in regard to the X rays, we answer: Yes, there is, on the surface, all the difference in the world between the two cases. In the case of the X rays, Prof. Röntgen made his announcement in a carefully worded memoir addressed to a learned body, and fully discussed therein the work done by predecessors in, if not the same, an adjoining field of research.

In the second place, there was a known cause of the effect produced in a powerful electric disturbance of an attenuated gaseous medium. There was something here which might very conceivably possess an action resembling that of light upon a photographic plate, and, seeing that ordinary light rays can pass through various solids, it was not taxing belief unduly to state that the X rays could pass through solids impermeable to ordinary light. If intelligent persons will only use the full measure of their intelligence in discriminating between authenticated and unauthenticated announcements, between consistent and inconsistent statements, between alleged facts that have a history behind them, and appear in some natural order of development, and others that have as little previous history and as little in the way of development as "the shield that fell from heaven," they will be all the better for it. They will gain in intellectual power, and, as a result, will be less at the mercy of the manufacturers of the marvelous. It may be a little difficult to exercise discrimination to this degree, but who can deny that the effort to do so would be eminently beneficial? The late Mr. Bagehot once wrote an instructive article on The Emotion of Belief, in which he showed to how large an extent emotion is responsible for belief. It is so to altogether too large an extent: when people believe, they are very often indulging an emotion instead of completing an intellectual process. This emotion is continually demanding nutriment and stimulus; and we need to be on our guard if we would not be continually believing simply for the sake of the pleasure accompanying the act.

We therefore see a good moral associating itself very closely with Prof. Jordan's *jeu d'esprit*; and there is consequently reason to hope that, when the returns are all in, the balance will be on the right side.

FADING FADS.

A CORRESPONDENT of The Nation, writing from Geneva, thus reports in regard to the Third International Congress of Psychologists lately held in that city: "The fact that the papers on 'hypnotism' were less than in earlier congresses, in proportion to the entire number, and that there were a bare half dozen on thought-transference and telepathy, shows the general tendency of psychology. The hypnotic period is past even in France. . . . As to telepathy, I think there is a real decay of interest in the subject, much as this is to be deplored." We must confess we do not feel like deploring the decay of interest to which the correspondent alludes. There would not be such a decay if facts were forthcoming of a nature and in sufficient number to sustain the interest. Telepathy is one of those things that appeal most strongly to popular credulity. The subject, or rather the alleged facts, might be studied without injury by a man of scientific training; but, handed over to the multitude, it is well adapted to become the fruitful source of every kind of intellectual mischief. There are hundreds of minds to-day that are perilously near the border land of insanity, and still more that are in a most unwholesome fever of unrest, simply on account of the obliteration, so far as they are concerned, of the boundaries of the possible and impossible. They do not know what to believe in or what to expect in the way of incursions from an invisible and intangible world, or what law of Nature they can safely regard as irreversible. Can any good come of this? We should certainly say

No; and we are sorry that some people of more or less scientific competence, who, as we think, might be better employed, are devoting their efforts toward promoting this general condition of mental unsettlement. It is a comfort to learn that the assembled psychologists at Geneva were not disposed to give much countenance to the telepathic Will-o'-the-wisp.

THE ABUSE OF FREE LIBRARIES.

AT its recent annual meeting in Cleveland, the American Library Association heard some candid criticism from its president, Mr. John Cotton Dana, Librarian of the Public Library of Denver. He feared that his enthusiasm for the free public library was born more of contagion than of conviction. In the public library, he said, you have stored a few thousand volumes, including, of course, the best books of all time—which no one reads—and a generous percentage of fiction of the cheaper sort. To this place come in good proportion the idle and the lazy, and also the people who can not endure the burden of a thought, and who fancy they are improving their minds, while, in fact, they are simply letting the cool water of knowledge trickle through the sieve of an idle curiosity. The more persistent visitors are largely men who have either failed in a career, or never had a career, or do not wish a career.

Mr. Dana charged the free public library with relieving the idle, the incompetent, and the indifferent reader from the necessity—would he have books—of going to work to earn them. It checks, he continued, the serious reader in collecting a library of his own adapted to the wants and tastes of himself and his family. It leads parents to regard with indifference the general reading of their children, just as the free public school may lead them to be indifferent to their formal education.

This and much more in the same strain was loudly applauded by Mr. Dana's large and representative audience of librarians. It is evident that the abuses of free public libraries have led to much searching of heart among their chief officers. They are feeling, as the teachers of the public schools also feel, that they can not take the place of the parent who abdicates from one of the primary responsibilities of parenthood. A child whose father and mother hand over its mental and moral culture to the teacher and the librarian virtually becomes an orphan. Neither public school nor public library can do its duty toward its pupils and readers without the hearty and intelligent co-operation of parents. Mr. Dana's address was clearly intended to traverse the easy optimism and self-gratulatory vein usual in presidential utterances. His criticisms will bear fruit in pointing to the abuses and losses inevitable when the form of gratuity is impressed upon a comfort or a luxury which each should buy for himself. The form of gratuity is a form only; at great and increasing cost a service is proffered which should be rendered, not in the free public library but in the home; or, if a compromise must be made, then by the free public library watchfully directed from the home.

Scientific Literature.

SPECIAL BOOKS.

THE vivisection question has not yet created nearly as much stir in America as it has in England, where it has long been a rival of the Deceased Wife's Sister controversy as a provoker of agitation and rhetorical discharges. It has, however, recently come into view here through an attempt to induce Congress to pass a bill imposing severe restrictions on vivisection in the District of Columbia. For the reason above stated England is our chief source of literature on the subject, and in a little book by Sir *Benjamin Ward Richardson*,* which comes opportunely to hand, we have a calm and philosophical examination of the main question at issue. Each of Sir Benjamin's chapters is a reply to one of nine questions submitted to him from the Leigh-Brown Trust, which holds an endowment for a biological institution from which painful experiments are to be excluded, hence the scope of the book is somewhat limited. The first question propounded to him is, "In view of the difference of organization between man and the lower animals, do you consider that painful experiment has played any indispensable part in the study of medical substances and methods for the cure of disease?" He answers this in the negative; "because," he says, "if what has seemed to be indispensable had never been thought of, some other plan equally good would or might have led to the same results." Yet he holds that every experiment hitherto performed for the prevention or cure of such a disease as cancer has been justifiable. Hence his complete answer is, briefly, "Experiment may be expedient, it is not indispensable." The second question asks about anæsthesia in particular the same that the first does about all medical substances. Sir Benjamin answers with an unqualified negative; but as he has made a special study of anæsthetics, having tested so many as twenty-nine, he goes on to give a brief history of anæsthesia and then to point out some still unfilled wants in this field. In answering the question, "Do you approve of the instruction of students by means of experimentalism on living animals?" he states that he taught physiology in a medical school for many years without experiments and his classes got on well. Afterward he introduced a few experiments, which were rendered painless, and found that they required so much time as to crowd out other subjects; that two students rarely saw the phenomena in the same way; and that some students were led to give undue attention to the matters that were illustrated experimentally. He therefore abandoned the experiments. The eighth question relates to legal restrictions on vivisection. It appears that there is a license law in England similar to what the American vivisection prohibitionists are trying to have enacted for the District of Columbia. Sir Benjamin condemns it utterly. He says that "it prevents men of really original mind from working out valuable original inquiries. Men like William Harvey, Thomas Willis, John Hunter, or Wilson Philip could never have worked under it." Further, that most of the objections to it "are minor when com-

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* Biological Experimentation. By Sir Benjamin Ward Richardson, M. D., F. R. S. Pp. 170, 16mo. London: George Bell & Sons; New York: The Macmillan Co. Price, $1.

pared with the demoralizing and degrading action of the law upon the noble profession of medicine. This law places the professors of medicine in the same position as the licensed publican, and for the same reason." And again, "it tempts weak men to weak practices; increases the number of experimentalists; makes experiments all but useless, and does not limit cruelty." There are, however, some restrictions to which Sir Benjamin has no objection.

Such laws are mainly advocated by the various "humane societies," and we turn to documents issued by several such societies to learn their positions on the question. The *Thirtieth Annual Report* of The American Society for the Prevention of Cruelty to Animals, of New York, shows that the efforts of that society in 1895 were restricted to stopping and remedying maltreatment of horses and other domestic animals. Vivisection is not mentioned. A letter to its secretary asking the position of the society on this matter has brought no response. A pamphlet on *Work Accomplished by the Toronto Humane Society during 1887–'91* shows that this society has covered a wider field. It has labored against abuse of beasts of burden, cruelty in the transportation of live stock, overloading horse cars, improper horseshoeing, the use of the check-rein and burr-bit, killing insect-eating birds and robbing their nests, killing birds for women's hats, clipping horses and docking their tails, cutting dogs' ears and tails, trap-shooting of pigeons and other birds, matches for cock and dog fighting, bleeding live calves periodically, plucking live fowls, and dehorning cattle. This society also protects children. Here, again, is no mention of vivisection. If these aims are not sufficient for any humane society it might add efforts against the slaughter of seals and other animals for their furs, robbing eider ducks' nests of down, killing small game birds which yield insignificant food supplies, caponizing cockerels, gelding horses without anæsthetics, hunting solely for amusement, especially where the birds or animals are bred for the purpose, the prolonged process of killing food animals required by the Hebrew theology, deserting or "losing" cats by families changing their residences, and confining animals in menageries so that they sicken and die prematurely. These things, as well as those previously mentioned, have not, like vivisection, the purpose of increasing knowledge, but cater only to the appetite, the vanity, the amusement, or the over-exacting convenience of men and women. The American Humane Association is one society that has busied itself with vivisection. It has been taking a census of opinions from clergymen, authors and editors, educators, and physicians of over fifteen years' practice—more than two thousand in all—by sending out statements of four differing views from which a choice could be made. Its replies from clergymen and authors carry little weight, as presumably none of these gentlemen ever saw a vivisection; and those from educators, excepting what teachers of biology there might be among them, are scarcely better. Only the physicians can be presumed to know what they were talking about, and of these there were for vivisection without restriction, 220; for vivisection when restricted to useful ends and under careful supervision, 513; for vivisection restricted and supervised by law, if it be without pain, 186; for the total prohibition of vivisection, 207; obscure or evasive, 24; total, 1,150. It thus appears that there is a wholesome difference of opinion on this subject among mature physicians, but that more of them favor vivisection as reputable men of science would voluntarily conduct it than any other of the four views. It is creditable to the reason of the persons of other occupations consulted that this group is largest in each class. The bill which is now awaiting the attention of Congress is meddlesome and impracticable. As shown by Dr. Charles W. Dabney, Jr., Assistant Secretary of Agriculture, in a letter to Senator McMillan, it would seriously hamper the researches of the United States Bureau of Animal Industry, and it has been condemned, among other societies, by the American Medical Association, the Association of Military Surgeons of the United States, the National Academy of Sciences (which was founded to advise the Government on scientific matters), the Association of American Medical Colleges, the Association of American Physicians, the Medical Society of the District of Columbia, the Joint Commission of the Scientific Societies of Washington (and several of these societies separately), and the American Academy of Medicine. The greatest mischief of such a law is that it would be used as a precedent for similar laws in the several States, and, what the vivisection prohibitionists incautiously avow, as an "entering wedge" to bring in more drastic measures. America is in a fair way to make vivisection literature of its own.

Our present knowledge of the ice age affords an admirable example of reconstructing the past from the present as practiced by geologists. The process by which this reconstruction is effected, the facts relied upon, and the reasoning employed in it are given especial prominence in the recent volume on *Ice Work*, by Prof. *T. G. Bonney*.* In order to show us what glaciers are and how they act, the author takes us first to the Alps. He points out the lines of *débris* and the occasional large bowlders carried by the frozen streams, and describes the moraines, giants' kettles, and other traces left by them. Going down the valleys below their present limits, he shows how deposits and marks of erosion testifying to their former greater extent can be identified. Such marks and deposits are found in other lands hundreds of miles from existing ice streams or any mountains that seem adequate to send forth glaciers of great extent. An ice sheet stretching across a continent must be assumed to account for these phenomena, and Prof. Bonney next shows us the ice fields of Greenland and the antarctic lands as evidence that this assumption is warranted. Leaving existing examples of glacial action, our author draws attention to various traces of the Glacial Epoch—lake basins, the parallel roads of Glenroy, eskers, etc. In dealing with phenomena whose meaning is not settled, he has first set forth the facts and then has given the leading rival interpretations of these data, pointing out in what particulars each seems to him strong and in what weak. Traces of ice work are numerous in the British Isles, and nearly one third of the volume is devoted to descriptions of them. In the northeast of England there are the Cromer till, contorted drift, and upper bowlder clays on the Norfolk coast, and similar deposits in Yorkshire, especially in the vicinity of Flamborough Head. In the northwest the Cumbrian Mountains and the adjacent lofty fells of the Pennine range obviously have been occupied by glaciers, and the mountainous part of North Wales affords evidence of similar import. The detached mountainous

* Ice Work, Present and Past. By T. G. Bonney. International Scientific Series. Volume 74. Pp. 295, 12mo. New York: D. Appleton & Co. Price, $1.50. London: Kegan Paul, Trench, Trübner & Co.

mass of Moel Tryfaen presents an interesting study for the glacialist, and there is a remarkable inland deposit of sand, shells, and bowlders, quite recently discovered, at Gloppa, near Oswestry. The midland counties also have their bowlder clays, and deposits extend southward to the neighborhood of London. Four chief sources of streams of bowlders are recognized in Great Britain—Kirkcudbrightshire, the English lake district, Wasdale Crag, and the Arenig region of North Wales, each of which is briefly described. Our author next presents the two rival theories as to how Great Britain received its glacial deposits—one that they were dropped from ice floes floating over the land while it was temporarily submerged, the other that they were dragged on to it by an ice sheet moving over it while it was at or about its present level. After referring briefly to evidence in Scotland and Ireland, Prof. Bonney proceeds to describe ice work in Europe and other parts of the world. For America he gives only the limits and the general character of the traces of glacial action, referring to Dr. G. F. Wright's book in the same series for fuller details. A large number of his illustrations, however, are from American sources. The four remaining chapters are devoted to theoretical questions. Here are discussed the fall in mean annual temperature required for the Glacial Epoch, the possible causes of such a climatal change, and whether there was more than one age of ice. The closing chapter presents some general principles of interpretation of glacial phenomena.

GENERAL NOTICES.

The author of this suggestive and useful book * admits the deficiency in the teaching of English, and particularly of composition, in our schools, to which attention has been called in a committee report to the Board of Overseers of Harvard College, and attempts here, by a thoughtful discussion of the subject in its theoretical and practical aspects, to point out the way in which the standard of scholarship in the vernacular may be improved. The book has grown out of his own regular work, and its purpose is to state fully and illustrate clearly the principles that underlie all practical language culture, to emphasize the value of such culture—the education that grows directly out of the use and study of the vernacular—to present methods for carrying on the child's instruction in language-arts in harmony with the underlying principles, and to discuss grammar and rhetoric with reference to their educational value and their relation to the language-arts. The results of the best discussions of the subject, from those of the Roman Quintilian to those of Preyer and the American writers, are brought into the study. The language-arts are defined, the value of the vernacular as an educational instrument is estimated, the condition of the child's mind, his acquisition in speech, and the origin of his knowledge are inquired into, and the teaching of the language-arts in the elementary and lower grades and in the higher schools is discussed under the three aspects of the substance of thought, the form of thought, and literature as an art. The principles having been thus established, the subject is considered under the headings of The Art of Reading, Reading and Mental Cultivation, Requisites for Reading, Teaching Reading as an Art, Teaching Reading as Thought, Teaching Composition, Teaching English Literature, the functions severally of English grammar, rhetoric, and criticism, and Teachers of the Language-Arts (qualifications, etc.). A bibliography of twenty-one titles is appended.

* Teaching the Language-Arts: Speaking, Reading, Composition. By B. A. Hinsdale. New York: D. Appleton & Co. (International Education Series). Pp. 205, 8vo. Price, $1.

In this book * the author considers a subject which he assumes, correctly as far as we know, has not hitherto received any system-

* The Evolution of Bird-Song, with Observations on the Influence of Heredity and Imitation.

atic treatment from ornithologists—Mr. Simeon Pearce Cheney, an American, being the only one who has published a special work of any considerable pretensions upon it. Mr. Witchell first thought of making a scientific investigation of it in 1881, while listening to a nightingale, from observing the repetition of a particular feature in its strains. After an interval of some years he became interested in the song of a thrush, and from the thrush was led to observe mimicry in other birds. As his observations were continued, the results assumed shape and now justify embodiment in a book. First he seeks for the origin of the voice, and finds it, with Darwin, in involuntary movements of the muscles—the excitement of combat being a possible occasion. The combat cries are serviceable also for purposes of alarm. A further development in the faculty of song is the call-cry, and from this the transition is not very great to the simplest songs, which are fixed and further developed and varied by heredity and imitation. In the filling out of the plan thus sketched, a chapter is devoted to noticeable incidents connected with bird-song, the influence of heredity is discussed, the causes and effects of variation in bird-song and the influence of imitation are inquired into, and an attempt is made to express the songs of various birds in musical notation, with transcripts of the music sung by blackbirds, thrushes, and skylarks. The book covers a field not occupied by any of the numerous bird books now current, except, in part, by Mr. Cheney's, and will prove an acceptable complement to them.

The *Year-Book of the United States Department of Agriculture for 1895* is the first volume published in accordance with the law of 1895 directing the separation in the reports of the executive and business matter intended for official information and those papers formerly incorporated in them "specially suited to interest and instruct the farmers of the country." We are very glad to find that the editors have sought to make it "a concise reference book of useful information . . . without making it an encyclopædia of general information"—"to make a book and not a mere Government report." It includes a general report of the operations of the department; the papers, presented in the form of popular essays rather than of scientific reports, which are its main reason for being; and an appendix, containing a large amount of miscellaneous matter taken from the reports of the department and presented with special regard to the requirements of the reader.

In the *Nineteenth Report of the Illinois State Entomologist* the first article details a series of experiments for the destruction of the chinch bug. A large portion of the remainder of the work treats of the parasitic and contagious diseases of insects, and details numerous experiments for the destruction of the noxious bugs by means of infecting them with some destructive disease. The last paper deals with the white ant, which it seems annually does much damage in Illinois.

The second of the popular writings of *Thomas Paine* that has been reprinted from the complete works edited by Moncure D. Conway is *The Age of Reason* (Putnams, $1.25). In this form it makes a volume of two hundred pages, octavo. The new edition will doubtless enable many persons to learn that the book is not atheistic, as they have been told, but deistic; that it is not blasphemous, but its whole tenor is, There is one God, and He is too great and good to be charged with the ignorant and wicked acts of men that are recorded in the Hebrew Scriptures.

The Administrative Report of the *Thirteenth Annual Report of the Bureau of Ethnology* (1891, 1892) presents a historical review of the development of the plan of the work of the bureau, which from a seemingly simple beginning has been found to involve some highly complex problems, and in which many lines of investigation have been opened. Seven publications were issued during the year. The general account of the work of the agents of the bureau during the year covered by the report is followed by a general summary of the special papers which compose the larger part of the volume. These papers are: Prehistoric Textile Art in the United States, by W. H. Holmes; Stone Art, by Gerard Fowke; Aboriginal Remains in

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By Charles A. Witchell. New York: Macmillan & Co.; London: Adam and Charles Black. Pp. 253. Price, $1.75.

Verde Valley, Arizona, by Cosmas Mindeleff; Omaha Dwellings, Furniture, and Implements, by J. Owen Dorsey; Casa Grande Ruin, by Cosmas Mindeleff; and Outlines of Zuñi Creation Myths, by Frank Hamilton Cushing.

The *Miscellaneous Papers by Heinrich Hertz*, in an authorized English translation by D. E. Jones and G. A. Schott, published by the Macmillan Company, form the first volume of the author's collected works, as edited by Dr. Philipp Lenard. The second volume is a reprint of his Researches on the Propagation of Electric Action (already published in English as Electric Waves), and the third volume consists of his Principles of Mechanics, of which an English translation is in press. The papers here included represent chiefly the earlier investigations which the author carried out before his electrical researches; but the last three—the Heidelberg lecture on the Relations between Light and Electricity, an experimental investigation of the passage of the cathode rays through thin metallic tubes, and a tribute to Helmholtz, are of later dates. Nearly all the papers are extremely technical. In the introduction Prof. Lenard gives a brief history of Hertz's career in investigation, with notices of the occasions on which some of the papers were composed, illustrated by liberal extracts from the author's letters to his parents.

The *Report of the Missouri Botanical Garden* for 1895, the seventh annual report, is a favorable one in all respects. The finances are entirely satisfactory, the receipts from rentals having been increased by $7,500; profitable improvements and valuable additions have been made in the garden; a larger number of visitors by one third were recorded than in 1894, and they "showed no disposition to vandalism"; the herbarium has been added to, and now contains 242,162 specimens, valued at $24,216; besides 4,807 wood specimens and veneers and microscopic slides of woods; and the library contains 20,549 volumes and pamphlets. The scientific papers appended to the report include one by Dr. Trelease on the *Juglandaceæ* of the United States, particularly the hickories, described with reference to their winter characteristics; a study of the Agaves of the United States, by A. Isabel Mulford; an account of the ligulate Wolffias—plants of the Duckweed family—of the United States, by Charles Henry Thompson; an address by President Henry W. Rogers, of Northwestern University, on the Value of a Study of Botany; and a catalogue of the Sturtevant Prelinnæan Library—a gift of early Herbals, Natural Histories, and Medical Botanies, made to the institution by Dr. E. Lewis Sturtevant, of South Framingham, Mass.

The *Annual Report of the State Geologist of New Jersey* for 1894–'95 relates to the Surface Geology, the Archæan Geology, Artesian Wells and Water Supply, and Forestry. In surface geology Prof. Salisbury made a general reconnaissance of the southeastern parts of the State, and Mr. G. O. Knapp of the southwestern; and the field work on the surface formations is now done over nearly all the State. Work was continued over the Cretaceous and Tertiary formations, the Red Sandstone formation, and the crystalline rocks of the Highlands; and special attention continues to be given to artesian wells, drainage, and natural parks and forest reservations. Of the special papers on these subjects we note that on forestry as being most timely and full and definite; and the subject of forest fires receives in it a very satisfactory discussion.

A pamphlet on *Oxides*, the first of a series under the general title, Chemistry at a Glance, has been prepared by *Herbert B. Tuttle.* After some introductory matter on chemical physics, and a list of elements, there follows a list of radicals with a graphic formula for each. About half the pamphlet is occupied by a list of oxides, giving the properties and a graphic formula for each, and there is a similar but shorter list of compounds that the author groups under the name "oxate." (The author, New York, 60 cents.)

The contents of the *Twentieth Annual Report of the Department of Geology and Natural Resources of Indiana* for 1895 pertain almost wholly to economic geology. The introductory portion embodies a general review of the natural fuels of the State (coal, petroleum, and natural gas), its resources other than fuels, its natural history, the condition of the State Museum—which is undergoing a scientific classification—and an account of the office work of the department. The special reports concern the clays and clay industries of the coal-bearing counties by the State Geologist, W. S. Blatchley; the carboniferous sandstones of western Indiana, by T. C. Hopkins; the whetstone and grindstone rocks, by Edward M. Kindle; and the crawfishes of Indiana, by W. P. Hay; besides which the reports of the State natural gas supervisor, the inspector of mines, and the oil inspector for 1894–'95 are given.

Volume XV of the *Bulletin of the United States Fish Commission*—the volume for 1895—consists of ten papers, most of which have also been issued separately. A notably comprehensive study of the habits and development of the American lobster, by Prof. Francis H. Herrick, occupies the first two hundred and fifty pages of the volume. Prof. Herrick has devoted to this subject all the time that he could spare from professorial duties during the past five years, and has used each summer the facilities of the Woods Hole Laboratory. The monograph is accompanied by over sixty finely drawn and engraved plates, a number of which are colored. An account of the attempts to acclimatize fish and other water animals in the Pacific States is the subject of a paper by Hugh M. Smith, M. D. Thirty-one species of fish, the lobster, the Eastern oyster, and the soft clam are mentioned as subjects of these experiments—the best results being obtained with shad, bass, carp, and catfish. Shorter papers deal with salmon investigations in Idaho, oyster beds of Alabama, the menhaden fishery, etc.

The *Chief Fire Warden of Minnesota* has issued his *First Annual Report*, and the document gives evidence of able and energetic work on his part during the year 1895. It contains a copy of the act under which protection of the forests and prairies of the State from fire has been organized, a copy of a warning placard, eighteen thousand copies of which were printed on cloth and posted in the districts liable to fires, a list of the town fire wardens, and statistics of forest and prairie fires in 1895. Owing to wet weather the year affords a much smaller record of destructive fires than 1894. A valuable and interesting feature of the report consists in answers of local wardens to questions as to the effect of the placards, the sentiment of their communities as to forest preservation, and ways in which fires can be prevented more effectually; also answers from lumbermen to a set of questions on present methods of lumbering. Means for preventing the starting of fires by sparks from locomotives, and other topics, are also discussed.

Volume V of the *Report of the Iowa Geological Survey*, 1895, is accompanied, like its immediate predecessor, by reports on six counties of the State. Each of these reports describes the geological formations of the county, and gives the location and character of its economic deposits. Of the latter the most valuable are the soil and its water supply, although this fact is frequently overlooked, and there are also clays, building stone, and some coal.

Among recent bulletins of the University of Wisconsin is one on *The Problem of Economical Heat, Light, and Power Supply for Building Blocks, Schoolhouses, Dwellings, etc.*, by *G. A. Gerdtzen*, B. S. From the engineering standpoint the author discusses the relative efficiency of electricity, steam, and gas in furnishing heat, light, and power, and arrives at a result which favors gas produced by a combination of retort and water-gas processes.

We heartily agree with the view of Locke quoted in the front of the new edition of *Alfred Ayres's Verbalist*—"If a gentleman be to study any language, it ought to be that of his own country." Science and the mother-tongue have been firm allies in the conflict against the monopolistic pretensions of the classics, and each rejoices in the other's success. If one has anything to say, The Verbalist will help him to say it in the most effective way. While the book is mainly concerned with pointing out errors in the use of words, it gives also instructions in punctuation and in the use of the figures of speech, and there are helpful articles on British against American usage in both diction and pronunciation, misplaced words, the use of Latin phrases, threadbare quotations, verbiage, etc. In its new edition the book has nearly fifty per cent more matter than it had on its first appearance fifteen years ago, and, although the words treated are arranged alphabetically, an index has been added to insure the ready finding of every bit of information that the volume contains. (Appletons, $1.25).

The Wagner Free Institute of Science, of Philadelphia, issues in Volume IV of its Transactions a memoir by Dr. *Joseph Leidy* on *Fossil Vertebrates from the Alachua Clays of Florida.* Dr. Leidy was engaged on this memoir at the time of his death, and it has been completed and edited by Frederic A. Lucas. The specimens on which it is based are chiefly the bones and teeth of a species of rhinoceros and of a mastodon. Others pertain to three species of llama, to two of hippotherium, to a tapir, another species of rhinoceros, a mastodon, and a megatherium.

The chief articles in Nos. 4 and 5 of the *Bulletin of the Department of Labor*, May and July, 1896, are chapters iii and iv of the papers on Industrial Communities, by W. F. Willoughby, describing respectively the village of the Coal Mining Company of Blanzy, France, and that of the Iron and Steel Works of Friedrich Krupp, Essen, Germany. No. 4 contains also an article on the Sweating System, by Henry White, General Secretary of the United Garment Workers of America, in which statistics and abstracts of recent legislation are given. In No. 5 there is a set of statistics and an abstract of laws passed since 1885 concerning convict labor, which brings the greater part of the information in the special report of the department on this subject, made in 1886, down to date. Both numbers contain currrent information on a variety of other matters affecting labor.

Mr. *George Haven Putnam* has brought out a second edition of his *Question of Copyright* (Putnams, $1.75)—a book that is at once a valuable manual and a memorial of a noble struggle for honest dealings with foreign authors. The new edition brings the record of copyright laws in the chief countries of the world down to March, 1896; it contains a chapter on the results of the United States law of 1891, a summary of lawsuits concerned with the international provisions of that law, and other new matter. In a preface to the new edition Mr. Putnam, while admitting that our law works better than the friends of international copyright expected, points out ways in which he believes it should be modified.

PUBLICATIONS RECEIVED.

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Compayré, Gabriel. The Intellectual and Moral Development of the Child. Translated by Mary E. Wilson. New York: D. Appleton & Co. Pp. 298. $1.50.

Corrigan, Severinus J. The Constitution and Functions of Gases. St. Paul: Pioneer-Press Co. Pp. 159.

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Dresser, Horatio W. The Perfect Whole. Boston: George H. Ellis. Pp. 259. $1.50.

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Hertwig, Oscar. The Biological Problem of To-day. (Translated by P. Chalmers Mitchell.) New York: The Macmillan Co. Pp. 148. $1.25.

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Sizer, Nelson. Uncle Sam's Letters on Phrenology. New York: Fowler & Wells. London: L. N. Fowler & Co. Pp. 145. 50 cents.

Smithsonian Publications. Bendire, Charles: Life Histories of North American Birds. Ill., pp. 518. Goode, George Brown, and Bean, Tarleton H.: Oceanic Ichthyology. Ill., pp. text, 552; plates, 123.—Hodgkins Fund Publications, 1033: Argon, a New Constituent of the Atmosphere, by Lord Rayleigh and Prof. William Ramsay, and Methods for the Determination of Organic Matter in Air, by David Hendricks Bergey.

Thorpe, T. E. Humphry Davy, Poet and Philosopher. New York: Macmillan & Co. Pp. 240. $1 25.

Trowbridge, John. What is Electricity? (International Scientific Series.) Pp. 309. $1.50.

White, Andrew D. Fiat Money Inflation in France. New York: D. Appleton & Co. Pp. 86. 25 cents.

Wise, P. M. A Text-Book for Training Schools for Nurses, with an Introduction by Dr. Edward Cowles. New York and London: G. P. Putnam's Sons. 2 vols. Pp. 230 and 327. Each, $1.25.

Fragments of Science.

Notes from the American Association.—The attendance at the Buffalo meeting of the American Association—three hundred and thirty—was the smallest in its recent history. A curve with very marked indentations published in Science shows that the attendance on the meetings has steadily decreased since it reached its maximum in 1880 to 1884. The curve further shows that it was very much greater when the association met in the larger Eastern cities—Boston, Montreal, Philadelphia, New York, Washington, and Brooklyn—though declining in them too, than in the cities farther west. Among the resolutions passed by the association were, one urging upon Congress the desirability of further legislation looking to the early adoption of the metric system; one authorizing the construction of authentic standards of electrical measurement, to be the property of the association; a resolution approving the proposition to create the office of Director-in-Chief of Scientific Bureaus and Investigations in the Department of Agriculture, "to be filled by a broadly educated and experienced scientific man, provided that such appointment shall be made only on the nomination of the National Academy of Science, the legally constituted adviser of the Government in matters relating to science"; and a protest to Congress against legislation on vivisection. In this protest the association declared that experiments on animals "have effected a saving of many millions of dollars in animal property, and are the basis of our knowledge of hygiene and preventive medicine, and, in part, of surgery"; and affirmed that, "while deprecating cruelty and needless vivisection experiments in the public schools, this association believes that those who are trained to biological research are the ones who are best able to decide as to the wisdom and utility of animal experimentation." A committee was appointed to consider the matter of instituting a study of the white race in America. Grants were made of one hundred dollars for a table at the Biological Laboratory at Wood's Hole, Mass.; fifty dollars to Francis E. Phillips for investigations on the properties of natural gas; and fifty dollars to L. A. Bauer for investigations on terrestrial magnetism in connection with the magnetic survey of Maryland. A happy adjustment was suggested, and partly carried out in the case of one of them, of the relations of the special societies to the association, under which, after the formal meeting of the special society, the papers contributed by members shall be held over to be read in the meetings of the association. The societies, by following this plan, may be made to contribute to the strength of the association and to the interest of its meetings.

New Elected Officers of the American Association.—The following are the officers elect for the next meeting (Detroit, 1897) of the American Association for the Advancement of Science: President: Wolcott Gibbs, of Newport, R. I. Vice-Presidents: (A) Mathematics and Astronomy, W. W. Beman, of Ann Arbor, Mich.; (B) Physics, Carl Barus, of Providence, R. I.; (C) Chemistry, W. P. Mason, of Troy, N. Y.; (D) Mechanical Science and Engineering, John Galbraith, of Toronto, Canada; (E) Geology and Geography, I. C. White, of Morgantown, W. Va.; (F) Zoölogy, G. Brown Goode,* of Washington, D. C.; (G) Botany, George F. Atkinson, of Ithaca, N. Y.; (H) Anthropology, W J McGee, of Washington, D. C.; (I) Social and Economic Science, Richard T. Colburn, of Elizabeth, N. J. Permanent Secretary: F. W. Putnam, of Cambridge, Mass. (office, Salem, Mass.). General Secretary: Asaph Hall, Jr., of Ann Arbor, Mich. Secretary of the Council: D. S. Kellicott, of Columbus, Ohio. Secretaries of the Sections: (A) Mathematics and Astronomy, James McMahon, of Ithaca, N. Y.; (B) Physics, Frederick Bedell, of Ithaca, N. Y.; (C) Chemistry, P. C. Freer, of Ann Arbor, Mich.; (D) Mechanical Science and Engineering, John J. Flather, of Lafayette, Ind.; (E) Geology and Geography, C. H. Smyth, Jr., of Clinton, N. Y.; (F) Zoölogy, C. C. Nutting, of Iowa City, Iowa; (G) Botany, F. C. Newcombe, of Ann Arbor, Mich.; (H) Anthropology, Harlan I. Smith, of New York, N. Y.; (I) Social and Economic Science, Archibald Blue, of Toronto, Canada. Treasurer: R. S. Woodward, of New York, N. Y.

The President's Address at the British Association.—The opening session of the Liverpool meeting of the British Association, September 16th, was witnessed by about three thousand persons. Sir Douglas Galton, the retiring president, in introducing the new president, Sir Joseph Lister, spoke of the occasion as marking the termination of his own services to the association which, as general secretary and finally as president, had extended over a quarter of a century. The presidency of Sir Joseph Lister, who is also President of the Royal Society, offers the first case in which a surgeon has held this position in the body solely in virtue of his professional attainments. It may well be so, for those attainments, as Sir Douglas Galton observed, "have been mainly devoted to mitigate suffering, and have revolutionized the surgeon's art"; and an English journal is moved to declare him "one of the greatest, if not *the* greatest, benefactor mankind has ever had." The new president's address was devoted to the illustration of the Interdependence of Science and the Healing Art, and began with an estimation of the value of the aid the Röntgen rays may render to the surgeon and physiologist. The fact that this is the jubilee of anæsthesia in surgery brought that subject properly forward. Next, the speaker referred to the researches of Pasteur on fermentation and his disproval of spontaneous generation as leading up to his own application of aseptic surgery, the development and ultimate method of which he described briefly and with remarkable clearness. The work of Robert Koch, Pasteur's attenuated virus and artificial immunity, the centenary of vaccination and Pasteur's application of the principle in rabies, Behring and Kitasato's antitoxic serum and its use in diphtheria, and Metchnikoff's investigations of the phagocytes, or white corpuscles, and their power to counteract infection were presented as specimens, culled from a wide field, of what the art of healing has borrowed from science and contributed to it.

The Sectional Addresses in the British Association.—In the sectional meetings of the British Association, Prof. J. J. Thomson, in Section A, made The Teaching of Physics the subject of his presidential address; Dr. Ludwig Mond, in the Section of Chemistry, reviewed the History of the Manufacture of Chlorine, with especial reference to the influence which the progress of pure science has had upon its development and simplification; Mr. J. E. Marr, of Cambridge, in Section C, spoke of Stratigraphical Geology and the effect which the work done upon the subject has had upon our knowledge of geology considered as a

* Died since his appointment.

whole; Prof. E. B. Poulton, in the Section of Zoölogy, discussed the difficulties which arise from both the physical and the biological points of view in considering the subject of organic evolution, and inquired whether the present state of paleontological and zoölogical knowledge increases or diminishes those difficulties; Major Leonard Darwin, of the Royal Geographical Society, described what has been done for railway construction in Africa and what remains to be done if the continent is to be opened up, and sought to indicate the relation of the proposed railway routes to the main physical features of the countries they are to traverse; Mr. Leonard Courtney, M. P., in the Section of Economic Science and Statistics, presented a qualified defense of individualism as opposed to the principles of collectivism; Sir Douglas Fox, in the Section of Mechanics, sketched the progress that had been accomplished in the several departments of civil and mechanical engineering during the quarter of a century since the association last met in Liverpool; Mr. Arthur J. Evans, in the Section of Anthropology, dealt with the Origins of Mediterranean and European Civilization, supporting the "Eurafrican" theory in contradistinction to the Aryan theory; Dr. G. H. Scott, in the Botanical Section, presented an Exposition of the Scope and Functions of Modern Morphological Botany.

The Tree-Emblem of the Sioux.—In a paper on The Emblematic Use of the Tree in the Dacotan Group, read as a vice-presidential address before the Anthropological Section of the American Association, Miss Alice C. Fletcher, after showing how the religions of the Indians probably began with the utterances of a seer, which, passing from mouth to mouth, gradually developed into ceremonials with their rites, spoke of the thunder as the universally accepted manifestation of Wa-kan-da, the mysterious power permeating life. This idea was connected with the thunder birds, and they lived in cedar trees. The pole of the cedar tree therefore became an emblem of the highest value, so that the ceremonies of the sacred pole were of the greatest importance. The development of this idea slowly through many years is a most interesting part of the story of the Dacotans.

Rainfall and the Forms of Leaves.—Observations made by Stahl at Buitenzorg, Java, and recorded in his book on Rainfall and the Forms of Leaves, establish the fact that the points and indentations of leaves are elongated and made more slender by the action of rain; that leaves under its influence tend to assume a vertical position; that the nerves are modified into little channels through which water can flow easily; and that the arrangement of the down on leaves and stems contributes to the scattering of the drops. Other observers, Lundström and Wille, for example, had already pointed out some of these facts, but Stahl's work presents new points of view and contains very instructive details. The morphological peculiarities described are explained by Stahl as results of the necessity of relieving the leaves from their load of moisture, of turning the water to the roots and freeing the tops of the plants from it, of freeing the leaves from epiphytic algæ, fungi, and lichens, and of drying their surfaces rapidly, thereby making transpiration more easy. The distinctive feature of leaves exposed to seasons of rain is the elongation of their points, and this form appertains not to tropical plants only, but also to those which grow on the beach and receive the spray from the sea, to plants on high mountains and elevated plateaus which are wet by heavy dews, and to plants of the temperate zones growing where the precipitation is considerable. New and interesting observations on this subject are contained in a work recently published by Junguer. Some of the most original of them relate to the influence exercised by the spray of waterfalls on the plants that grow in the gorges, below or by the side of the falls. Plants situated thus are styled in German *Träufelspitzen*, or drip-pointed. In the leaves exposed to the spray, their usual down, which would tend to retain the moisture for some time, disappears from the leaves; and the grouping of the leaves on the stems is observed to be favorable to the passing away of the water. These effects may be produced experimentally; and it is possible, in greenhouses, to modify the shape of leaves by exposing them constantly to a fall of water or to spray. Jungner's experiments all tend to the support of the modern ideas concerning adaptation. These conclusions were reviewed in papers read at the recent meeting of the American Association by Prof. D. T. McDougal.

Meteorology and Sacrilege.—A recent debate in the Volksraad, at Johannesburg, on the subject of artificial rain-making has some scientific interest for the psychologist. The report is as follows: "The debate on the memorials from Krugersdorp requesting the Rand to pass an act to prevent charges of dynamite being fired into the clouds for rain was continued. Mr. A. D. Wohnaraus spoke in favor of his proposal, and denounced the action of certain persons in Johannesburg as invoking the wrath of God. Mr. Birkenstock said there was nothing irreligious or sacrilegious in these experiments; they were purely scientific experiments. The chairman said it was a monstrous thing to shoot into the clouds; it was nothing less than defiance of the Almighty; it should be made a criminal offense. Mr. Labuschagne was of the opinion that the offenders should be imprisoned. After a further discussion it was resolved, by fifteen to ten votes, to instruct the Government to draft a law to prevent such things happening in future, and submit it this session."

A Cambodian Lesson in Anatomy.—M. Adhémard Leclère, in his examinations of Cambodian schools, came upon a retired scholar-bonze who continued to teach in his rural retreat. He was giving lessons on anatomy to six students of a religious vocation, describing the bones of the human body. He said: "There is a bone in the tongue, which you do not know of, which you have never seen, but which nevertheless exists, for I have seen it. The most surprising thing about it is that it is isolated, and not attached to any other bone. It is all alone." The teacher had given a lesson on the Pali language the day before, and the day before that on the world as described in the sacred books, and also according to what he had heard from Europeans concerning it. "He showed me," says M. Leclère, "on his blackened tablet, a map of the world which he had drawn according to the best of his knowledge. I had some difficulty in recognizing France among all the round marks he had drawn, for it was larger than India, surrounded by water on all sides, and placed northwest of the Himalaya Mountains. 'My map,' he said, 'is not like the map in the sacred books, but it is true all the same.' I did not dare tell him, before his pupils, that it was not like our maps; so I asked him to go on with his lecture, and said I was very glad to be present. The students, each with his palm-leaf tablet and his iron-pointed stylus, listened quietly and respectfully, writing down the names of the bones as he mentioned them. 'The bones of the back are boxed into one another like the bones of a snake or of a fish; if there was only one bone, you would not be able to bend yourself gracefully, or to bend back, or to round your back or to turn yourself. At the slightest shock the bone would break, and you would not be able to carry anything heavy. If the bones of the back were imperfectly boxed, they would not roll upon one another, or else they would roll too much; and your body would be too stiff or too supple, and you would not be able to carry anything heavy.' While he was speaking thus I was looking at him. His body was bare; his long, bald head was slightly inclined toward his hearers, and his bright eyes had an expression befitting an old professor seeking to be correctly understood. He spoke slowly, pronouncing distinctly, and in dignified language; and his six students looked at him attentively, trying their best to understand all he said."

Wire-Glass.—Some instructive tests of wire-glass as a protection against fire were recently made by the Philadelphia Fire Underwriters' Association. Wire-glass consists of a more or less open meshwork of wire imbedded in glass plates in such a manner, it is claimed, that—under conditions where, unsupported by the wire network, the glass would speedily be shivered, and of no use in retarding the fire—the wire-glass interposes a barrier which, even when heated to incandescence and then drenched with cold water, still retains its effectiveness. A brick test house, about three feet by four feet, inside measurement, and nine feet high, was constructed. In one side of this structure a wire-glass window was fastened in a wooden frame covered with lock-jointed tin. In another side a Philadelphia standard fire door was hung. The upper part of this door had a pane of wire-glass, eighteen by twenty-four inches, set into a wood, metal-covered frame. The entire roof of the test house was replaced by a skylight. One side of this skylight was provided with three lights of a quarter-inch ordinary rough glass; the other side with three lights of a quarter-inch wire-glass. In order to make the test as severe as possible, iron grate bars were placed in the bottom of the test house, and openings were left in the wall near the ground for the purpose of free draught. The house was filled two thirds full of wood, liberally treated with coal oil and resin. In a few moments after the fire was started the ordinary rough glass began to crack and fall into the fire. The wire-glass in the fire door soon became red hot, so that a piece of paper held against it on the outside was easily ignited. The three plates of wire-glass in the skylight, subjected to the entire heat of the fire, also became red hot, but retained their position throughout the test. At the end of thirty minutes water was thrown on the fire and glass. After the fire was extinguished the three plates of glass in the skylight were found to be cracked into countless pieces, but still adhered together, forming one sheet. The window-light—which, as the result showed, was not properly secured to its frame—was found to be in the same condition as the skylight, excepting that a large crack had developed. The plate of glass in the fire door was cracked the same as the skylight, but, being well secured, it did not give way.

Constitutionality of Time Labor Laws.—The general trend of the decisions of courts, cited by Mr. S. D. N. North, in his paper on Factory Legislation in New England, concerning laws limiting the hours of labor, is against their validity. They are regarded as attempts to limit the constitutional right of freedom of contract. But some of the decisions are conflicting. The Illinois Supreme Court has decided that the effect of a law of this kind would be to deprive men of liberty and property. The Supreme Court of California declared an eight-hour ordinance of the city of Los Angeles simply an attempt to prevent certain parties from employing others in a lawful business and paying them for their services, and a direct infringement of the right of such persons to make and enforce their contracts. In Nebraska, an eight-hour law was held to be unconstitutional, as being special legislation, and as attempting to prevent persons legally competent from making their own contracts. In Illinois, an eight-hour law for women in clothing factories was declared to be unconstitutional because it interfered arbitrarily with the right to buy and sell labor. The mere fact of sex, the court held, would not justify the enactment of limiting legislation, unless there may appear "some fair, just, and reasonable connection between such limitation and the public health, safety, or welfare proposed to be secured by it." These facts are used by Mr. North as an argument against further attempts to limit the conditions of labor by legislation, lest the test of constitutionality should be pushed to the extent of overthrowing the restrictions we already have and accept as just.

Indians of the Paraguay River.—An interesting account is given by an Italian artist, Cavaliere Guido Bozziani, of two Indian tribes dwelling on the Paraguay River, among whom he spent some time, whose civilizations are very different. The Chamacocos are a people of noble stature and fine appearance, wearing no clothing "except rough sandals of peccary skin when on the tramp and a profusion of feather ornaments and necklets of reeds, etc., on festive occasions," and excel in feather work, forming combinations of great beauty with the variously bright-colored plumage with which the region supplies them abundantly. They have, too, the singular taste of making much use of rattlesnakes' rattles for ornamental purposes, wearing them with feathers in diadems, armlets, and leglets, bunching them into pendants for earrings, and tying them on axes and clubs. During their dances they use as rattles small gourds containing stones and belts made of loosely strung carapaces of tortoises or the hoofs of stags. Their pottery is all hand-made and rude. Their weapons and implements are long-handled stone axes—quite singular—plain clubs, wooden spears, large bows for shooting arrows pointed with hard wood, and small bows with a double string, shooting clay bullets, and used for catching birds. The women make bags of netting, and hammocks. They have superstitions about their food, among which is the prohibition of deer flesh to the women, who have to satisfy themselves with birds and small game; and of the eggs of the South American ostrich to the children. The Caduveos, Mbaryas, or Guaycuru, are a warlike and agricultural people, with fixed residences, and have the art of weaving, excel in pottery, and execute designs of wonderful beauty and variety. These qualities are regarded by the author as real results of a logical study of the harmony and æsthetic combination of lines and figures, and not of accidental combinations. Ornamental designs are painted on their skins with the juice of a plant producing a blue-black color, which penetrates the epidermis a little way, and lasts six or seven days. It is applied by women, with small sticks, to the end of which tufts of cotton wool are sometimes tied. The effect of the painting is often heightened by adding powdered charcoal to the juice. The people wear their hair short and well combed and greased; file their upper incisor teeth to a point; practice depilation; are very cleanly, bathing often; and wear decorous clothing and tasteful ornaments.

A Humorous Elephant.—In illustration of the sense of the humorous in elephants, Meredith Nugent, in Our Animal Friends, tells a story of an elephant in the *Jardin des Plantes*, in Paris, that was kept in the same inclosure with a large hippopotamus, for whose comfort and amusement a great stone basin had been constructed and filled with water. "It was quite early in the morning—before the hour for admitting the public to the garden—when I noticed the elephant walking around on the stone edge of the basin curiously watching the hippopotamus, which was completely under water. I felt quite sure that the elephant was up to some prank, and I was not mistaken, for just as soon as the ears of the hippopotamus came into view the elephant quickly seized one of them with his trunk and gave it a sudden pull. The enraged hippopotamus lifted his ponderous head clear out of the water and snorted and blew, but every time he rose to take breath the elephant would recommence his antics. Around and around the great quadruped would go, keeping a sharp lookout for the little ears of the hippopotamus, which he would instantly seize the moment they appeared. His evident delight in teasing his huge neighbor was very comical, and there is no doubt that he thoroughly enjoyed it. Again, one day the keeper placed some food for the hippopotamus in the corner of the inclosure, and at once the animal began to leave the water to get it; but the elephant slowly ambled over to the same corner and, arriving there first, placed his four feet over the favorite food in such a way that the hippopotamus could not get at it, gently swayed his trunk back and forth, and acted altogether as though he were there accidentally, until the garden was thrown open to the public, and he went forward to receive the daily contributions of bread, cake, pie, etc., which were always offered him by his hosts of admirers."

The Future of Wood Engraving.—Notwithstanding the apparently almost universal supplanting of the old methods of engraving by process illustration, Mr. W. Biscombe Gardner affirms that wood engraving was never more alive as a fine art or in a higher state of perfection than it is at the present period; "and it is still capable, in the hands of right, good, earnest workers, of being lifted to a much higher position." Process may hold the advantage for work that has to be done in a rush, and for that in which cheapness rather than quality is sought, but "wood engraving as a reproductive fine art never can be touched and never will be touched by any process yet invented." It is even "far and away" above any of the higher fine-art processes "in its marvelous versatility of technique, which enables the engraver to translate not only the value but the very individual touch of each artist from whose picture he may be engraving. All processes dependent upon photography are bound to go wrong in the rendering of values, since photography has not yet been brought to such a state of perfection as to master the difficulties of exact color translation. In fact, photography is utterly inadequate in the most simple wash drawings in black and white." While it is admitted that a pen-and-ink drawing could hardly be better reproduced than by the best process, "nothing does or ever can compare with the work done through the sensitive medium of the eye and hand of man. In fact, I consider wood engraving far better than any or all the reproductive arts, as it stands quite alone in its wonderful adaptability, for any variety of texture one likes can be produced on the boxwood block. This can not be said for either etching, mezzotint, steel, or copper, each having its own methods, great as the masters have been who have worked upon one or the other of these materials. . . . The crowning advantage enjoyed by wood engraving, through which it obtains its immense superiority over all other methods, is that the engraver is enabled to work in both black and white line. . . . Nothing is out of the range of imitation possible to wood engraving. The differences of textures of flesh, silk, satin, cloth, wood, steel, glass, the grain of wood, marble, weather-worn stone, furs and skins of animals, atmospheric effects, foliage of all kinds—all these it can represent, and beyond everything it can render the differences between oil and water color, and can accurately transcribe the old master's work with all its cracks and blemishes from damp and shrinkage." The author looks forward to a great future for wood engraving as a fine art.

The Mescal Ceremony.—At a recent meeting of the Washington Chemical Society Mr. Mooney read an interesting paper on The Mescal Ceremony among the Indians. The mescal plant is a small variety of cactus native to the lower Rio Grande region and about the Pecos River, in eastern New Mexico. Its botanical name is *Lophophora*, or *Anhalonium williamsii*. It is grayish green, club-shaped, and without spines. There is another mescal plant, the maguey of Arizona, with which the New Mexico species should not be confounded. The local Mexican name for the plant is *peyote*, a corruption of the original Aztec name, from which it would seem that the plant and ceremony were known as far south as the valley of Mexico at a period antedating the Spanish conquest. Several related species are described by Lumholtz as being used with ceremonial rites among the tribes of the Sierra Madre. The dried tops when eaten produce such marked stimulating and medicinal results and such agreeable mental effects, without any injurious reaction, that the tribes of the region regard the plant as the vegetable incarnation of the Deity, and eat it at regular intervals with solemn religious ceremony of song, prayer, and ritual. The juice of the cactus has an intensely bitter taste, due to an alkaloid pellotine, which is present to the extent of 0·75 to 0·89 per cent. This alkaloid has recently been investigated by Dr. A. Heffter, of the University of Leipsic. Its composition is expressed by the following formula: $C_{13}H_{19}NO_3$. It seems as a therapeutic agent to have two distinct actions. The first effect is narcotic in nature, owing to a paralysis of the brain; this stage is shortly followed by a tetanic condition, owing to the heightened irritability of the spinal cord. Thus pellotine falls into the pharmacological group with morphine. Prof. Jolly, of the Charité, in Berlin, has made clinical use of it as a narcotic in doses of 0·04 gramme.

Æsthetics in Engineering.—The address of Prof. Frank O. Martin, of the Section of Engineering of the American Association, on The Artistic Element in Engineering, was a plea for consulting beauty as well as utility in engineering construction. The engineer is not so bound by the mathematical traditions of his profession but that he has abundant opportunities to cultivate the æsthetical side. It is not true, as is often supposed at the first thought, that there is a conflict between the utilitarian and the artistic. While the mere application of money will not secure beauty, that feature may often be obtained without additional expenditure, or at most with one that is relatively trifling. As an example in which beauty had considerable influence in matters where it seemed little concerned, Prof. Marvin mentioned an engine room which had been elegantly fitted up, with the result that the engine fell under closer and more minute inspection than it could receive in the ordinary dark room, and was more carefully attended to—and that meant more economy for the owner. Our railroad companies find it advantageous to beautify their stations and cultivate their embankments. The engineer may find a wide field in beautifying municipalities and all public works on which he may be engaged.

An India-Rubber Famine.—The world's consumption of India rubber has been increasing so enormously during the past few years that the time does not seem to be far distant when the demand will greatly exceed the supply. The bicycle is of course responsible for a large part of this increase, and, as the pneumatic tire is becoming more of a necessity every day for all city vehicles, there promises to be a still greater demand hereafter. It is stated that only within the last year has there been any attempt to regulate the gathering of caoutchouc and to stop the wanton destruction of the tree, which it seems is usually cut down, so as to facilitate the collecting of the sap. This puts an end to the productiveness of whole districts every year, and, as it has been found that by properly made incisions about two pounds of rubber can be gathered from each tree annually, without in any way interfering with its growth or life, vigorous attempts are called for, and it is stated are being made, to regulate the treatment of the trees. Owing to the danger of a rubber famine, several chemists in both France and Germany have been working on methods for the artificial production of India rubber, and several new processes have already been announced. Attention has also been turned to the *balata*, a South American tree. This *balata* rubber, while not so good for insulation and other purposes as caoutchouc, is yet specially adapted for a great many uses, such as machinery belting, mackintoshes, surgical appliances, etc., and British Guiana has developed quite an export trade in it, the annual quantity amounting to over three hundred thousand pounds.

MINOR PARAGRAPHS.

A recent number of the American Medical and Surgical Bulletin contains an article on the artificial generation of ozone for purifying the air in our public schools. In many cases the schoolroom air is so stale and depressing that before the children have been in it half an hour all their brightness and vim has disappeared, they become listless and sleepy, and are in the worst possible condition for study. This alone would be bad enough, but breathing this vitiated air renders them more vulnerable to the attacks of pathogenic germs, some of which are sure to be present in such a favorable location. Ozone is markedly germicidal and stimulating, and the suggestion, although not a new one, seems worthy of attention.

It has been decided to erect in one of the squares of Paris a monument to Pasteur, and to make the enterprise an international one. Consequently, the people of all countries will be given an opportunity to participate in the subscriptions. The Paris committee is under the presidency of M. J. Bertrand, Perpetual Secretary of the Academy of Sciences, and has among its honorary members the President of the Republic and his Cabinet, and about one hundred and sixty prominent men of the French nation in all walks. A committee has been formed in the United States, at Washington, with Dr. D. E. Salmon as chairman and Dr. A. E. de Schweinitz as secretary, which gladly accepts the privilege of organizing the subscription and of receiving and transmitting the funds which are raised. "We believe it is unnecessary," the committee says in its circular, "to urge any one to subscribe. The contributions of Pasteur to science and to the cause of humanity were so extraordinary and are so well known and so thoroughly appreciated in America that our people only need the opportunity in order to demonstrate their deep interest." Subscription blanks will be supplied by the committee, and no one who can not give a large sum need be deterred from giving a small sum. The committee's address is at the Cosmos Club, Washington, D. C.

The *Biologisches Centralblatt*, conducted by Drs. J. Rosenthal, M. Rees, and E. Seleuka, and published semimonthly at Leipsic by Eduard Besald, aims to keep its readers in current with the progress of the biological sciences, and to inform the students of single branches of what is going on in the other and related branches. With a view to that object it presents original communications, particularly those embodying the results of investigation which are of general interest outside of the bounds of their several specialties, and summaries; comprehensive reviews of the more important events in the progress of investigation, weeding out what is temporary or subsidiary, and presenting only that which is of lasting value and a literary record.

Consul Merritt, of Barmen, is authority for the following statements regarding mineral wool, or silicate cotton, as it is sometimes called. The wool appears on the market in a variety of colors, and is coming to be used very extensively as a non-conductor of heat and also as a protection against fire. It is made by blowing molten rock into a fibrous woolly state by means of a jet of steam. The furnace slag or the rock, as the case may be, is melted in a large cupola, and as it trickles out at the taphole in a somewhat sluggish stream it meets a high-pressure steam jet which blows it into a woolly, fibrous condition, in which state it settles in fleecy clouds on the floor, the heavier wool coming down first, while the lighter portions are blown farther along by the force of the steam. The material thus naturally grades itself.

For an inquiry whether fishes have a sense of hearing, Herr A. Kreidt experimented upon goldfish—normal, fish poisoned with strychnine, and fish deprived of their labyrinths. Sounds were made by sonorous rods plunged in the aquarium, to which tuning forks or bows were applied out of the water. Whistling and the ringing of bells outside of the water produced no impression on either of the three classes experimented upon. But all responded whenever the apparatus within the aquarium was struck with the production of an audible sound. The conclusion was drawn that fish do not hear as in ordinary hearing with the ears, but that they are sensitive to sonorous waves which they can perceive through some skin-sense.

A Mr. Chaplin, in introducing a bill in the English House of Commons, which was intended to ameliorate the widespread agricultural depression, gave some striking facts regarding the present unjust methods of taxing land. One instance, of two men living side by side, each of whom started in life with $100,000. A invested his money in various securities, and now has an income of $2,800 a year. He lives in a house rated at $200 a year, and his rates come to about $22. B invested his capital in a farm, for which he paid $75,000, and afterward put $25,000 in as tenants' capital. His farm is rated at about $2,585, and his rates amount to about $335. Another striking case was that of a factory employing 2,000 hands, rated for local purposes at $2,000. A farm of 200 acres in the same parish is assessed at $2,300, and pays more to the local rates than the factory. Another case cited was that of a farm of 265 acres in Essex, where the rent was only about $76 and the rates $90.

An International Atlas of Clouds has been published under the direction of a committee consisting of M. Hildebransson, of Upsala; Riggenbach, of Basle; and Tesserenc de Bort, of Paris. It contains fourteen plates, each including two or three figures, the several classes of clouds in the classification adopted being represented by from one figure for the "fracto-nimbus" to ten for the cumulus, while some transitional forms are also delineated. The figures have been selected from more than three hundred representations of clouds from all quarters of the earth. The plates have been approved by eminent meteorologists, and their accuracy is guaranteed. In the text are given the definitions and official instructions adopted by the International Meteorological Committee at its meeting in Upsala in 1894.

It is proposed to explore the island or rock of Rockall, which is situated in the open Atlantic, in 57° 36′ north latitude, about two hundred miles west of the Hebrides, with no other land nearer. It is about two hundred and thirty feet in circumference at the base and sixty feet at the top, and looks at a distance like a ship under sail, being whitened by the guano that has been deposited upon it. It appears to be the emerged point of an extensive mountainous submarine table land, stretching from the southwest to the northeast, and giving rise to a number of dangerous rocks and reefs in the neighborhood. It offers advantages of great promise as a meteorological station, situated as it is in the zone of the most extensive area of cyclones in the northern hemisphere, but it is not easy to land upon when the sea is at all rough. It is but little visited. It bears a few plants which have not been collected and studied, and is the resort of numerous sea birds. The curious peak is situated at a greater distance from any mainland than any other isolated rock of like dimensions in any part of the world.

Old shoes are not lost by any means. In this country they are dissected and subjected to a course of manipulations by which they are converted into a kind of artificial leather, which is made to look very fine, and may be elegantly ornamented. In France they go through a less elaborate transformation. At the military prison in Montpellier the shoes, the majority of which come from Spain, are ripped apart; the nails are drawn out. The parts are softened in water, and are then cut up by a machine into vamps for children's or little girls' shoes. The soles are likewise utilized. The smallest pieces are used to make the Louis XIV toes which were in fashion a few years ago. Pieces a little larger and thinner are made into the soles of babies' shoes. The nails of iron are separated by means of a magnet from copper nails, and the latter are sold for a higher price than the others. The manager of the prison represents that the returns from this manufacture nearly equal the cost of the old shoes.

NOTES.

Hon. David A. Wells's chapters on The Principles of Taxation, the publication of which has been unavoidably suspended in the October and November numbers of the Monthly, will be renewed in the December number, and regularly continued thereafter.

The British Association has resolved to invite the president, vice-presidents, and officers of the American Association to attend its meeting next year at Toronto as honorary members; also to admit all fellows and members of the American Association as members of the British Association on the same terms as old annual members—namely, on payment of £1 (or $5), without requiring an admission fee.

In regard to the proper designation of its vice-presidents, the American Association directed that that term be used in official publications in expressing the relation of the presiding officer of any section to the association, and the term *chairman* in expressing his relation to the section; and that the term *vice president* precede the name of the officer and *chairman* follow it when both relations are to be expressed. When referred to, these officers are to be termed vice-presidents *for*, not *of*, the sections.

Prof. Wolcott Gibbs, the new President of the American Association for the Advancement of Science, Rumford Professor and Lecturer on the Application of Science to the Useful Arts, is the oldest living professor in Harvard University, though not now in active service.

A very satisfactory dressing for wounds, consisting of bags of straw charcoal, is used by the Japanese. It fits perfectly to the wounds, and has considerable absorbing power and antiseptic properties. The charcoal is prepared by burning straw in a covered vessel.

A shrub in Madagascar, called the *vonimperono*, bears a seed, the feathery tuft of which possesses some of the qualities of silk, and may be found useful in the arts. The flower and the pod, as pictured in *La Nature*, suggest affiliation with the *Asclepiads;* and the tuft does not contradict the suggestion. It is a little more than an inch and a half long; its fibers have considerable strength; and, according to M. Georges Chapin, they form a veritable vegetable silk. The people of the western coast of Madagascar collect it, and, often without taking the trouble to remove the seed, make soft cushions and pillows of it; and the Hova ladies use it for stuffing the seats of their *filanzanes* or sedan chairs.

The term *roches moutonnés*, used by geologists to describe a peculiar topographic appearance resulting from glacial action, is usually interpreted as meaning resembling a flock of sheep asleep, and that is the explanation given by M de Lapperent in his geological treatise. The dictionaries, however, define *moutonné* as meaning frizzled like sheep's wool. The term was first used by De Saussure in his *Voyages dans les Alpes;* but the passage had escaped recent observation till Mr. Whymper found it. It reads, translated, "These contiguous and repeated roundnesses produce as a whole the effect of a well-grown fleece, of the wigs which *are called moutonnées*." Mr. Grenville A. J. Cole in Nature cites this passage to justify his comparison of these shapes to the mammillations upon an antique wig.

A paper read some time ago in the Linnæan Society by Mr. R. Morton Middleton, recording the observation of Mr. Miltiades Isigonis of the use of ants by the Greek barber surgeons of Asia Minor for holding together the edges of a cut, brought out the fact that the same custom exists in Brazil as among these Greeks. The Eastern barbers hold the ant—a large-headed *Camponotus*—in a forceps, when it opens its mandibles wide, and, being permitted to seize the edges of the cut, which are held together for the purpose, its head is cut off as soon as a firm grip is obtained. A similar practice was observed in Brazil several years ago by M. Mocquerys, of Rouen, and is cited by Sir John Lubbock, but it is not mentioned by either Bates or Wallace.

Judgment was recently given in an English court, in the suit of an actress against the Nottingham Theater company for damages for injuries by falling through a dilapidated stairway, on the evidence of an X-ray picture of the injured foot.

The third volume of Poggendorff's Biographical and Literary Dictionary, now in publication, will contain notices of scientific men in various fields who lived between 1858 and 1883. A fourth volume will cover the years from 1883 to 1900. Full lists of contributions to scientific literature will accompany the notices. The dictionary will contain many names not often heard of, among them those of Arabian philosophers.

Experiments are in order to protect letters against exposure by the Röntgen rays. MM. Thayer and Hardtmuth, of Vienna, bronze the inside of their envelopes or ornament them with designs in bronze. It is found that the X rays have only a feeble action through the bronzed envelopes, while in those ornamented with bronze pastes only the spots that are left white are exposed; and in both cases the written characters are not revealed in intelligible shape.

In an experiment recently made at an Austrian wood-pulp factory to determine how quickly it was possible to make a newspaper from a tree, three trees were felled in the presence of a notary and witnesses at 7.35 a. m. The trees were taken to the factory and cut up into short pieces, which were stripped of their bark and converted into mechanical pulp. This was placed in a vat and mixed with the materials necessary to form paper, and the first leaf of paper came out at 9.34 a. m. Some of the sheets were taken, the notary still watching the proceedings, to a printing office about three miles away; and the printed newspaper was issued at ten o'clock. It thus took two hours and twenty-five minutes to convert a tree into a newspaper.

American science has suffered a serious loss in the death, September 6th, of Dr. George Brown Goode, Assistant Secretary of the Smithsonian Institution. Dr. Goode was born at New Albany, Ind., February 13, 1851; was interested in natural history from an early age; was graduated from Wesleyan University in 1870; and made a collecting trip to the West Indies in 1872 and 1873. In the latter year he became connected, on the invitation of Prof. Baird, with the Smithsonian Institution, where he spent the rest of his life. He performed many special services, especially in connection with the interests of fisheries; as director of the Natural History division in the Philadelphia Centennial Exhibition of 1876; United States Commissioner to the International Fisheries Exhibitions in London and Berlin in 1880 and 1883; statistical expert with the Halifax Fisheries Commission in 1877; representative of the Smithsonian Institution at the Chicago Exhibition of 1893; and member of the Board of Awards at the Atlanta Cotton States Exhibition of 1895. Among his published reports and works are those on the Game Fishes of the United States, The Fishes and Fishing Industries of the United States, American Fishes and Oceanic Ichthyology, the Plan of Classification for the World's Columbian Exhibition, and the Museums of the Future.

Prof. Hubert A. Newton, of Yale University, mathematician, and one of the most distinguished investigators of meteors and meteoric showers, died in New Haven, Conn., August 12th. A sketch of his life and his work on the problem of the meteors was published, with a portrait, in the Popular Science Monthly for October, 1885 (vol. xxvii, p. 840). His address as President of the American Association, at the Buffalo meeting in 1886, on Meteorites, Meteors, and Shooting Stars, was published in the Monthly for October, 1886 (vol. xxix, p. 733). Subsequently to these dates, Prof. Newton continued his studies of meteors by the aid of stellar photography, with many interesting and valuable results; and through his exertions a battery of cameras was placed in Yale Observatory for more extensive meteoric photography. His work in mathematics was also of the highest order.

We announce with regret the death of Prof. J. L. Delbœuf, of the University of Liége, at Bonn, August 13th. Prof. Delbœuf was a student and scientific writer of more than ordinary power to interest, original and genial, and possessing considerable humor. We have published several articles and extracts from his writings; among them are Dwarfs and Giants in the twenty-second and What may Animals be taught? in the twenty-ninth volume of the Monthly; and more recently, Observations on the Psychology of Lizards.

Herr Otto Lilienthal, the inventor of a flying machine with which he had achieved some small successes, was killed during an experiment with his apparatus at Rhinow, near Berlin, August 12th. The machinery became deranged, and the whole concern fell, with Herr Lilienthal, to the ground.

HENRY DARWIN ROGERS.

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PRINCIPLES OF TAXATION.

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IV.—RELATION OF TAXATION TO THE STATE.

THE next step of importance in this discussion is to recognize clearly the relation which the exercise or function of taxation, as it has been defined, sustains to the state.

ORIGIN AND JUSTIFICATION OF TAXATION.—The question at once suggests itself, "By what right does that *entity* which we call the state, whatever may be its concrete form, and whether its powers are exercised by a single man (Cæsar), by a particular class, or by a majority of citizens, take from the individual that which hitherto was absolutely his, annul his ownership, and convert the thing of value to its own use?" * How happens it that the exercise of this right is so absolute that the state requires the citizen to set apart from the earnings of his labor a certain sum for its use before he applies any of those earnings to the support of his family? †

On this point there has been considerable speculation and philosophizing. It has been assumed that there must be an actual or implied contract between the state and the citizen, in virtue of which the state supplied a certain amount of protection to life

* "Titius is to render to Cæsar that which is Cæsar's. But when Cæsar comes to take the shock of wheat or the firstling of the flock Titius may well ask, as he gives them up, Why are they Cæsar's rather than mine? What right to them has Cæsar and not my neighbor Mævius?" Tyranny in Taxation. Theodore Bacon. New-Englander, 1867.

† The probate judiciary of the State of Connecticut has recently held that in the settlement of insolvent estates taxes due prior to the assignment of an assigning debtor should be regarded as preferred claims, and as such should be paid in full by the trustee.

and property, and for which the citizen in return pays an equivalent in money, merchandise, or personal service. There is, however, no historical example of any such contract.

Others have sought to refer the origin of this right on the part of the state to take the property of the citizen to an antecedent right of might, and have assumed that, as the ruling power, whether monarch or majority, is physically able to take and apply to its own use all that the individuals ruled over may call their own, it is therefore legitimate and morally correct for it to exercise this right and take such part of its subjects' property as it may see fit.

A *third* and more plausible theory is, that as all rights of property are conventional and not natural, and without the intervention of the state by its laws could not be enforced nor protected, and, indeed, could hardly be said to exist; therefore the state is the source of all title, and the individual holds only by grant or sufferance of the state. From these premises it follows that the state, in compelling contributions from its subjects, or, as is ordinarily expressed, in "taxing," is in the position of an absolute proprietor who takes simply what is his own. This was the theory accepted and practically carried out by all the monarchs of Europe in the seventeenth century, or about two hundred and fifty years ago, and defended by the best and most eminent men of the time, as Bossuet in France and most of the great jurists of England under Charles I, as was exemplified in the case of John Hampden, who was prosecuted for refusing to pay an arbitrary tax known as "ship money"; and the decision in which, by the High Court of Exchequer, placed the property of every Englishman at the disposal of the crown. It was also so clearly expressed by Louis XIV that his words are worthy of exact citation. Thus, in a manual which he wrote for the guidance of his heir and successor, the Dauphin, he says: "I hold the place of God. To me belong exclusively the lives and fortunes of my people. The nation resides entirely in the person of the monarch. Kings are absolute masters, and may naturally, fully and freely dispose of all the property possessed by either the clergy or laity, to use at all times like wise stewards and according to the needs of the state."

Herbert Spencer refers the growth of revenue, which involves the right to take it, from the outset, like the growth of political headship which it accompanies, directly or indirectly, to the results of war. "The property," he says, "of conquered enemies—at first goods, cattle, prisoners, and at a later stage land—coming in larger share to the leading warrior, increases his predominance. To secure his good will, which it is now important to do, propitiatory presents and help in labor are next given; and these, as his power further grows, become periodic and compulsory, making him more despotic at the same time that it augments his kingdom. Continuance of this process increases his ability to enforce contributions, alike from his original subjects and from tributaries; while the necessity for supplies, now to defend his kingdoms, now to invade adjacent kingdoms, is ever made the plea for increasing his demands of established kinds and for making new ones. Under stress of the alleged needs, portions of their goods are taken from subjects whenever they are exposed to view for purpose of exchange. And as the primitive presents of property and labor, once voluntary and variable, but becoming compulsory and periodic, are eventually commuted to direct taxes; so those portions of the trades goods which were originally given for permission to trade, and then seized as of right, come eventually to be transferred into percentages of value paid as tolls and duties. But to the last as well as at first, and under free governments as under despotic ones, war continues to be the usual reason for imposing new taxes or increasing old ones, at the same time that the coercive organization, in past times developed by war, continues to be the means of exacting them." * Mr. Spencer further asserts that "in the early stages of social evolution nothing answering to revenue exists." These conclusions of Mr. Spencer seem, however, to be singularly imperfect, inasmuch as they do not appear to recognize that there can be such things as voluntary or beneficial taxes, or that society in order to exist would in the course of time institute taxation, even if there had been no war. He does, however, recognize that the increasing progress and complexity of civilization, by continually enlarging its sphere and functions, would continually necessitate an increase of taxation.

All such speculations and theories as to the origin and sphere of the rights of government in respect to appropriating the property of its subjects or citizens, although of philosophic interest, are, however, of no practical importance.† It is only necessary to recognize that in some form the organization or entity which we call the state exists for certain definite purposes, even though they be difficult of precise limitation; and to analyze the situation, as we find it, to obtain a satisfac-

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* Abundant illustrations from historical or recent experiences of the successive stages of such assumed evolution of taxation are given by Mr. Spencer in the chapter On Revenue in his volume on Political Institutions.

† Edmund Burke, the great Irish statesman, is on record as characterizing any discussion of the abstract right of taxation in place of the actual facts of the situation, as belonging to the domain of political metaphysics, "a great Serbonian bog in which armies whole have sunk," and that it was by fighting for such "a phantom, a quiddity, a theory that wants not only a substance but even a name," that English statesmen threw away their American colonies.

tory answer to the question at issue. For the command of a constant and adequate revenue being beyond dispute absolutely essential to the existence of organized government, the power to compel or enforce contributions from the people governed, or, as it is termed, "to tax," is inherent in and an incident of every sovereignty, and rests upon necessity.* The question of the obtaining of such revenue obviously, therefore, is the question of first importance in the economy of a state; the one in comparison with which all others are subordinate. For without revenue (and a government never has any resources except what it has obtained from the people), regularly and uniformly obtainable, no governmental machinery for the protection of life and property, through the dispensing of justice and the providing for the common defense, could long be maintained; and in default thereof production would stop or be reduced to a minimum, accumulations would cease or become speedily exhausted, and civilization would inevitably give place to barbarism and the wilderness. For like reasons also, or as the old-time Latin maxim, "*salus populi suprema lex,*" concretely expresses it, the state holds command over the lives and liberties of its citizens equally as it does over their fortunes. In fact, the sovereignty of a state consists and exemplifies itself in the power to abridge the liberty of the individual citizen and to take his property; and the character of every government is mainly determined by the intent and purpose for which these two great functions from which all its force proceeds are exercised.

THE SPHERE OF TAXATION.—The sequence of these premises is no less important, or rather of transcendent importance; for if the power of taxation is an incident of sovereignty, as it confessedly is, then the *right to exercise that power must be coextensive with that of which it is the incident;* or, in other words, as the power of every *complete* sovereignty over the persons and property of its subjects is unlimited, the power, therefore, in every *such* sovereignty to compel contributions for the service of the

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* "When we ask, What right has the state to infringe upon man's natural freedom? we are involved in the difficulty that there are no rights, in the strict sense of the term, antecedent to the state. All rights that we know anything about are either legal or moral. The right of the state to govern man can not be derived from law, for law is the creature of the state. If it is a moral right, it must rest on the same basis on which all morality rests, and this must be either conscience, or divine revelation, or utility. Of course, consent has nothing to do with morality. Conscience, furthermore, will not do as a basis for the state, for conscience does not enlighten us further than to let us know that we ought to obey the state if it is right to do so. Revelation, also, answered only so long as a direct and miraculous connection was believed to exist between human and divine authority. This leaves nothing but utility as the basis for the moral right of the state to interfere with man's natural freedom."—*Anonymous.*

state, or, as we term it, "*to tax*," must be unrestricted. "The power to tax is therefore the strongest and most pervading of all the powers of government, reaching directly or indirectly to all classes" (United States Supreme Court; Loan Association *vs.* Topeka, 20 Wallace, 655).

The power to tax, said Chief-Justice Marshall, in giving the opinion of the United States Supreme Court denying the right of Maryland to tax the Bank of the United States (McCulloch *vs.* Maryland, 4 Wheaton, pp. 316–431), "involves the power to destroy, and may be legitimately exercised on the objects to which it is applicable to the utmost extent to which the Government may choose to carry it." In the case of Weston *vs.* the City of Charleston, the same court, by the same eminent authority, also held that "*if the right to impose a tax exists, it is a right which, in its nature, acknowledges no limits. It may be carried to any extent within the jurisdiction of the State or corporation which imposes it, which the will of such State or corporation may prescribe.*" And in a more recent case (Loan Association *vs.* Topeka, 20 Wallace) the court, through the late Justice Miller, again expressed itself to the same effect as follows: "Given a purpose or object for which taxation may be lawfully used, and the extent of its exercise is in its very nature unlimited."

The government of a complete sovereignty can therefore tax all that it can lay hands on to enforce the tax—men, women, and children; all property and business—and the power may be exercised again and again until the subject taxed is exhausted or the privilege can be no longer exercised. This statement finds abundant illustration in history of people absolutely impoverished by taxation, and of individuals who have been sold into slavery because of their inability to pay the taxes that the state or ruling power had assessed upon them. The popular idea is that such examples of the extreme exercise of power on the part of the state to compel contributions have passed into history; but this is not the case. In every purely despotic Government there is no limitation on its exercise except such as arises from the inability of the subject to contribute. The head of the state—shah, czar, or emperor—decides how much shall be exacted and the time and manner of exaction; and not infrequently the amount taken is only a little short of what it is necessary to leave to the producer in order to enable him to maintain a mere animal existence. Thus in Russia the present governmental exaction—under the name of taxes—from the agricultural peasant is understood to amount to about forty-five per cent of his annual product or earnings.

In 1890 the excise taxation of Russia—which is mainly levied upon distilled spirits and other alcoholic drinks, tobacco, sugar, kerosene, and matches—is reported to have amounted to seventy-five per cent of the value of the articles taxed. On the other hand, the Russian customs duties in the same year averaged but thirty-four per cent of the import value of the foreign goods imported—a circumstance that may find an explanation in the fact that a large proportion of imports of Russia are in the nature of machinery or crude materials for industrial use or elaboration, and apart from this the requirements of the masses in Russia for foreign products are comparatively small.

In Egypt until quite recently, as has been already shown (see previous chapter on The Tax Experiences of Egypt), the annual exactions from its peasantry—the fellahs—under the name of taxation produced an extremity of want which closely bordered on starvation.

In Italy, which in ancient times was regarded, as it is in fact to-day, potentially the richest country in Europe, and although its present Government can not fairly be characterized as despotic, its agriculture is burdened with state exactions that are reported as absorbing from one third to one half of the value of its annual product. The existing debt of the country, created largely by enormous military and naval expenditures, entails an annual interest charge of about $3.75 per head of its population.*

Another disastrous interference with the prosperity of the state is the system of taxing all business enterprises, after they have been established three years, at rates which in some cases swamp the profits. And in addition to such disturbing elements, there is undoubtedly an all-pervading evasion for a consideration of all forms of taxation by the functionaries whose business it is

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* A national tax on movable (personal) property—the *ricchezza mobile*—is levied on the poorest of the Italian people; and often the bed has to be sold or the saucepans pawned to pay it.

The gate tax, *dazio consumo*, best known to English ears as *octroi*, which has been the especial object of the Sicilian fury, is a curse to the whole land. Nothing can pass the gates of any city or town without paying this odious and inquisitorial impost. Strings of cattle and of carts wait outside from midnight to morning, the poor beasts lying down in the winter mud and summer dust. Half the life of the country people is consumed in this senseless, cruel stoppage and struggle at the gates; a poor old woman can not take an egg her hen has laid, or a bit of spinning she has done, through the gates without paying for them The wretched live poultry wait half a day and a whole night cooped up in stifling crates or hung neck downward in a bunch on a nail; the oxen and calves are kept without food three or four days before their passage through the gates, that they may weigh less when put in the scales.

By this insensate method of taxation all the food taken into the cities and towns is deteriorated. The prating and interfering officers of hygiene do not attend to this, the greatest danger of all to health—that is, inflamed and injured animal and fowl carcasses sent into the markets. The municipalities exact the last centime from their prey; whole families are ruined and disappear through the exactions of their communes, who persist in squeezing what is already drained dry as a bone.—*Fortnightly Review, 1894.*

to collect the revenue. A very general feeling, therefore, naturally prevails that it is a laudable thing to cheat or rather rob the Government whenever opportunity offers.*

LIMITATIONS IN THE SPHERE OF TAXATION.—Attention is next asked to the fact that the foregoing propositions respecting the unlimited power of a state to compel contributions, or to tax, and which (as shown) have received the sanction of the highest judicial authorities, are predicated on the assumption of *complete* sovereignty on the part of the state. But in a truly free state such sovereignty does not exist, and the conditions which make it free necessarily preclude its existence. Thus in every such state the two great functions which constitute its sovereignty, namely, the right to interfere with the liberty of the citizen and with his property, have been called into existence and can be rightfully exercised for certain purposes only, which admit of precise definition. In such a state *the fundamental and essential purpose of government is not to abridge the liberty of the individual citizen in respect to his person, or his possession and use of property, but to increase it;* and this result (overlooked in a great degree by economists and legislators), as has already been pointed out, can only be attained by taking a part of the property of the citizen which the existence of the state has enabled him to acquire, for the purpose of maintaining instrumentalities for preventing any encroachment upon his rightful liberty and punishing those who attempt it. In fact, in every free state there are limitations on the exercise of the taxing power, growing out of the structure of

* It is enough to see how railways are built by the Government of Italy to form an idea of the openings afforded for rascality and fraud in their construction. "They are not built by contract, but on estimate. A building company estimates that a certain line will cost a certain sum and receives the job, which is always indeed a 'job.' The Government guarantees a certain income per kilometre, and the constructor makes the road as long as possible; but when the grant (which is made in bonds of the state) for the amount authorized is exhausted, the constructor coolly tells the ministry that the road must stop there unless the ministry makes another grant, which is of course done, and the invariable result is that the original estimate is nearly, or quite, or even more than doubled; with the consequence that none of the roads, as they are made, ever pay their expenses and interest on their cost of construction. More than that, they are so burdened with deadheads that it is estimated that only forty per cent of the passengers they carry pay full fare, the remaining sixty per cent paying from nothing up to seventy-five per cent of the fare. Deputies and senators travel free everywhere in the kingdom, but as the state pays a block sum for their privilege, it is not a dead loss, though, as every deputy who travels insists on having a whole compartment for himself, the road becomes anything but a profitable one. Every employee of the great systems of Italian railways has the right to make three journeys a year on each one, where he likes, and with his family, and the consequence is that some of them ruin themselves taking long railway journeys for which they have not the money to pay the expenses. And they are sixty thousand, with as many more pensioned off who have the same privilege; and, as all travelers know, the railway fare is the smallest part of the expense of a journey."—*Correspondence New York Evening Post, June, 1890.*

its government, or because it is free; or, as Chief-Justice Marshall expressed it, "by the implied reservations of individual rights growing out of the nature of a free government, and the maintenance of which is essential to its existence."

From the first dawn among the Anglo-Saxon race of the idea of a constitutional or free government, the necessity of establishing an inhibition on the power of government, in respect to the taking of property, was recognized; expressed or implied in the *Magna Charta,* and subsequently incorporated in the Federal Constitution, through its provisions respecting the equality of taxation, and that private property shall under no circumstances be taken for public uses without just compensation.

The necessity of a free state may, however, be so great—i. e., in the prosecution of war for national defense, or the maintenance of national existence—as to require that the entire resources of its people should be at the disposal of the Government, and compel a resort to taxation, even to the exhaustion of everything—property and business—which may be its objective; and in this sense —i. e., for the preservation of individual liberty and property—and in this sense only, is involved any inherent power or right in taxation to destroy. The nature of the principle involved also finds illustration in the circumstance that municipal authorities are warranted, in the case of extensive conflagrations, in absolutely destroying large amounts of property in the shape of buildings and their contents, in order to preserve a much larger amount of like property from destruction. The principle under discussion would not accordingly justify the use of taxation in time of peace (as has been exercised by the Federal Government of the United States) for the primary purpose of destruction, and not for revenue or the preservation of property. Clearly, if this right of taxation is unlimited, the property of every citizen would be subject to the absolute disposition and control of the depositary of power in the state for the time being; and the recognition or nonrecognition of such limitation marks, as before pointed out, more than any other one thing, the dividing line between a free government and a despotism.*

* "The dictum of Chief-Justice Marshall, used by this distinguished jurist in the heat of argument, has been adopted by many courts as justifying the uncontrolled exercise of the taxing power. A slight consideration will not justify the dictum. The proposition that the power to tax is the power to destroy is in opposition to the fundamental principles of a free government. It asserts the broad doctrine that the power to tax, one of the legislative powers, is unlimited and arbitrary. It is claimed that there is no such thing as arbitrary power in this country: that the form of government being republican, those who exercise the powers of government, whether executive, legislative, or judicial, are clothed with a trust which is not to be executed in accordance with a mere whim, or in an arbitrary manner, but according to the purpose of its creation."—*Burroughs's Law of Taxation,* 1877.

Probably the most weighty and concrete judicial opinion on this subject was that given by the Supreme Court of the United States in 1874 in the now celebrated case of the Loan Association *vs.* Topeka, 20 Wallace, in which the late Justice Miller, with the substantial concurrence of his associates, indorsed and amplified the opinion of Chief-Justice Marshall touching the reservation of individual rights under a free government as follows:

"It must be conceded," he said, "that there are rights in every free government beyond the control of the state. A government which recognized no such rights, which held the lives, the liberty, and the property of its citizens subject at all times to the absolute disposition and unbounded control of even the most democratic depositary of power, is after all but a despotism. The theory of our governments, State and national, is opposed to the deposit of unlimited power anywhere. The executive, the legislative, and the judicial branches of these governments are all of limited and defined powers. There are limitations of such powers which grow out of the essential nature of all free governments—implied reservations of individual rights, without which the social compact could not exist, which are respected by all governments entitled to the name. . . . Of all the powers conferred upon the Government that of taxation is most liable to abuse. Given a purpose or object for which taxation may be lawfully used, and the extent of its exercise is in its very nature unlimited. This power can as readily be employed against one class of individuals and in favor of another, so as to ruin the one class and give unlimited wealth and prosperity to the other, if there are no implied limitations of the uses for which the power may be exercised. *To lay with one hand the power of the Government on the property of the citizen, and with the other bestow it upon favored individuals to aid private enterprises and build up private fortunes, is none the less robbery because it is done under the forms of the law and is called taxation.* This is not legislation. It is a decree under legislative forms." And in the same case the same court declared that "the whole theory of our governments—State and national—is opposed to the deposit of unlimited power anywhere."

No one would probably question that if an assemblage of men reasonably intelligent—though not versed in law, political economy, or the teachings of social science—were to come together for the purpose of founding a state *de novo,* they would, while recognizing at once, and as it were instinctively, the necessity of insuring to the government of such state a revenue adequate to its support, never even so much as dream for one moment of intrusting to it a power to take the property of any individual member of such assemblage, except so far as might be absolutely necessary to carry out and fulfill the purposes for which it was proposed to call the state into existence. They would be mentally blind if they did not see at once that intrusting to the state a power of unlimited interference with the citizen's right to property, they would create not a free government but a despotism.

The question may be here naturally asked, Is there any record in history of any assemblage of the founders of a state which discussed this subject, or took definite action in respect to it? In answer it may be said that the two most striking assemblages in history which resulted in the formation of states, and of which any record is preserved, occurred in connection with the first settlements of New England, and that which resulted in the formation of the Federal Constitution and the creation of the nationality of the United States. The assertion would hardly be warranted that the early plantations of New England were formal assemblages gathered together for the avowed purpose of forming a state. They were, in fact, land companies, and so far as the law then existing permitted, were incorporated as such. This act of incorporation, derived from a corporation created by James I of England in 1606, and known as the Plymouth Company, was in the first instance and at once used as the basis for forming a political organization by the members of a land company or plantation. The necessity of a revenue to defray the expenses of the organization or incipient government, and in default of which there would be no adequate protection to persons and property, or, what is the same thing, no civilization, was at once recognized; and probably the very first act of the assemblage of the members of the company, after the selection of persons to exercise authority, was to authorize the levy of taxes. These taxes were assessed and collected in all respects as they are now in the great States that have been the outcome of these feeble plantations, through what may be termed a process of political evolution. That is, the individual members of the various communities or their authorized representatives met in their "General Court," as it was called, made appropriations, and, in order to pay them, levied what they termed a "rate" or assessment. This levy was put into the hands of a constable, who proceeded to enforce or collect the tax, either in the form of work or commodities or money. There is furthermore no indication in the records of these early times of any limitation as to the extent or degree of assessment, and for the very obvious reason that it never then occurred to any one that the power of taxation could possibly be used for the destruction of private property or controlling the acquisition and distribution of property—the inventions of a later period. The taxation of those days was necessarily of the crudest possible character. It fell almost exclusively on real property, and what was manifestly tangible and visible, for the very good reason that there was very little of what is now called personal property in existence—that is, there were no credit or paper representatives of property, but everything in the nature of property existed in the form of land, slaves, houses, animals, agricultural products, tools, or furniture.

The record of the assemblage (convention) that drafted the Constitution, which by adoption by the parties (States) thereto called the United States into existence as a nation, on this subject of guarding and limiting the taxing power on the part of the prospective State or Government which they proposed to create, is comparatively full and complete. The Revolution, which involved the renouncing of all allegiance of the British-American colonies to the mother country, had its origin in unjust taxation; and in the Declaration of Independence this fact was made conspicuous among the reasons that were relied on by the colonies to justify their action in the opinion of mankind. The attempt in 1778 to establish a General Government by the union of all the colonies under certain conditions, known as Articles of Confederation, was found after a few years of experience to be wholly lacking in all the elements of strength and stability, through the lack of any proper adjustment of the power of taxation; thereby entailing an almost complete inefficiency of sovereignty. Thus, there was no power in the Congress of the Confederation to raise money by taxation; but the Confederation depended for revenue upon requisitions on the several States, with which the States might comply or not, as they chose, and with which they generally did choose not to comply, either promptly or fully, if at all. Some of the States levied duties on the imports of merchandise at the expense of their neighbors; and adjacent ports in different States competed with each other by arbitrarily varying the rates on imports, as the Congress of the Confederation had no authority to regulate commerce, or legislate on this subject for the whole country.* The result was, as Mr. Madison expressed it, that "the Federal authority had ceased to be respected abroad, while at home it had lost all confidence and credit." It was to remedy this one radical infirmity, more than any other, that the present Constitution was projected and formed. Other great improvements in the Articles of Confederation were contemplated and made in the Constitution when it was formed, but the most important of all was in the regulation of taxation. Hamilton, who drafted the address to the States inviting them to send dele-

* The author of The Federalist (No. 7) refers to the situation of New York, as compared with that of Connecticut and New Jersey, as affording an example of the opportunities which some States had under the Confederation of rendering others tributary by a monopoly of the taxes on imports, and said that New York would neither be willing nor able to forego the advantage of levying duties on importations, a large part of which must be necessarily paid by the individuals of the other two States in their capacity of consumers.

gates to the convention by which it was formed, wrote thus in The Federalist:

"The power of taxation is the most important of the authorities proposed to be conferred on the Union."

The necessity of conferring adequate power in this particular upon the new Government which it was proposed to create was admitted by all; and yet there was no power which the people were more determined to guard, so that it could never be arbitrarily or unjustly exercised. And if it had not been supposed that the provisions of the new Constitution furnished ample security against any such action, not one of the States would have assented to its ratification.

The preamble of the Constitution asserts, almost in the first instance, that the object of its formation was to "establish justice," an obvious correlative of which is that there must be equality, and no discrimination in taxation as respects the same persons or things. In its first article (second section) it next provided that "representatives (in Congress) and direct taxes shall be apportioned among the several States according to their respective numbers, excluding Indians not taxed." The explanation of this provision, which now seems singular, is undoubtedly to be found in the assumption of the framers of the Constitution that taxation in the future, as it had been in the past, would be mainly *direct* in its assessment and incidence; and that wealth was so equitably distributed in the colonies (as it was at that time), and, as Roger Sherman, of Connecticut, expressed it, "the number of people alone" was "the best rate of measuring wealth." And on such supposition the absolute requirement of a strict apportionment of taxation according to population, with an inherent penalty of loss in congressional representation as the result of evasion, was undoubtedly regarded as a safeguard against unjust or discriminating taxation.

Next, in section 8, article 1, after empowering Congress "to lay and collect taxes, duties, imposts, and excises," to pay the debts and provide for the common defense and general welfare of the United States, was added another provision, the like of which does not find an exact counterpart in any political constitution or statute of which there is historical record—namely, that "all duties, imposts, and excises shall be uniform throughout the United States." This provision is one of the first importance. It would seem that there could be no doubt that the framers of the Constitution, having specially in view the fact that, under the Articles of Confederation, the several States endeavored to tax everything belonging to every other State that came within their territorial jurisdiction, and that there was no authority on the part of the then General Government to prevent such action, did not mean that the entity, called a State, they were about to create, should have any power of discriminating in respect to the imposition of duties, imposts, and excises in any degree; fully recognizing that the moment a State or government thus discriminates it passes the line of distinction between a free government and one that is not free. It is to be further noted that the words "to pay the debts and provide for the common defense and general welfare of the United States" should also be regarded in the light of a limitation of the purpose for which the taxes, etc. (authorized in the opening words of the section), may be laid and collected. This view was taken and strongly presented by Mr. Jefferson in 1791, shortly after the adoption of the Constitution. He says: "To lay taxes to provide for the general welfare of the United States is to lay taxes for the purpose of providing for the general welfare. For the laying of taxes is the *power*, and the general welfare the *purpose*, for which the power is to be exercised. They are not to lay taxes *ad libitum for any purpose they please*, but only *to pay the debts or provide for the welfare of the Union*. In like manner they are not *to do anything they please* to provide for the general welfare, but are to *lay taxes for that purpose*."—*T. Jefferson's Works, p. 557.*

Finally, there was added by amendment to the Constitution the following provision, which, although implied in the *Magna Charta*, had not been previously so explicitly expressed in the Constitution or statutes of any other State: "*Nor shall private property be taken for public use without just compensation.*" Obviously this provision constitutes another limitation on the power of Congress in respect to the taking of private property for public use by taxation or any other method. In a case involving the bearings of this provision on the taxation of a citizen of New Jersey, the Supreme Court of that State analyzed and interpreted its meaning as follows: "A tax upon the person or property of A, B, and C individually, whether designated by name or in any other way, which is in excess of an equal apportionment among the persons or property of the class of persons or kind of property subject to this taxation is, to the extent of such excess, the taking of private property for a public use without compensation. The process is one of confiscation and not of taxation."—*36 New Jersey, p. 66, 1872.*

It is certain, therefore, that in at least one assemblage for the purpose of creating a State—namely, the Federal Convention—its members clearly recognized the incompatibility of the possession and exercise of an unlimited power of taxation by a State and the coexistence of a free government.

Right of Eminent Domain.—Apart from the right of a State to take private property for its use by taxation, the State may also legitimately take such property when the interest of the public requires it, through what is called the *law or right of eminent domain*. The distinction between the power of taxation and the power of eminent domain is, however, clear and well defined. An appropriation of property under the right of eminent domain is a forced sale which its owner is compelled to make for the public good, and for which a pecuniary consideration equal to the estimated full value of what is taken is due from the State. And the exaction can not be considered as a tax "unless similar contributions are made by the public itself, or be exacted rather by the public will, from such constituent members of the same community as own the same kind of property." On the other hand, no pecuniary consideration is paid when money is demanded under the power of taxation, the benefits which the taxpayer is assumed to receive being indirect.

An Important Imperfection or Omission in the Federal Constitution.—Any discussion of the sphere of taxation in the United States would be incomplete that failed to recognize a feature, in the way of imperfection or serious omission, in the Federal Constitution, that hitherto has not attracted the attention it deserves. All powers inherent in the Constitution of the United States were derived from the States, and granted by them in their acts of ratification; and "the powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively or to the people."—*Article X, Constitutional Amendments.*

As has been already pointed out, the convention that framed the Constitution was especially solicitous and careful to guard and limit the power of taxation on the part of the new Government which it was proposed to create, so that it could never be arbitrarily or unjustly exercised. They anticipated in action the aphorism of John Stuart Mill, that "men do not need political rights in order that they may govern, but in order that they may not be misgoverned"; for, as was truly said by Guizot, "a constitution is only a device for turning ordinary mortals into tolerable monarchs." At the same time, the convention practically omitted to impose any limit or restriction on the exercise of the power of appropriating private property on the part of the States; or, as Chancellor Kent expressed it in his Commentaries on the Constitution, they left "to a State the command of all its resources and the unimpaired power of taxing the people and property of the State." On this point the only direct provisions of the Constitution are that neither the Federal nor State governments shall take private property for public uses—i. e., by taxation or right of eminent domain—without due compensation; and that no State, without the consent of Congress, shall lay any imposts or duties on imports or exports. By repeated decisions of the United States Supreme Court, another provision has been substantially ingrafted in the Constitution—to wit, that neither the Federal Government nor the governments of the States shall tax any of the instrumentalities or exclusive property of the other. The result is that, except for possible provisions in the Constitutions of the several States, their respective legislative assemblies may regulate, restrict, or appropriate the property of its citizens to an unlimited extent, and may delegate this sovereign power to local municipal corporations created by them. In short, in virtue of the power of levying unlimited taxes, the power of the Legislatures of the States that make up the Federal Union is as absolute as that of the Czar of Russia or the Sultan of Turkey. Not only may they take in this form all the property in the commonwealth, but also the property of its citizens in other countries. There is no Federal constitutional hindrance to their taxing, to any amount, real estate in any other State or country owned by citizens resident within their territorial jurisdiction. The constitutional provision that private property must be paid for when taken for public uses mainly refers, in the States, to the taking of land for highways and other similar acts of necessity by eminent domain.*

How little the people of the United States recognize the fact that they are living under a dual form of government, with like powers to some extent, especially in respect to the exercise of taxation, finds an illustration in the following incident. The question was recently put to the writer by a gentleman who had filled with ability the office of Governor of one of the leading States of the Federal Union, how it happened that the Federal

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* "There is nothing in the Constitution of the State of New York which requires that taxation shall be general, so as to embrace all taxable persons in the State, or within any district of the State; or that it shall be equal, or that it shall be in proportion to the value of the property of the person taxed, or that it shall not be apportioned according to the benefit which each taxpayer is supposed to receive from the object on which the tax is expended."—*People ex rel. Griffin vs. Mayer, 4 N. Y., 419, 1851.*

"There is no constitutional limitation upon the legislative power to tax the persons and property of individuals within the State. The power may be exercised to pay debts contracted before the property-holder comes within the jurisdiction."—*Pampelly vs. Village of Oswego, Ct. of App., 1863, N. Y.*

"Unless restrained by provisions of the Federal Constitution, the power of the State as to the mode, form, and extent of taxation is unlimited when the subjects to which it applies are within her jurisdiction."—*Kirtland vs. Hotchkiss, Connecticut.*

"The Legislature can constitutionally impose a tax on all watches, pianos, carriages, dogs, spirituous liquors, or other chattels without reference to their value. It can impose an arbitrary tax upon any avocation or business without estimating its volume or value."—*People vs. Equitable Trust Co. of New London, Conn., 1887; System of Taxation in the State of New York, prepared by Hon. Julien T. Davis, at request of a committee of the Legislature, 1888.*

Government could impose on him an income tax, and his own State, at the same time, assess him with not only another like income tax, but also with a tax on the property from which his income was derived? The idea of a dual government and its inconveniences, and that the Congress of the Federal Government had not cared to remedy the latter, had not occurred to the interrogator.

Had the power of the States to take money by taxation from their people been limited at the time of the formation of the Federal Union by constitutional provisions, the injury and disgrace of State repudiation might have been wholly avoided, and much wasteful extravagance checked.

"Within an hour's ride from the city of New York several towns can be reached that were bankrupted by undertaking 'public works upon a magnificent scale.' The number of Western communities that have been ruined from the same cause is countless. A very great number of people in the Eastern States, both poor and of the middle class, have been impoverished by the sudden check to the prosperity of these communities. Nor is any severer tax imposed upon any class than that which is paid by those who have only their wages to live upon, when they are deprived of these by the collapse of municipal credit and the consequent sudden stop to extravagant expenditure. The average cost of the pensions paid by the United States is ten to twelve dollars a year to every family in the country, and in many cases the pension charge alone is equal to half a month's or even to a month's wages. Not a few of the governments of the earth are now insolvent because of excessive expenditures upon public works. In South America and Australia, extravagant undertakings of this kind have caused widespread ruin and distress; and the poor of several other nations are likely to find out eventually that the alleviation of temporary distress by governmental expenditure of capital is like keeping off the cold by burning down the house." —*D. MacG. Means, The Forum, 1894.*

That the State governments should have bestowed the unlimited and imperial power of taxation upon city governments, and given up to their use and control the entire property of the citizens, is an extraordinary abuse of trust and a renunciation of the true functions of government. As a result of this policy these delegated governments have, within a comparatively recent period, absorbed for alleged public uses a large proportion of the property of the citizens, to the estimated extent in some instances of more than one third—that is, the usufruct (right of using and enjoying)—and the American citizen has to-day no constitutional or legal remedy. "No such plunder was ever sanctioned or practiced before in the history of civilized governments. That it has been possible in the United States argues the gravest defect in its political system. That a check is needed of the most absolute kind is recognized by all thoughtful men. Such check can only be had from the Legislatures of the States, who can not be too prompt in correcting the evils resulting from this extraordinary surrender of their supreme jurisdiction on the vital subject of taxation. The Legislature holds the public purse, and is false to its trust as its custodian when it authorizes corporations to put their hands, unwatched, into this purse and take from it, uncounted, all that their extravagance and cupidity desire. It is no apology that city governments are chosen by popular vote. It is the essence of our government that personal rights are, by our Constitution, wholly independent of the voting power, and certainly property should be equally so protected."

The question here naturally arises, How happened it that the framers of the Constitution and founders of our Government, while carefully defining and limiting the powers of the Federal Government in respect to the taking of property through taxation, omitted to make any like provisions applicable to the States? An answer is, that it was probably an oversight, favored by the circumstance that there was no English precedent for suchp rovisions. At the time of the Revolution it was, and ever since has been, the occupation and duty of the British House of Commons to limit and, if considered expedient, resist the pecuniary demands of the crown, and latterly of its ministers; and this occupation and duty were never delegated without restriction to any subordinate legislative assemblage. It might have been, and probably was, assumed by the framers of the Federal Constitution, that the several States in making their Constitutions would have followed the precedents respecting the rights and duties of taxation that they (the framers) had established; and, if the several Legislatures of the States had been confined to these rights and duties, and had never delegated them without restriction to the complicated, ill-organized, and irresponsible municipal corporations, which in latter days have grown to such portentous size, little of danger would have followed.* It should, however, be here noted that remedial action in this matter has recently been taken by some of the States, by forbidding their counties, cities, towns, or villages from incurring an indebtedness in excess of a percentage, varying with their population, of the valuation of the real estate subject to taxation. Constitutional restrictions on

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* In his treatment of this important topic, the author is mainly indebted to Mr. Manley Howe, of Boston, who, in a newspaper article published some years ago, seems to have been the first person to intelligently present the facts in the case and their consequences to the general public.

the borrowing power of the State itself, and of the municipalities within its territorial jurisdiction, have also in some of the States been adopted.

From the above discussion the following conclusions would seem to be fully warranted:

The limitation on the exercise of the power of taxation under a free government necessarily grows out of the source and sole justification of the power—namely, its *necessity;* and the righteousness of any specific interference by the state with individual rights in respect to property (as well as in respect to personal liberty) may be tested by the question, *Is it necessary?* Not Is it convenient? Not Is it suitable? If the necessity exists, then the power may be justifiably exercised to a corresponding extent. But, on the other hand, if the interference transcends that which is absolutely essential for fulfilling the rightful purposes for which the state exists, then it loses its sole justification of necessity and becomes tyranny, the definition of which is "despotic use of power." Further, "if the state, even to promote its necessary and legitimate objects, takes the amount of property to which it is entitled in such a manner as requires a citizen to pay more than his just share of the requisite amount—whether it be great or small—it takes that to which it has no right; it does what, if done by a citizen in defiance of law, is called robbery; if under color of law, is called fraud; but which in a government which makes law is simply confiscation and tyranny." And yet, very strangely, this tyranny has come to be regarded and defended by not a few intelligent persons who claim to understand the theory and nature of a free and just government as an act of wisdom and statesmanship, and in the highest degree beneficent to the citizen whose property is confiscated.

Reporting concerning the progress made on the English Philological Society's New English Dictionary, now in F, Mr. H. Bradley observed that the F-words include many scientific terms, and some of the oldest English and Romanic words, besides several onomatopœic words of arbitrary coinage. Initial *fl* has attracted makers of imitative and contemptuous words: *flip, flap, flop; flish, flash, flush; flick, flack, fluck; flim-flam, flip-flap,* etc. Of special words, *foist* has not the nauseous origin often attributed to it, but is analogous to the dialectical German *fäusten*, to get into one's fist. It occurs first in Dice-Play, of 1532, and means the holding in hand of a false die, to introduce at any point of the game; the false die was "foisted in"; all the known senses flow from this and parallel those of *cog. Fogger* in "pettifogger of the law," of about 1550, and in trade a huckster, peddler, sweater, is probably from the Fuggers, the great merchants of Antwerp in the fifteenth century. The word has passed into many languages. To *fog*, to cheat, swindle, is a back formation from *fogger*.

THE RELATIONS OF BIOLOGY, PSYCHOLOGY, AND SOCIOLGY.

By HERBERT SPENCER.

FROM time to time proof has come to me that in the United States there have arisen erroneous conceptions of my views concerning the connections between the sciences dealing respectively with organic evolution and super-organic evolution. These misconceptions will, if nothing be said, become established. Hence it seems needful that I should point out how entirely at variance with the evidence they are. The following extracts from two leading American writers on Sociology will sufficiently exemplify them. Mr. Lester Ward says:—

"The founder of sociology placed it next above biology in the scale of diminishing generality and increasing complexity, and maintained that it had that science as its natural basis and as the substratum into which its roots penetrated. Herbert Spencer, although he treated psychology as a distinct science, and placed it between biology and sociology in his system of Synthetic Philosophy, made no attempt to affiliate sociology upon psychology, while on the contrary he did exert himself to demonstrate that it has exceedingly close natural affinities with biology, as was shown in the third paper. At the close of that paper the fact came clearly forth that almost the only legitimate comparisons between society and a living organism were those in which the nervous system was taken as the term of comparison. In other words, it was clear even then that the class of attributes in the individual animal with which those of society could best be compared were its psychic attributes. If we are to have a science of psychology distinct from biology these attributes belong to that science, and hence it is really psychology and not biology upon which sociology directly rests." ("Sociology and Psychology." In *American Journal of Sociology*, vol. i, No. 5, March, 1896.)

In his recent work, published under the same title as my own, *The Principles of Sociology*, Prof. Giddings recognizes the fact that by me "the principles of sociology are derived from principles of psychology and of biology" (p. 8). But by his expressed belief that "the time has come when its principles, accurately formulated and adequately verified, can be organized into a coherent theory" (p. 17), he tacitly implies that my own theory is not coherent; and he proceeds to supply that which he regards as the needful bond—an ultimate psychological bond. His words are:—

"Accordingly, the sociological postulate can be no other than this, namely: The original and elementary subjective fact in society is *the consciousness of kind*. By this term I mean a state of consciousness in which any being, whether low or high in the scale of life, recognizes another conscious being as of like kind with itself." (*Ib.*)

And then on p. 19, after indicating the external conditions which prompt social aggregations, he goes on to say:—

"But presently, within the aggregation, a consciousness of kind appears in like individuals and develops into association. Association, in its turn, begins to react favorably on the pleasures and on the life chances of individuals."

To deal properly with the several questions thus raised I must go back to the beginning. In my first work, *Social Statics*, published in 1850, will be found evidence that at the very outset I regarded the Science of Society as having for its chief datum the Science of Mind. This was not overtly asserted, for at that time questions concerning the filiation of the sciences were not entertained by me; but it was taken for granted as an obvious truth. All through the work there runs the implication that societies are determined in their actions and structures by the mental characters of their units; and in a closing chapter, entitled "General Considerations," there is a delineation of the way in which, along with mental evolution in men, there goes higher social evolution. Here are some extracts indicating this:—

"So that only by giving us some utterly different mental constitution could the process of civilization have been altered."

"Dependent as they are upon popular character, established political systems can not die out until the feeling which upholds them dies out."

"So that wild races deficient in the allegiance-producing sentiment can not enter into a civilized state at all; but have to be supplanted by others that can."

"Of course the institutions of any given age exhibit the compromise made by these contending moral forces at the signing of their last truce."

"The process by which a change of political arrangements is effected, when the incongruity between them and the popular character becomes sufficient, must be itself in keeping with that character, and must be violent or peaceful accordingly."

That these conceptions remained unchanged in 1860, when the prospectus of the Synthetic Philosophy was issued, might be inferred even from the order of the subjects specified in it, which ran:—*Principles of Biology, Principles of Psychology, Principles of Sociology.* But this prospectus contains much more definite evidence of my persistent belief in the dependence of Sociology upon Psychology. Of the divisions constituting the *Principles of Psychology* the last stands thus:—"VIII. Corollaries.—Consisting in part of a number of derivative principles which form a necessary introduction to sociology." And then in pursuance of the thought there expressed, the enumeration of the divisions constituting the *Principles of Sociology* begins thus:—"Part I. The Data of Sociology.—A statement of the several sets of factors entering into social phenomena—human ideas and feelings considered in their necessary order of evolution; surrounding natural conditions; and those ever complicating conditions to which society itself gives origin:" in which statement of data, be it observed, there is no mention of biological data. Even without saying more, I should, I think, have furnished adequate disproof of the erroneous assertions quoted above. But now let me pass on from the programme of these works to the works themselves. The closing division of *The Principles of Psychology*, entitled "Corollaries" (as in the programme), opens with a chapter containing the following passages:—

"Having presently to follow out Evolution under those higher forms which societies present, the special psychology of Man, considered as the unit of which societies are composed, must be briefly outlined." . . .

"It is manifest that the ability of men to co-operate in any degree as members of a society, pre-supposes certain intellectual faculties and certain emotions. . . . Hence, in preparation for the study of social evolution, there have to be dealt with various questions respecting the faculties it brings into play, and respecting the modes in which these are developed during continued social life." (§ 477.)

In pursuance of this announcement, there presently follows a chapter on "Language of the Emotions," which introduces a chapter entitled "Sociality and Sympathy." The manifest implication is that recognition of these mental factors must precede the interpretation of social phenomena. After indicating, as Prof. Giddings has recently done, the genesis of sociality, which in certain classes of animals becomes "naturally established as furthering the preservation of the species," I have gone on to say:—

"Sociality having thus commenced, and survival of the fittest tending ever to maintain and increase it, it will be further strengthened by the inherited effects of habit. *The perception of kindred beings, perpetually seen, heard, and smelt, will come to form a predominant part of consciousness*—so predominant a part that absence of it will inevitably cause discomfort." (§ 504.)

Here, it seems to me, there is described in other words, that "consciousness of kind" which Prof. Giddings regards as the "new datum which has been sought for hitherto without success" (p. 17); and that it is regarded by me as the primary datum is shown by a subsequent sentence running as follows:—

"Among creatures led step by step into gregariousness, there will little by little be established a pleasure in being together—a pleasure in the consciousness of one another's presence—a pleasure simpler than, and quite distinct from, those higher ones which it makes possible."

After proceeding, through a dozen pages, to trace the development of sympathy as a result of gregariousness, there comes a brief statement of—

"The cardinal facts which it has been the aim of this chapter to bring to view, and which we must carry with us as aids to the interpretation of emotional development, and to the subsequent interpretation of the sociological phenomena accompanying emotional development." (§ 512.)

And then in a subsequent chapter on "Altruistic Sentiments"—sentiments all having their roots in sympathy—there is a delineation of the ways in which these stand related to social evolution.

We come now to a still larger mass of evidence directly disproving the statement that I have "made no attempt to affiliate sociology upon psychology." On passing to the *Principles of Sociology* itself I have, in setting forth its data, dealt elaborately with certain further psychological dependencies. After preliminary chapters come three entitled respectively "The Primitive Man—Physical," "The Primitive Man—Emotional," and "The Primitive Man—Intellectual": a fact which implies full recognition of the psychological factors. But this is far from being all. There follows a chapter which begins with the sentence:—"Yet a further preparation for interpreting social phenomena is needful;" and the preparation thereupon commenced is an account of "Primitive Ideas." After 30 pages describing the genesis of these, come seventeen chapters setting forth the resulting development of ancestor-worship and the accompanying superstitions. More than 300 pages are thus occupied; avowedly because the conduct of men in society can not be understood until the natures of these primitive beliefs and accompanying emotions are understood. Sentences from the succeeding chapter on "The Scope of Sociology" run:—

"And now observe the general conclusion reached. It is that while the conduct of the primitive man is in part determined by the feelings with which he regards men around him; it is in part determined by the feelings with which he regards men who have passed away. From these two sets of feelings, result two all-important sets of social factors. While *the fear of the living* becomes the root of the political control, *the fear of the dead* becomes the root of religious control." (§ 209.)

In pursuance of these general conclusions there are given in subsequent parts of the work various illustrations of the ways in which these psychological factors conduce to social evolution—as in the chapter on "Political Heads" (§§ 477, 482); as in the chapter on "Laws" (§§ 529, 535); as in the whole division on "Ecclesiastical Institutions"; and in many less conspicuous places.

How has it been possible for these misconceptions to have arisen? is a question that necessarily suggests itself. Among causes to be considered is the occurrence of two chapters in *The Study of Sociology* entitled respectively "Preparation in Biology" and "Preparation in Psychology." In the first of these, along with avowed dissent from certain of M. Comte's sociological views, there goes applause of him for having "set forth with comparative definiteness the connection between the science of life and the science of society"; and again, concerning his general conception, it is said that "among other of its superiorities was this recognition of the dependence of sociology upon biology." Moreover a subsequent sentence runs thus:—

"In the first place, all social actions being determined by the actions of individuals, and all actions of individuals being vital actions that conform to the laws of life at large, rational interpretation of social actions implies knowledge of the laws of life."

But though these passages seem to support the interpretation of my views which I repudiate, yet on looking at the context it will be seen that this is not so. For, as shown by preceding and succeeding passages, "the laws of life at large," as here understood, are laws comprehensive of both bodily life and mental life. Though, as I have conspicuously shown, I do not, like M. Comte, merge psychology in biology—though, under its objective aspect, I regard it as a science clearly marked off, and under its subjective aspect as a science fundamentally contrasted with all others; yet, as every one must do, I admit that the science of mind is dependent on the science of life. For we know nothing whatever of mind save as exhibited by living bodies. That by "laws of life at large" I mean laws of bodily life and mental life taken together, is, indeed, clearly implied by the use of the words "the actions of individuals," as being dependent on these laws of life; since the actions of individuals are all mentally determined. But there are set forth in the chapter named, certain direct dependencies of social phenomena on vital phenomena. It is said that the sociologist must learn "the laws of modification to which organized beings in general conform"; that he must recognize the effects of use and disuse in causing increase and decrease of bodily and mental powers; that he must remember how, as a consequence, human nature "is always adapting itself both directly and indirectly to its conditions of existence"; and that he must bear in mind the truth that "every species of creature goes on multiplying till it reaches the limit at which its mortality from all causes balances its fertility," so that taking away one cause of mortality by and by entails intensification of other causes arising from increased pressure of population. Against this evidence, however, has to be set the evidence contained in the next chapter, which shows the still more important dependencies of sociology upon psychology, and ends with the conclusion that "without preparation in mental science there can be no social science."

But the small regard paid to all the proofs given at the outset that the psychic factors of social phenomena are by me considered the predominant ones, appears to have resulted from thinking only of the parallelism I have asserted between certain traits of individual organisms and certain traits of social organisms. Prof. Giddings writes:—

"The second form in which the characteristic error of sociological classifications appears is that of the overworked biological analogy. Mr. Spencer's essay on 'The Social Organism' made a lasting impression. At present the greater part of sociological literature is written in terms of a biological nomenclature. . . . Sociology will have to discard this classification and nomenclature. . . . In certain fundamental things social organization is like vital organization, but in all that justifies Mr. Spencer's own phrase of 'super-organic evolution' it is peculiar, and not to be classed with organisms. Were this not true, sociology would be a mere division of biology." (Pp. 62–63.)

Most readers will, I think, carry away from these sentences the impression that I am supposed to have dwelt too much on this analogy in my sociological interpretations. But any one who reads through *The Principles of Sociology*, or even reads the titles of its chapters, will see that this analogy plays but a relatively inconspicuous part. I must be excused if, to make clear the way in which I conceive and use the analogy, I go back to the origin of it. In a chapter of *Social Statics* entitled "General Considerations" (pp. 451–3 in the edition of 1850) occur the following passages:—

"Hence we are warranted in considering the body as a commonwealth of nomads, each of which has independent powers of life, growth, and reproduction; each of which unites with a number of others to perform some function needful for supporting itself and all the rest; and each of which absorbs its share of nutriment from the blood. And when thus regarded, the analogy between an individual being and a human society, in which each man, while helping to subserve some public, want absorbs a portion of the circulating stock of commodities brought to his door, is palpable enough.

"A still more remarkable fulfillment of this analogy is to be found in the fact, that the different kinds of organization which society takes on, in progressing from its lowest to its highest phase of development, are essentially similar to the different kinds of animal organization. Creatures of inferior type are little more than aggregations of numerous like parts—are molded on what Prof. Owen terms the principle of vegetative repetition; and in tracing the forms assumed by successive grades above these, we find a gradual diminution in the number of like parts, and a multiplication of unlike ones. In the one extreme there are but few functions, and many similar agents to each function: in the other, there are many functions, and few similar agents to each function. . . .

"Now just this same coalescence of like parts, and separation of unlike ones—just this same increasing subdivision of functions—takes place in the development of society. The earliest social organisms consist almost wholly of repetitions of one element. Every man is a warrior, hunter, fisherman, builder, agriculturist, toolmaker. Each portion of the community performs the same duties with every other portion; much as each portion of the polyp's body is alike stomach, skin, and lungs. Even the chiefs, in whom a tendency toward separateness of function first appears, still retain their similarity to the rest in economic respects. The next stage is distinguished by a segregation of these social units into a few distinct classes. . . . And without further illustration the reader will at once perceive, that from these inferior types of society up to our own complicated and more perfect one, the progress has ever been of the same nature."

In pursuance of the analogy it is then shown that in either case in proportion to the multiplication of unlike parts, severally taking unlike functions, there is "an increasing mutual dependence" and a consequent individuation (integration) of the whole organism, animal or social: * the mutual dependence of parts being represented as that which constitutes the aggregate an organism.

Ten years later, in the essay on "The Social Organism," the conception here briefly outlined was elaborated. Four analogies between living bodies and bodies politic were enumerated.

"Commencing as small aggregations, they insensibly augment in mass. . . . While at first so simple in structure as to be considered structureless, they assume, in the course of their growth, a continually-increasing complexity of structure. . . . Though in their early, undeveloped states, there exists in them scarcely any mutual dependence of parts, their parts gradually acquire a mutual dependence. . . . The life of a society is independent of, and far more prolonged than, the lives of any of its component units." (*Essays*, Library ed., vol. i, p. 272.)

Neither in *Social Statics*, nor, I believe, in this essay is there any assertion that this analogy between animal structures and social structures is to be taken as the basis for sociological interpretations. In what way the analogy has been regarded by me was shown at a later date in *The Study of Soclology*. In that work it is said:—

"Now if there exists this fundamental kinship, there can be no rational apprehension of the truths of Sociology until there has been reached a rational apprehension of the truths of Biology." (P. 334.)

Taken by itself this sentence appears to justify the interpretation given of my view, but the sentences immediately succeeding show that this is not so.

"The services of the two sciences are, indeed, reciprocal. We have but to glance back at its progress, to see that Biology owes the cardinal idea on which we have been dwelling, to Sociology; and that having derived from Sociology this explanation of development, it gives it back to Sociology greatly increased in definiteness, enriched by countless illustrations, and fit for extension in new directions."

In pursuance of this assertion it is pointed out that Milne-Edwards derived "the conception of 'the physiological division of labor'" from the generalizations of political-economists. It is then said that "when carried from Sociology to Biology, this conception

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* In passing I may remark that in the alleged progress from uniformity to multiformity, as well as in the implied processes of differentiation and integration, may be seen the earliest germ of the thought which eventually developed into the formula of evolution at large.

was forthwith greatly expanded"; and further on it is said "that the truth thus found to be all-embracing in Biology returns to Sociology ready to be for it, too, an all-embracing truth." Here it is manifest that the two sciences are regarded as yielding mutual elucidations; and if, as the first sentence taken alone may appear to imply, I regard the analogy as showing that Sociology must be based on Biology, then, on the strength of the subsequent sentences, it may just as truly be said that I base Biology upon Sociology. Clearly, when taken together, these passages show the thought to be that for distinct understanding of either science certain conceptions furnished by the other must be possessed. It can not be said that each science is based on the other. Hence the alleged connection must be not a necessary dependence but an exchange of enlightenments. There is direct proof of this. The sociological division of labor had been recognized long before Biology had assumed a scientific form; and "the physiological division of labor," though not thus named, had been long recognized in living bodies as a co-operation among the various organs. In either science the conception might gradually have been elaborated to the full without aid from the other, though with nothing like the same rapidity and clearness.

Let us pass finally to the exposition of the analogy contained in Part II of *The Principles of Sociology*. It is there said that "between a society and anything else, the only conceivable resemblance must be one due to *parallelism of principle in the arrangement of components*." (§ 213.) It is shown "how the combined actions of mutually-dependent parts constitute life of the whole, and how there hence results a parallelism between social life and animal life." (§ 218.) Mutual dependence of parts being thus regarded as the essential trait in either case, there is subsequently pointed out a fundamental contrast between the modes in which this mutual dependence is effected in individual bodies and in bodies politic. § 221 begins—

> "Though coherence among its parts is a prerequisite to that co-operation by which the life of an individual organism is carried on; and though the members of a social organism, not forming a concrete whole, can not maintain co-operation by means of physical influences directly propagated from part to part; yet they can and do maintain co-operation by another agency. Not in contact, they nevertheless affect one another through intervening spaces, both by emotional language and by the language, oral and written, of the intellect."

It is argued that mutual dependence of parts requires the conveyance of impulses from part to part, and that while "this requisite is fulfilled in living bodies by molecular waves," "it is fulfilled in societies by the signs of feelings and thoughts, conveyed from person to person."

Here, then, we come to a proof, more conclusive even than that before given, that social actions are regarded by me as resulting from mental factors. Though the specialization of functions, or division of labor, is held to be analogous in living bodies and social bodies—though, in both cases, co-operation of the mutually-dependent parts has to be effected by stimuli conveyed from one to another; yet it is shown that while in the one case this prerequisite is effected by a physical process, it is in the other case effected by a psychical process. So that beyond the proofs variously given that the organization of each society is mainly caused by the mental traits of its units, there is here given the proof that these mental traits produce their results through certain mental products—the signs of feelings and thoughts.

And now let me add a not unimportant conclusion brought into view by this long explanation. In the course of it there has become manifest to me the essential distinction, which I had not before observed, between the dependencies of Sociology on Biology and the dependencies of Sociology on Psychology. They concern respectively the substance of society and the structure of society. We may contemplate the social aggregate simply as a mass of living units, ignoring any arrangement of its parts; or, tacitly positing the existence of the mass, we may occupy ourselves exclusively with the arrangement of its parts. Under the one head we are concerned only with changes of quantity and quality—increases or decreases of the units in number, and organic modifications of their natures: changes produced in the course of generations by subjection of the units to certain conditions of life. For interpreting social phenomena included in this group, we depend directly upon Biology. Under the other head we are concerned only with the development of this social aggregate into an organization of mutually-dependent parts performing different duties—the gradual evolution of structures and correlative functions and formation of a more and more integrated whole. For interpreting the phenomena included in this far more conspicuous and important group, we depend directly upon Psychology. Though the two can not be sharply separated, since bodily life and mental life are indissolubly united, and exert reciprocal influences, yet, as being respectively concerned with social substance and social form, the two are sufficiently contrasted.

THE editors of the Zoölogical Record count 366,000 distinct species in the animal world, of which 230,000 are insects and only 2,500 are mammals. Next most numerous to the insects are the mollusks, 50,000 species; crustaceans, 20,000; birds, 12,500; fishes, 12,000; and arachnids, or the spider family, 10,000 species.

BOTANIC GARDENS.

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I.—ORIGIN AND GENERAL ORGANIZATION.

THE term *botanic garden* is used to designate a limited area of ground on which is grown a collection of plants of a large number of species, arranged in a manner that will subserve some educational, æsthetic, scientific, or economic purpose. At the present time the utilitarian feature embraces the chief design of but few gardens, yet it is to the economic purpose that these institutions owe their origin. It will be interesting in this connection to note the successive changes of organization by which these institutions, at first as directly practical as possible, have come to subserve the most complex and highly scientific uses.

After the discovery of the medical properties of plants, it must have followed, in course of time, that representatives of the species to which remedial properties were attributed should be collected and grown in some place conveniently and readily accessible as need demanded. The last step did not immediately follow, however, since, among the conditions which were earlier supposed to influence the potency of medicinal herbs, the locality in which grown and the mysteries attending their collection were of the greatest importance. The first authentic record of the introduction of medicinal plants into cultivated plots of ground dates no further back than the time of the elder Pliny (23–79 A. D.), who writes of the garden of Antonius Castor, at Rome, in which were grown a large number of medicinal plants. This step may have been taken much earlier by the Greeks, Chinese, or Mexicans, however. Later the Benedictine monks of northern Italy paid great attention to the growing of remedial herbs, and devoted an important proportion of the monastery gardens to this purpose. This practice was also carried beyond the Alps, and in 1020 a garden was in existence at the monastery of St. Gall, in Switzerland, a few kilometres distant from Lake Constance, which contained sixteen plots occupied by medicinal plants. A garden of this character was founded in 1309, at Salerno, and another in Venice in 1330. In 1309 the Benedictine monks founded an academy called "Civitas Hippocratica" at Monte Cassino, in Campania, which appears to the writer to be among the earliest, if not the first, school of medicine, and established in connection with it a "physics garden." Two centuries later, courses of lectures on the "simples," as the unmixed preparations of herbs were termed, were given in the greater number of Italian universities, under the title of "lectura simplicium," by the professors of anatomy and surgery. It is interesting to note that the laboratory method of handling the course in "cognitio simplicium" was not introduced until the establishment of the botanic garden at the University of Padua, when, in addition to the lectures, exercises in the demonstration of remedial plants growing in the garden were given under the title of "ostencio simplicium."

The sixteenth and seventeenth centuries witnessed the foundation of many gardens in England, France, Germany, Holland, and Sweden, some of which have had a continuous existence to this day. The garden of Bologna was founded in 1568; Leyden, 1577; Leipsic, 1579; Montpellier, 1596; and Paris in 1597. The last

View of the Laboratory in the Oxford Botanic Garden. After a photograph.

named was organized for the purpose of determination of "what variations were possible in the style of bouquets worn at the royal courts." Then followed the establishment of the gardens at Giessen in 1605, Strasburg in 1620, Jena in 1629, Oxford in 1632, Upsala in 1667, and Chelsea in 1680.

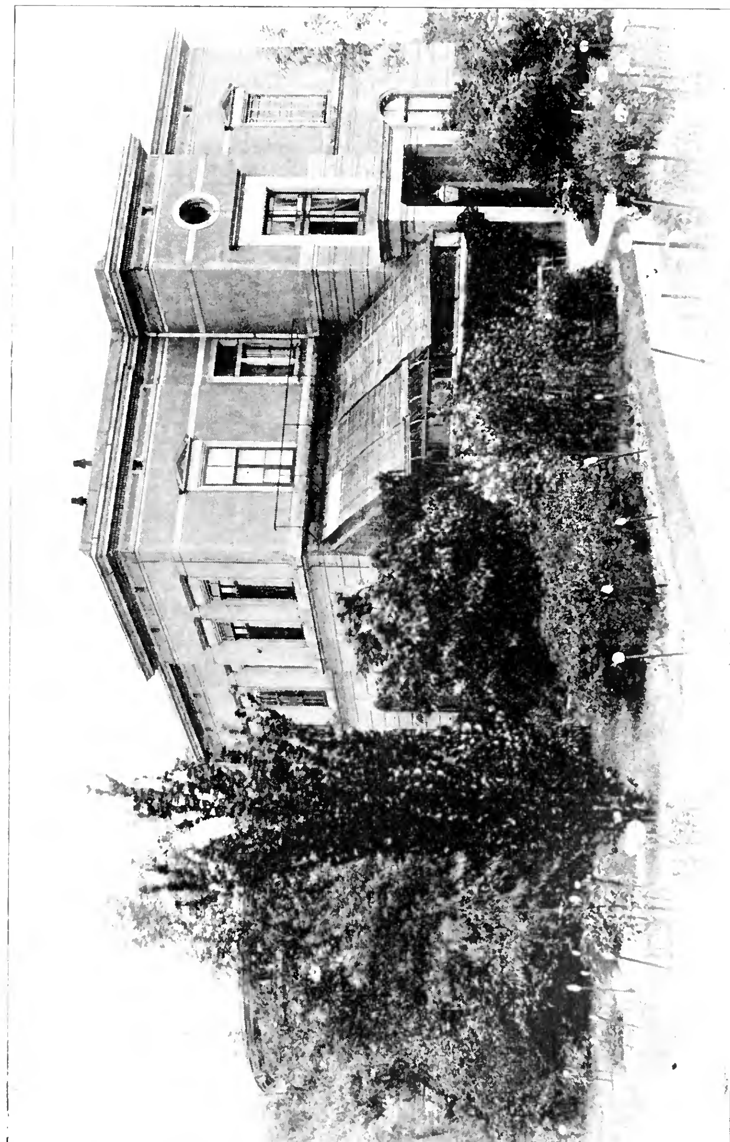
The Oxford garden is the oldest in England, and a curious feature in its organization is that during its entire term of existence—two hundred and sixty-four years—it has occupied leased ground. It owes its existence to the munificence of the Earl of Danby, who, besides making such alterations in the surface as to secure it from overflow, erected the wall that still incloses it, at a cost of five thousand pounds. The portion of the garden shown in the view of the Botanical Laboratory exhibits the formal style of planting which prevailed in earlier times.

The Chelsea garden is situated near the Thames, about two miles south from Hyde Park. It was formed by the Apothecaries' Guild of London, for the growth of plants for commercial purposes. Later it was converted to its present use, that of furnishing material to illustrate lectures in pharmacy and medicine. Surrounded on all sides by brick buildings, and shaded by smoke and fog, the rectangular plots of officinal plants exhibit very strikingly the deleterious effects of an atmosphere laden with acids. The would-be visitor to this quaint old place must arm himself with an admission card obtained from the Apothecaries' Society, and from the creaking formalities attendant upon the granting of such permission by unaccustomed but polite officials it may be inferred that the casual sight-seer does not often find his way into the place.

During the period inclusive of the foundation of the last-named institutions plants began, however, to be considered from another point of view—from a strictly scientific standpoint, and as independent organisms. While the Aristotelian school studied plants in a manner closely approaching that of the present time, yet this beginning of biological science had no logical continuation, and during many succeeding centuries was completely lost to sight. In the latter half of the sixteenth century two new forces were manifest in the development of these institutions. Many of the wealthier class who had private gardens began to enlarge them by the addition of species because of their rarity, or because they were brought from some foreign country, and in many instances special collections were made chiefly for this purpose alone. Thus it may be seen that beyond the useful properties of plants, perhaps the first truly scientific idea of them concerned in a crude way some of the principles of geographical distribution. This phase of the subject received an increasing attention, and finally assumed form and order upon the introduction of the Linnæan system of classification into Germany and that of Jussieu into France.

Before this, however, a still more important development in the method of study of plants had ensued, as is shown distinctly in the botanical writings of the latter half of the sixteenth century. The all-important fact of the natural affinities of plants had gradually assumed distinctness—an idea not within the grasp of any one of the herbalists of the time, whose accumulating and repeated descriptions of individual species gave rise to the perception of resemblance and difference in forms, and finally to the idea of natural relationship. This idea finally became paramount: "All the foreign matter introduced into the descriptions of plants by medical superstition and practical considerations were seen to be of secondary importance, and were soon thrown aside in the effort to establish a natural system of classification."

At the time of this "renaissance" of botany the gardens represented the ideas of geographical distribution and classification



The Botanic Institute at Leipsic, showing Entrance from Garden, and Glass Compartment for Use in Experiments with Living Plants. After a photograph. Reproduced by permission from the Minnesota Magazine, vol. ii, No. 1, 1895.

in addition to the practical aspects of the subject. With the development of physiology and morphology the ideas thus brought into prominence have found expression in the gardens, and the purposes and usefulness of these institutions have steadily broadened until all the more important phases of the subject are more or less represented in the greater majority of instances.

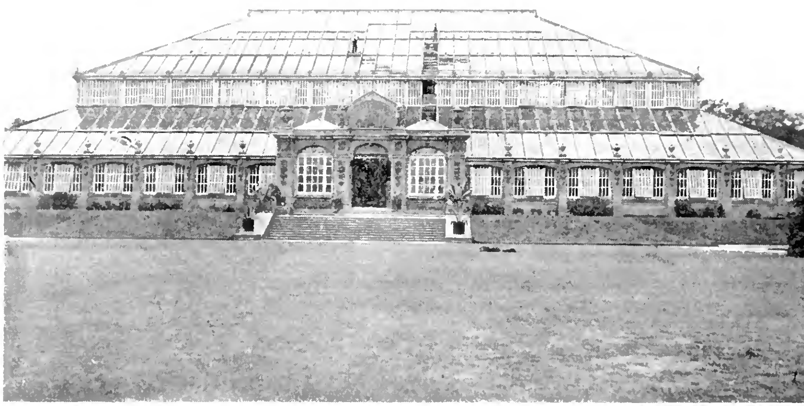
In addition to the scientific and practical uses enumerated above, the botanic garden has become a laboratory for the landscape artist, who may dispose of its masses of plants with a feeling regard for their artistic value in outline and color, making a most effective means of cultivation and gratification of public taste. In many of the better known gardens, especially those located in the great cities, this æsthetic feature has become a very prominent and in many instances the predominant idea.

Only when a botanic garden is equipped with laboratories for the furtherance of investigation, and sustains an organic relation to a school or university, may it be said to attain its highest possibilities of usefulness, in the demonstration of the principles governing the nature and development of one of the two great groups of living things. When designed for this purpose the collection of growing plants should represent as many of the principal forms of vegetation as is possible. Since the probable number of living plants is estimated at half a million, it is obviously impossible to bring together in any restricted area more than a fraction of this number. A census of the flora of the section of Bronx Park in New York, inclusive of about two hundred and fifty acres, which is to be converted into a botanic garden, showed that nearly a thousand species of ferns and seed-forming plants were to be found on that area, only a small number of which were introduced. Of these thousand species many were represented by thousands or perhaps hundreds of thousands of individuals. In the conversion of the tract into a botanic garden, the gardener will remove all but a few dozen, or perhaps a few hundreds, of each species, which will be confined to certain designated limited areas. In this way he will relieve each species from the competition of its neighbors, and so far as possible from the ravages of insects and animals—the most telling factors in the struggle for existence—and obtain space for the introduction of a large number of species. If these conditions alone determined the flora of a region, the number of species which could be grown in a garden would be determined only by its size and the number of plots it might contain. It is found, however, that the substratum and climate offer rigid limitations to an extension of the flora which may be grown out of doors in any locality. The gardener partially overcomes this limitation by the use of glass houses, where plants from nearly all parts of the world may be grown in specially prepared soils, and kept at temperatures resembling those of the natural habitats of the plants. But under such conditions it becomes extremely difficult to properly adjust the moisture and light, and only a comparatively small addition may thus be made to the flora of a garden. The conditions described above are such that it has not been found possible to grow in one place more than fifteen thousand species of the higher plants. It will be found, moreover, that a large number of the species included are not able to attain normal stature and appearance, and will thus be useless in representing the form intended.

In consequence of this limitation of the number it is customary to supplement the living plants by collections of prepared specimens of contemporaneous and fossil forms, in order to represent more completely the vegetation of the globe. The living as well as the prepared plants are generally so assembled as to demonstrate the descent and relationship of the different groups, distribution over climatic and geographic zones, as well as their principal biological adaptations to the factors to be met in their native habitats. In addition to this strictly natural method of treatment it is also customary to illustrate by proper groups the forms which have become of special interest because of their food-furnishing, textile-yielding, medicinal, or other economic value. In order to accomplish these purposes a suitably equipped garden must contain, besides the necessary facilities for growing plants, museum buildings arranged for the display of prepared specimens, and if it designs to afford opportunities for research it must also be furnished with a library and laboratory facilities.

The Main Palm House of the Royal Gardens at Kew, with Lake in Foreground.

There are in the world more than two hundred institutions designed as botanic gardens, a large proportion of which are devoted to the cultivation of decorative plants, or subserve the use of pleasure parks, while only a small number are organized on the broader basis of the needs of the branches of botanic science. Thirty-six of these institutions are located in Germany, twenty-



View of Main Portion of Temperate House of the Royal Gardens at Kew.
In process of repair. After a photograph.

three in Italy, twenty-two in France, thirteen in Austria-Hungary, twelve in Great Britain and Ireland, and ten in the United States.

One of the most widely known is the Royal Botanic Garden at Kew, located on the south bank of the Thames, six miles from Hyde Park. The beginning of the Kew Gardens may be dated from the formation of the exotic gardens of Lord Capel in 1759. After a long series of changes in ownership and purpose, additions and alterations in plan, the gardens were transferred from a private possession of the crown to a national institution in 1840, with Sir William Hooker as the first director. About two hundred and seventy acres are included, of which seventy are planted as a botanic garden and the remainder as an arboretum and public park. Besides the large number of well-planned conservatories, greenhouses, museums, and other buildings, it contains a number of structures which reflect somewhat of the varied history of the institution. The main palm house is three hundred and sixty-two feet in length, with a central dome seventy feet in height (Plate IV), and the temperate house has a total length of five hundred and eighty feet, covering an area of an acre and a half of ground. In addition, the garden contains fourteen smaller glass houses. The herbarium and library, which occupy the old palace of the King of Hanover, are probably the largest and most complete in the world. While the research work carried on in the gardens has been principally taxonomic, by the co-operation of the twenty-four gardens of which Kew is the organic head, much of value has been accomplished in the acclimatization of useful plants. There is also located in the garden the Jodrell Laboratory, in which some important results in physiology and morphology have been reached. Its operations, however, are greatly constrained by lack of suitable endowment.

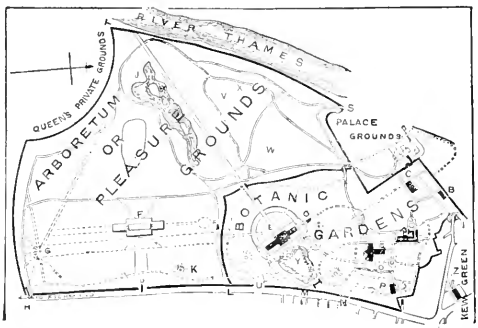
I quote the following explanatory paragraph from a guide to the grounds:

"It may be mentioned that Kew is not only a great educational establishment and pleasure resort, but also the recognized center of the various botanic gardens throughout the empire. The part it has played in the introduction of the cinchona into India, and in fostering various other important industries, is well known. It may be described as the great botanical clearing house of the empire. To it a large number of plants are constantly being forwarded from all parts of the world to be named,

THE CUMBERLAND GATE, ROYAL GARDENS AT KEW, WITH GUARD ON DUTY.
Looking outward. After a photograph.

for which purpose a staff of botanists is provided, and the collection of dried plants, or herbarium, as well as the large botanical library, is unrivaled throughout the world. In the same way the collection of cultivated plants and trees, both hardy and exotic, is the most perfect in existence."

The number of visitors to the gardens during the year amounts to one and a half million, according to newspaper reports. The gates, six in number, are open from noon until dusk. The administration and care of an establishment of this character near a great center of population require the closest organization and the most scrupulous attention to detail on the part of the executive. In this matter tradition as well as current testimony speaks of the rigid manner in which the numerous necessary regulations are enforced. The general plan of the grounds is shown in Plate VI.



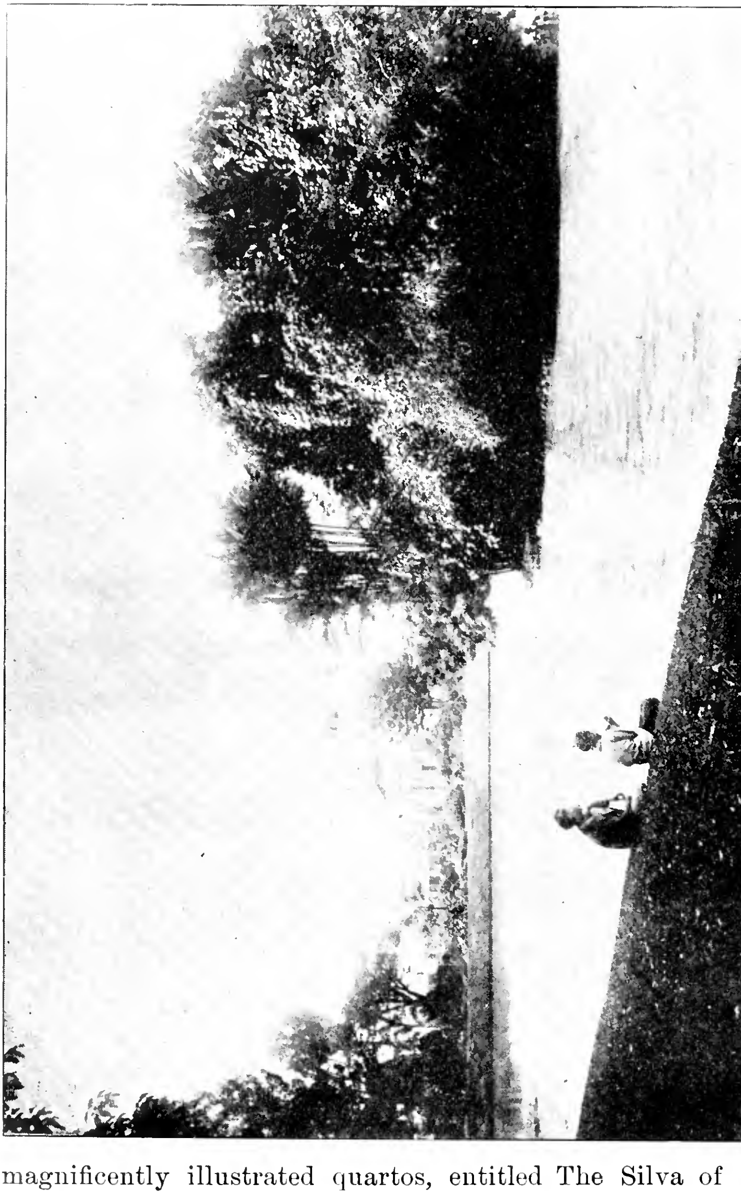
Plan of Kew Gardens. Explanatory references: A, principal entrance from Kew Green; B, tropical house; C, timber Museum No. 3; D, water-lily house; E, palm house; F, temperate house; G, pagoda; H, Lion or Richmond Gate; I, "North" gallery; J, lake; K, flagstaff; L, Unicorn Gate (closed); M, Museum No. 1; N, Cumberland Gate; O, rockery; P, Museum No. 2; Q, new range; R, succulent house, greenhouse, and ferneries; S, Brentford Gate; T, Ilesworth Gate; U, Victoria Gate, for Kew Gardens Station; V, bamboo garden; W, azalea beds; X, Rhododendron Dell; Y, ornamental water; Z, Kew Church.

When organized chiefly for research the botanic garden differs in many essential features from the one described above. From this point of view, and with regard to advantages of geographical position and botanical possibilities, the garden at Buitenzorg in Java occupies a foremost position. Originally founded by the Government of Holland in 1817, for the purpose of testing the economic value of plants indigenous to the colonies of the East Indies, and for the distribution of seeds, plants, etc., after the customary manner of such institutions, it has widened its scope and developed its facilities until almost all branches of purely scientific and applied botany may be pursued to advantage within it.

The Buitenzorg Garden is situated within a few degrees of the equator, and by reason of the elevated areas included within its different divisions furnishes suitable conditions for the growth in the open air of plants native to latitudes as high as forty or fifty degrees. The luxuriance of the growth of plants in the lower tropical area may be imagined when it is stated that the average temperature is 85° Fahrenheit, and the yearly rainfall amounts to twelve feet. Of the eleven hundred acres available for the purposes of the garden, an area of about one hundred and seventy-three acres is devoted to experiments with cultivated plants, one hundred and forty-eight to the botanic garden proper, seventy-five to a mountain garden at an elevation of about seven thousand feet, and the remainder is comprised in a mountain forest. The laboratories are most excellently equipped for investigation in forestry, agricultural chemistry, and pharmacology, besides the main divisions of the pure science. In addition to a very complete library and herbarium, the administration has at its service a lithographic establishment for the preparation of illustrations for its publications. It would be difficult to overestimate the value of the results accomplished by the various divisions of this institution, or to predict its future performances. By reason of its facilities and resources it has become a Mecca for the botanists of the world.

The foundation of a botanic garden in the United States dates from that of John Bartram in Philadelphia in 1728, which is still preserved in a modified form. Botany has been given an important place in the college curriculum in America scarcely more than sixty years. In comparatively recent years a few gardens have come into existence, nearly all of which are still in a state of rapid development. During this period of flux they have been able only to afford facilities for general elementary instruction, and to make possible original work in the classification of native plants—a line of research which has been carried on more or less steadily since the earlier settlements were made on this side of the Atlantic. At the present time a few have begun to offer opportunities for research in the more important branches of botanical science. Among these may be mentioned the Missouri Botanical Garden at St. Louis, connected with the Washington University, the Botanical Garden and Arnold Arboretum of Harvard University, and the Botanic Garden of New York, now in process of formation and to be connected with Columbia University.

The Botanic Garden of Harvard University was established in 1805. It has an area of seven acres, on which are cultivated about seven thousand species of plants, principally native. For this reason it finds but one greenhouse necessary. The garden contains the famous herbarium and library in which Asa Gray accomplished his work on the plants of North America. The main laboratories and museums are located in the university buildings. Some very important work on the morphology of the cryptogams has been published from these laboratories. The Arnold Arboretum of Harvard University is organized entirely independent of the botanic garden. It includes an area of two hundred and fifty acres, of which one hundred and sixty are planted with trees and shrubs. It is furnished with a museum, herbarium, and library, for the purpose of aiding study and research in forestry and dendrology. By an arrangement with the city of Boston the arboretum is thrown open to the inhabitants of that city as a public park. The arboretum has nearly completed a description of all the trees of North America north of Mexico in a series of



Island and Lake in Botanic Garden, Buitenzorg, Java. Reproduced from "Der Botanische Garten 's Lands Plantentuin zu Buitenzorg, Java. Festschrift zur Feier seines 75-jährigen Bestehens," 1893.

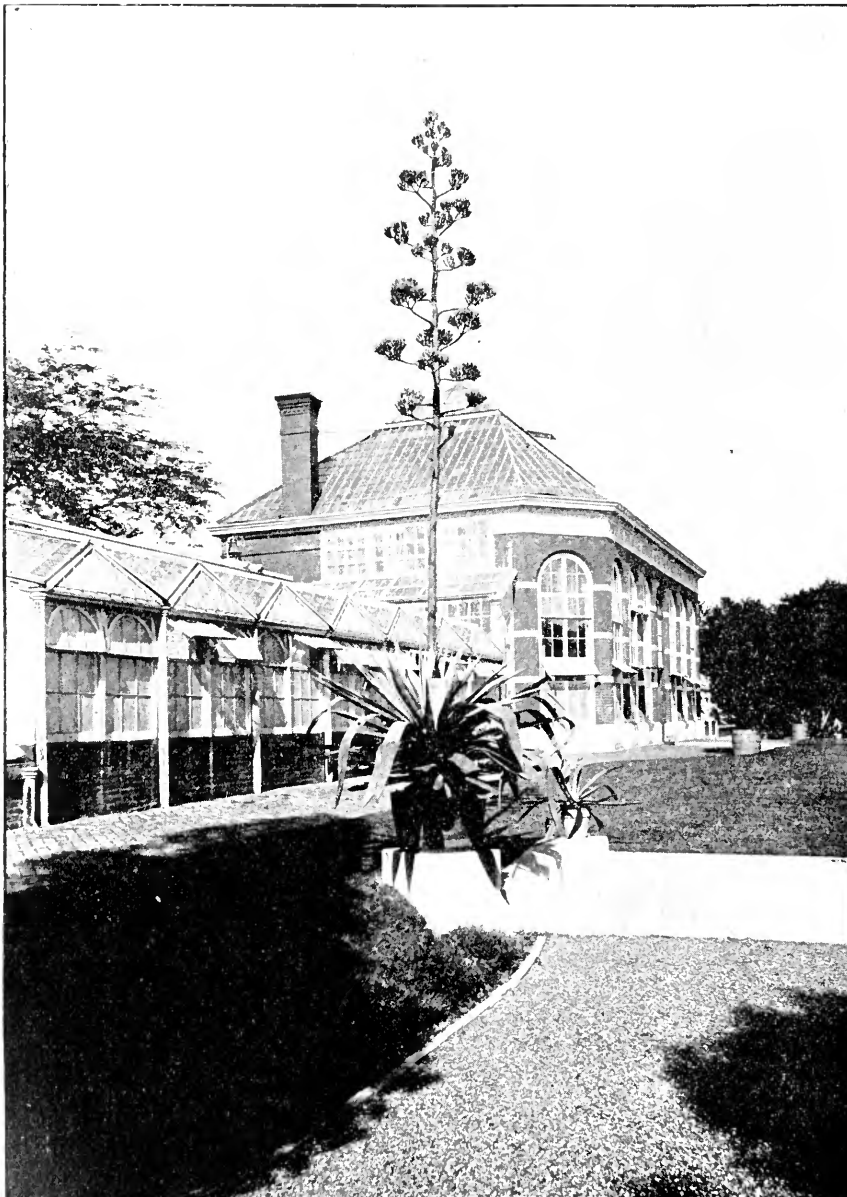
magnificently illustrated quartos, entitled The Silva of North America.

The foundation of the Missouri Botanic Garden at St. Louis is due to the munificence of Mr. Henry Shaw, who bequeathed for that purpose a tract of seven hundred and sixty acres of land and other property in and near St. Louis. The scope of this institution may be best illustrated by the following quotation from the will of its founder: "With a view to having for the use of the public a botanical garden, easily accessible, which should be forever kept up for the cultivation and propagation of plants, flowers, fruit and forest trees, and other productions of the vegetable kingdom, and a museum and library connected therewith, and devoted to the same and to the science of botany, horticulture, and allied objects." It is connected with the Washington University, which has a School of Botany also endowed by Mr. Shaw in 1885. The botanic garden occupies an area of forty-seven acres. The grounds are laid out in such a manner as to be highly attractive, and as many as thirty thousand people have passed the gates in a single day. Much important work in plant taxonomy has been accomplished in this institution, and the facilities for work may be set forth in the following official statement:

"The herbarium is supplemented by a large collection of woods, including veneer transparencies and slides for the microscope. The library, containing about eight thousand volumes and ten thousand pamphlets, includes most of the standard periodicals and proceedings of the learned bodies, a good collection of morphological and physiological works, nearly five hundred carefully selected botanical volumes published before the period of Linnæus, an unusually large number of monographs of groups of cryptogams and flowering plants, and the entire manuscript notes and sketches representing the painstaking work of Engelmann.

"The great variety of living plants represented in the garden and the large herbarium, including the collections of Bernhardi and Engelmann, render the garden facilities exceptionally good for research in systematic botany, in which direction the library also is exceptionally strong. The living collections and library also afford unusual opportunity for morphological, anatomical, and physiological studies, while the plant-house facilities for experimental work are steadily increasing. The E. Lewis Sturtevant Pre-Linnæan Library, in connection with the opportunity afforded for the cultivation of vegetables and other useful plants, is favorable also for the study of cultivated plants and the modifications they have undergone."

The New York Botanic Garden is the most recent acquisition to the list of these institutions in America. Its establishment was authorized by the Legislature in 1891, but the enabling act being defective, no steps could be taken in its organization until 1894. To comply with the act of incorporation, a sum of two hundred and fifty thousand dollars was raised by private subscription, and then the Commissioners of Public Parks of New York City were authorized to set aside two hundred and fifty acres of Bronx Park, and the Board of Estimate and Apportionment was directed to issue bonds amounting to five hundred thousand dollars, to be used in the construction of the necessary buildings, greenhouses, museums, laboratories, etc.



View of Main Greenhouse in the Missouri Botanic Garden, with Flowering Specimens of Agave Mexicana in Foreground. Reproduced by permission from the Fifth Annual Report of the Missouri Botanical Garden, 1894.

The scope of this institution may be best illustrated by the following extract from the act of incorporation: "To be located in the city of New York for the purpose of establishing and maintaining a botanical garden and museum and arboretum therein, for the collection and culture of plants, flowers, shrubs, and trees, the advancement of botanical science and knowledge, and the prosecution of original research therein and in kindred subjects, for affording instruction in the same, for the prosecution and exhibition of ornamental and decorative horticulture and gardening, and for the entertainment, recreation, and instruction of the people." The site of the garden embraces an area of such wide diversities of soil and slope, marsh, meadow, shores, and granite ridges, that it will afford peculiarly fitting conditions for the growth of an extensive flora in the open air. As mentioned above, about one thousand species of plants, nearly all of which were native, were found on the inclosed area at the time of organization of the garden. Through a co-operative arrangement entered into with Columbia University, the herbarium of this institution, numbering over six hundred thousand specimens, as well as the library, will be deposited with the garden, and most of the research and graduate work of the university in botany will be carried on in the museum building. The plans of the museum building are such as to offer ample facilities for laboratories in all the divisions of the subject, while the glass houses promise to surpass anything in existence at the present time. The conditions of organization are such that a high efficiency for the entire equipment will be at once attained. The establishment of this garden marks an important step in the development of botany in America.

Perhaps the greatest opportunity for furthering botanical investigation that has existed since the beginning of the science now confronts the American universities in the proposal to establish a botanic garden and laboratory in the tropics. The real value of such an institution may be best understood when it is stated that botany in its present elementary condition, especially with reference to the physiology and ecology of plants, is based chiefly on the results of investigations carried on in botanical gardens and laboratories situated in the northern hemisphere between the parallels of forty and fifty-five degrees. In the herbaria it has been possible to study normal specimens of prepared plants from the equator to the poles, and consequently the systematic relationships are much better known than any other characteristic. Morphology has shared these advantages to some extent.

In the study of the physiology, ecology, and other branches of the science in which living plants are necessary. attention has been necessarily confined to those indigenous to a zone fifteen degrees in width, extending across one small continent and half way across another, together with introduced species growing under more or less abnormal conditions in gardens and conservatories. As the science progresses it is becoming more and more apparent that many of the generalizations based upon investigations carried on under such circumstances are incapable of general application, and that before a permanent foundation for the science can be laid, research along all lines must be extended to include the most highly developed forms, in the primitive habitat of the plant kingdom, in the tropics. The principles of the relations of plants and their relations to the animal kingdom may only be attained by the study of undisturbed communities of plants in the natural groupings resultant from the struggle for existence. Here are to be found such rapidity of growth and metabolism that the adaptive possibilities of the organism reach their highest expression.

The centers of botanical activity in Europe are so far removed from a tropical flora that only occasionally does a transatlantic investigator find time and opportunity to extend his researches to include normal tropical forms. To do this he must visit Buitenzorg or some other garden nearly half way round the world.

The center of botanical activity in America has at its very doors a tropical region (in the West Indies), unsurpassed in every feature, which may be reached in four or five days from any important city in the country. The establishment of a laboratory and garden in any convenient locality would not only be of untold value in the general development of botanical science, but it would place within easy reach of the investigator or graduate student in American universities facilities unequaled by that of any other country.

The European botanist would also find a laboratory in the American tropics much more easily accessible than those of the antipodes. The foundation of such an institution would be of direct benefit to the greater number of active botanists, and would go far toward making America the scene of the greatest development of the biology of one of the two great groups of living organisms.

A FELICITOUS tribute was paid to Darwin at the opening of the English Church Congress in Shrewsbury, the philosopher's birthplace, by the Bishop of Lichfield, presiding, who said that "all members of the Church of Christ owed a great debt of gratitude to Charles Darwin. He had simplified and interpreted, as a true man of science would be anxious to do, the methods which have been pursued by the Great Almighty Creator in his works, and in so doing he had added to the dignity of the conception which they were able to form of Him who made us and all the world."

ANIMAL SYMBOLISM IN ECCLESIASTICAL ARCHITECTURE.*

By ANDREW D. WHITE,
EX-PRESIDENT OF CORNELL UNIVERSITY.

PROF. EDWARD P. EVANS is already well known to the readers of the Popular Science Monthly as a contributor of historical and psychological articles especially valuable and interesting.

His position upon the editorial staff of one of the most important European journals gives him extraordinary opportunities to discern events having a real bearing upon contemporary thought. As a scholar deeply interested in the most important modern questions, he has for several years past interpreted to Germany the significance of current American history and literature, and at the same time he has kept thoughtful Americans informed regarding various important political and philosophical developments in the New Germany, and in Europe generally.

This latest of his works is one for which every student of history, in its largest and best sense, should be grateful to him. Under the title of Animal Symbolism in Ecclesiastical Architecture he has thrown a bright light into the evolution of thought during the middle ages, and at the same time into the whole course of human development; and his book is not only learned but interesting; so that it will not only prove profitable to scholars but attractive to the general reader.

Many a ponderous and voluminous work on mediæval history and art, requiring months for its study, is really far less valuable than this little book, which can be read delightfully by the fireside during the winter evenings of a single week.

The great majority of thinking Americans who travel abroad are naturally attracted and impressed by the mediæval cathedrals. Representing the most profound and brilliant phase of architecture, these great creations attract even those who have little feeling for art in general. Among all structures reared by man they take strongest possession of thoughtful minds.

Yet few, even of the most attentive, see in them their full depth of meaning. Even the most scholarly traveler has been wont to give up some of the most interesting cathedral problems in despair. By the side of some sculptured group of heavenly beauty he sees masses of carving, grotesque, and not infrequently profane and even obscene. He can not understand why a sculp-

* Animal Symbolism in Ecclesiastical Architecture. By E. P. Evans. With a Bibliography and seventy-eight Illustrations. New York: Henry Holt & Co., 1896.

tor who seems to have caught sight of cherubs and seraphs should suddenly revel in the creation of devils, imps, and animals, real and imaginary. The whole seems an incongruous jumble. This jumble, and much else, Prof. Evans interprets to us, and shows us how all grew naturally out of human thought and aspiration.

The key which he furnishes us to these strange problems presented by mediæval art is mainly the old dogmatic relation between Nature and Scripture. In the early Church the science of Aristotle and his successors was speedily turned into a channel of which they never dreamed. Scientific truth ceased to be studied for truth's sake, but was used to ascertain and illustrate the meanings of the Bible, and to establish the dogmas of the Church. The book of Nature was held more and more to be the counterpart, and therefore the interpreter, of the book of Revelation. The visible creation was held to be a mirror of the spiritual realm. Hence a new and most extraordinary growth, which, while it has been supplanted in our time by the blooming forth of modern science, still shows some lingering blossoms.

Very early in the history of the Church appeared the treatise known as the *Physiologus*. In this, various objects in Nature were made to interpret and to be interpreted by various passages in Scripture. So successful was this work that there grew out of it great encyclopædias of sacred science, and the historical student still finds in all properly furnished university libraries works of such vast scope as those of Vincent de Beauvais, Thomas de Cantimpré, and Gregory Reysch.

Most important among the early sources of this stream of mediæval thought was Origen. Early in the third century that eminent biblical scholar, profound and prolific, laid down a great doctrine, as follows: "The visible world teaches us concerning the invisible; the earth contains images of heavenly things, in order that by means of these lower objects we may mount up to that which is above. . . . As God made man in his own image and after his own likeness, so he created the lower animals after the likeness of heavenly prototypes." *

The main biblical basis for this great statement was found in two passages, one from the Old Testament, the other from the New. The first was the text from Job, as follows: "Ask now the beasts, and they shall teach thee; and the fowls of the air, and they shall tell thee." This outburst of poetry, from perhaps the most profound poem in human history, was taken as a prosaic statement of truth. The other text was the statement of St. Paul, that "the invisible things of Him from the creation of

* See Evans's work cited, p. 28.

the world are clearly seen, being understood by the things that are made."

The result was that the *Physiologus*, which interpreted the sacred significance of the animal kingdom, had a wider circulation than any other book save the Bible, and was translated into the languages even of the remotest Christian peoples.*

It will appear strange to any one not well acquainted with the ways of mediæval thinkers that the animal which had perhaps the earliest and greatest significance was one which existed neither in the Bible nor in Nature, but which was evolved by early Christian thought, brooding over statements which came from the sun worship of earlier nations and from pagan literature. This animal was the phœnix; it was made to teach a world of church doctrine, and was even stamped upon the coin of the first Christian emperor.

In the twelfth century we have, as an outgrowth of the *Physiologus*, the *Bestiaries*. These developed this theological learning still further, and now it comes in with a full tide. The sculptures of cathedrals, the paintings on stained glass, the illuminations of manuscripts, the embroideries of vestments, are all filled with phœnixes, unicorns, salamanders, as well as with the whole range of animals having real existence.

Of animals having real existence, the lion was perhaps most frequently sculptured, and regarding him the *Physiologus* is especially explicit. Among other things it ministers to edification as follows: "First, when the lion perceives that the hunters are pursuing him, he erases his footprints with his tail, so that he can not be traced to his lair. In like manner our Saviour, the lion of the tribe of Judah, concealed all traces of his Godhead when he descended to the earth. Secondly, the lion always sleeps with his eyes open; so our Lord slept with his body on the cross, but awoke at the right hand of the Father. Thirdly, the lioness brings forth her whelps dead and watches over them, until after three days, the lion comes and howls over them and brings them to life by his breath; so the Almighty Father recalled to life his only begotten Son, our Lord Jesus Christ, on the third day."

Another animal which we constantly find lurking in the sculptured foliage of cathedrals is the lizard. Regarding this the *Physiologus* informs us that in its old age it becomes blind, creeps into some crevice looking eastward, and, beholding the rising sun, is restored to sight: on this the mediæval naturalist advises us: "In like manner, O man, thou who hast on the old garment, and the eyes of whose heart are obscured, seek the wall

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* See Evans, p. 62.

of help, and watch there until the sun of righteousness rises with healing power and removes thy spiritual blindness." *

Mixed in with real animals come those whose existence is more doubtful. Great stress was laid upon the unicorn, and John of Herse, in his pilgrimage to Jerusalem toward the end of the fourteenth century, declares regarding the river Mara, whose bitter waters Moses made sweet, that "even now, evil and unclean beasts poison it after the going down of the sun; but in the morning, after the powers of darkness have disappeared, the unicorn comes from the sea and dips his horn into the stream, and thereby expels and neutralizes the poison, so that the other animals can drink of it during the day. This fact, which I describe, I have seen with my own eyes."

Naturally, among the animals which first attracted the attention of those who thus expounded the ways of God to man was the elephant. First, as to its birth, we are told that it takes place in the water, and that this fact symbolizes baptismal regeneration. Then, too, we are told that the elephant "always sleeps standing, and leans for support against a tree. The hunters take advantage of this fact and saw the tree almost asunder, so that the tree gives way, the elephant falls, and is captured. This evidently symbolizes Adam, whose fall was caused by a tree."

The serpent, of course, comes in for a large share of this kind of interpretation, and therefore appears most frequently among the carvings in wood and stone, both within and without the cathedrals.

As to the lessons thus taught, one of the first is that "when the serpent has grown old it fasts forty days and forty nights until its skin shrivels and loosens. Thereupon it squeezes itself through a narrow crevice in the rocks, and thus casts its skin and renews its youth. And thou, O son of man, if thou desirest to put off the old Adam and be regenerated, must pass through the strait gate and walk in the narrow way which leadeth unto life."

And again: "When the serpent goes to a spring to drink water, it leaves its venom behind in its den; so he who would refresh his soul with the waters of eternal life must leave behind him every sin of his carnal heart." †

Of course, in any such pious treatises the eagle naturally came in for a considerable share of attention, and we are informed that "the eagle, when it has grown old and its eyes become dim, flies upward toward the sun until it has purged away the film from its eyes; it then descends to the earth, plunges three times into a spring of pure water, and thus recovers its sight and renews its youth"; so the Christian should "fly aloft on the wings of the

* See work cited, p. 94.

† See work cited, p. 114.

spirit to the sun of righteousness, . . . and then dip himself thrice in the well-spring of salvation."

Again, one version of the *Physiologus* tells us that the upper beak of old eagles grows so long that it would prevent them from eating and cause them to die of hunger did they not break off the superfluous part of the beak against a stone; and on this alleged fact is based the statement that "the rock of salvation is the only cure for the growth of carnal-mindedness, and the sole means of preventing spiritual starvation."

Of marine animals the early Christian philosophers knew little, but naturally they had heard of the whale, and found important meanings in him. One of the lessons taught by the whale is given as follows: "When he is hungry, he opens his wide mouth seaward and a pleasant odor issues from his maw, so that other fishes are deceived and swim eagerly toward the place whence this sweet odor comes. In heedless shoals they enter into his extended jaws; then suddenly the grim gums close and crush their prey. Thus the devil allures men to their destruction and closes upon them the barred gates of hell."

The mediæval imagination played curiously about the pelican. A type of the atonement was found in the supposed fact that the pelican tears open its breast and feeds its young with its own blood. New value was given to the pelican by that great thinker, St. Augustine. Writing upon the passage in the one hundred and second Psalm—"I am become like a pelican in the wilderness"—he says: "The males of these birds are wont to kill their young by blows of their beaks and then to bewail their death for the space of three days. At length, however, the female inflicts a severe wound on herself, and, letting her blood flow over the dead ones, brings them to life again."

Naturally, this statement, coming from a man so widely venerated, proved a great source of inspiration to the pious writers and sculptors of the middle ages.

The otter and the crocodile also attracted the attention of these pious writers, and they developed in good faith the following statement: "When the crocodile sleeps, it keeps its mouth open; but the otter wallows in the mire until it becomes thickly coated with mud, which dries and hardens and forms a sort of armor, thus enabling it to run securely into the jaws and down the throat of the sleeping crocodile, and to kill it by devouring its bowels. So our Saviour, after having put on flesh, descended into hell and carried away the souls dwelling therein; and, as the otter comes away unharmed from the belly of the crocodile, so our Lord rose from the grave on the third day, alive and uninjured." *

* See work cited, pp. 131, 132.

Interesting also is the pious use made of the panther. Of this beast it is said: "It is the nature of the panther to live in friendship with all animals except the dragon. . . . When it has eaten a little it is satisfied and goes to sleep in its lair, and after three days it awakes and roars with a loud voice, and out of its mouth proceeds a sweet smell; then all the beasts of the forest far and near follow after it," but "this rare scent is offensive only to the dragon, which hastens to flee as soon as it gets a sniff of it. In like manner our Lord Jesus Christ arose out of the sleep of death and drew all nations unto him through his 'sweet savor.' But this same savor discomfits the dragon, that old serpent which is the devil." The very curious statement regarding the beaver is perhaps best read in the original, where it is illustrated by a striking engraving. It serves to show that some cathedral sculptures usually considered obscene were not so intended.

Of course, the domestic fowls could not escape the notice of these keen interpreters of theology and science. We may take as typical the following: "When the cock finds anything, it does not eat it, but calls the hens together and divides it among them. In like manner the preacher should distribute among his flock the kernels of divine truth which he discovers in Holy Writ, picking them to pieces in order that they may be more readily taken in and digested." *

Very curious are sundry long and intricate developments of theory regarding various animals. One of these was evolved out of the beautiful text, "As the hart panteth after the water-brooks, so panteth my soul after thee, O God." The *Physiologus* tells us that "the hart is the foe of the dragon, which, when it sees its enemy, runs away and creeps into a cleft of the rocks. Then the hart goes to the stream, fills himself with water, and vomits it into the cleft where the dragon is. Having thus drowned the dragon, the hart tramples it under its feet; as the prophet Isaiah predicts that at the coming of Christ a man shall 'go into the clefts of the rocks and into the tops of the ragged rocks, for fear of the Lord.' Thus our Saviour slew with the water and blood flowing from his side the great dragon, . . . and taught us to contend against the hidden designs of the devil."

A comical *quasi*-scientific profundity is at times mixed up with these statements. Thus some commentators upon Scripture declare that "the hart, in killing the dragon, inhales its poisonous breath, which produces intense thirst and consequent longing for the water-brooks."

So, too, regarding the antelope, we are told that "the antelope

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* See the curious mediæval poem given at page 162.

is a wild animal with two powerful horns, with which it saws trees asunder and fells them. . . . The two horns are the books of the Old and New Testaments, with which the believer can resist the adversary and push him to the ground, and can cut down all growing sins and vices." Mingled with this statement are a number of subordinate lessons.

Very curious among these developments of the pious mediæval imagination are the barnacle geese, as described in the Bestiaries. It is declared that "they grow on trees by the seaside, and hang from the boughs by their beaks until they are covered with feathers and fall like ripe fruit. If they reach the water, they swim and live; but if they remain on the dry ground, they perish." Naturally, this illustration was used with great force to prove the efficacy of baptism in saving the soul, and Gerard of Wales made a curious use of it to prove the doctrine of the Immaculate Conception.

Very justly and aptly does Prof. Evans call attention to the fact that some of the dogmas which have long obscured and even supplanted Christianity, and which are still insisted upon as substitutes for the Christianity taught by Christ himself, were devised and handed down to us by the very thinkers who developed these legends and made this pious use of them.

But another very interesting field is opened by the use of mediæval sculpture for satirical purposes. The growth of it in this direction begins to be especially evident in the thirteenth and fourteenth centuries, and it culminated about the time of the Reformation. Monkeys appear as choristers, swine as monks, asses as priests, sirens as nuns, wolves as the father confessors of lambs. In one painted window a fox is represented preaching to a flock of geese from the text, "God is my witness how I long for you in my bowels." In Ely Cathedral a fox is represented arrayed as a bishop. Here comes in what has so astounded many travelers—the apparent obscenity of some of these representations. Gentlemen who have visited some of the greater cathedrals are hardly likely to forget the leer with which the sacristan sometimes raises the wooden seats of the choir, or points to a bit of carving in a corbel, which seems the result of the grossest license. It was really the outgrowth of the same bitter feeling against the growing corruptions in the Church, which led such pious preachers as Geyler of Kaisersberg to speak in the plainest terms against the same evils.

Various writers in these days have found fault with Luther for the grossness of some of his utterances, but as we note these earlier representations in art and Christian literature we see that his diatribes were but a natural evolution out of an earlier Catholic phase of thought.

Among the animals which took a leading part in mediæval sculpture at this period was the fox, and a text of the *Physiologus* was widely translated into sculpture. This text ran as follows: "When the fox is hungry, it lies down in a furrow of the field and covers itself partly with earth, as though it had been long dead. Then the ravens and other rapacious birds come to devour it, when it suddenly leaps up and tears them to pieces. Thus the devil deceives those who love the corrupt things of this world and obey the lusts of the flesh, and entices them to their own destruction." Representations of this scene and others in which the fox plays a leading part are very common in the later mediæval sculpture. In Worcester Cathedral is a carving showing foxes running in and out of holes, while John the Evangelist stands near with his gospel in his hand and an eagle at his feet. Here the foxes are types of the devil, and John the Evangelist the herald of divine truth. In Canterbury Cathedral are sculptures representing a fox dressed like a monk and preaching to an assembly of geese.

Very severe at this later period were some of the caricatures by devout Catholic sculptors upon the begging friars. In the church of St. Victor at Xanten are carvings in which is represented a monster with the feet of a pig, the tail of a fox, and the head of a monk.*

The ass was also used for a similar purpose. Thus, on a column of St. Peter's Church at Aulnay an ass is represented as standing on his hind legs and clothed in ecclesiastical costume. Even in so devout a country as Spain, and in such a theological center as the Cathedral of Toledo, we find striking examples of this same satirical spirit; and at the Cathedral of Burgos are sculptured satires no less striking, against vice and folly.

More and more frequently throughout Europe we have in sculpture these figures of foxes preaching to fowls, with other foxes lying in wait behind the pulpit to catch the congregation; of asses wearing rosaries, of donkeys playing upon the lyre, of pigs playing upon the bagpipes, of foxes confessing birds, and of wolves confessing sheep; and these appear not only in sculpture, but in other forms of art. In the collections at Cornell University are some very curious specimens. A very rare missal, obtained by the writer of this article in Germany some years since, is full of illustrations of this kind.

Very interesting is the final chapter of Prof. Evans's work, entitled Whimseys of Ecclesiology and Symbology, and among these the reader will doubtless most rejoice in the extracts from a paper on Vestiges of the Blessed Trinity in the Material Crea-

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* See work cited, p. 224.

tion, published in the Dublin Review for January, 1893, by the Rev. John S. Vaughan, who finds traces of this doctrine "'written large across the whole face of Nature,' and everywhere suggested by 'such familiar things as rocks, mountains, seas, and lakes.'"

This reminds us of Mr. Gladstone's famous discovery that the trident of Neptune, in some occult manner, symbolized the Christain Trinity; the trident being, after all, nothing but the most natural form of fish spear, devised in consequence of the fact that, owing to the refracting power of water, a single spear head is not likely to be so useful in catching fish as one with three prongs.

Into the concluding chapter of the work is brought a bird which greatly exercised the mediæval imagination—the peacock. A text is cited from the *Physiologus* to the effect that "when the peacock wakes suddenly in the night, it cries out as if in distress, because it dreams that it has lost its beauty, thus typifying the soul, which in the night of this sinful world is constantly fearing to lose the good gifts and graces with which God has endowed it." Perhaps one of the most curious typical examples of ultra-theological reasoning is seen in the pious argument of the Bestiaries that "the tail of the peacock denotes foresight, since the tail, being behind, is that which is to come; and foresight is the faculty of taking heed to that which is to come."

Much light is thrown into mediæval ideas, also, by other sculptures, especially those representing Satan. This, indeed, opens a great chapter, and a chapter which was by no means concluded at the Reformation. Undoubtedly a considerable part of Luther's theology regarding the devil was drawn from this source. The writer of this article, some years since, staying for a time at Wittenberg, and being frequently in the great church where Luther so often preached, noted directly opposite the pulpit a sculptured imp emerging from a mass of carving. Nothing could be more natural than that the great Reformer, wearied with other themes, should by this and similar sculptures in other churches be constantly drawn off from his main subject to his well-known denunciations of Satan and satanic influences.

It should be remembered that in the ages before printing the cathedral sculptures took, for the people at large, the place of the printed book. Robert de Luzarches and Erwin von Steinbach, who built, preceded Faust and Schoeffer, who printed. Victor Hugo recognized this when he pictured his Quasimodo, the Hunchback of Notre Dame, as absorbed in the study of the series of sculptures about the choir of that cathedral. The special value of Prof. Evans's book lies in the fact that, like Prof. Crane's book on the *Exempla* of Archbishop Jacques de Vitry, it enables the American reader to get really into the thoughts of his ancestors who worshiped in the cathedrals. For the general thinker, also, such works are of real use, as revealing more and more clearly that all progress in thought is the result of an evolution which is by no means to cease in our time.

Prof. Evans's work is thus valuable, not only to the student of art and literature, but to every one who wishes to penetrate the meanings of history in general. The writer of this article, having visited and studied nearly every cathedral and church of any importance from Throndhjem to Palermo, and from Dublin to Moscow, can vouch for the exactness of the statements made in this little book; and it should be added that the learned professor has attached to it a bibliography which, to any one who wishes to carry this fascinating subject still further, will prove most helpful.

TWO SCIENTIFIC CONGRESSES.

By J. MARK BALDWIN,
PROFESSOR OF PSYCHOLOGY, PRINCETON UNIVERSITY.

THE pursuit of science does not stop in summer, and those who go abroad for rest or recreation find that science pursues them. It is a very profitable form of science which is thus prosecuted in summer, however, and that in two respects: for, in learning science in a summer congress, one gets the things which the best men oftentimes save up for just this or that occasion, and then again one gets the men thrown in. This latter fact is really the redeeming feature of a scientific congress. It is appreciated, too; and the social side of the congress idea has had such development that it is a question whether the fatigue incident to the attendance upon the social functions does not sometimes enervate the scientist when he should be mentally most brave and sharp.

The International Congress of Experimental Psychology, of which I shall first speak, certainly touched the summit of social privilege, as a citizen in any monarchy would certainly agree, since certain of the members were given a dinner in Munich—the seat of the congress—by the reigning house in the person of Prince Ludwig Ferdinand of Bavaria, himself a man with a medical degree and the author of sundry medical monographs. This, together with the official reception by the city of Munich and the many other private and collective entertainments, will make this meeting memorable to those who had the good fortune to attend it. It was a chance, too, to meet almost every great—or less great—worker in the various departments of psychology in Germany.

The organization of an international congress for psychology dates back to 1888, when the first assembled in Paris under the presidency of Prof. Th. Ribot, of the Collége de France. It was devoted very largely—and that intentionally—to two topics which were then uppermost in the French psychologists' minds: hypnotism and telepathy. Very few Germans were there. Of English-speaking delegates, Prof. Sidgwick, of Cambridge, and Prof. James, of Harvard, who were the two best men at that time—as they are yet—interested in both these subjects, were prominent. The second meeting was in London, in 1892, under the presidency of Prof. Sidgwick—a large and profitable meeting; and it is significant of the change that had come over the *personnel* of the congress, as well as of the growth of ideas in the interval between the two meetings, that at this second session the name of the organization was changed from "Congress of Physiological Psychology" to "Congress of Experimental Psychology." For at the London meeting the range of topics was greatly broadened; both hypnotism and telepathy took a much less prominent place; and all the varied branches of psychological work came in for treatment, especially the purely academic experimental psychology of the laboratory.

The third session of this congress, held August 6th to 9th in Munich, showed the same development, and so became the great unrestricted body that it should be. All departments of psychological investigation were adequately represented in the five sections into which it was found necessary to divide the more technical papers; while the general sessions, devoted to topics of more universal interest, were full and most instructive. Indeed, the president found it necessary to repeat what the former presiding officer had said in London, that the word "experimental" in the title of the body did not describe laboratory work alone, but all investigations into mental things which were conducted by competent men in accordance with inductive scientific methods. This range is shown by the titles of the five sections referred to: "Neurology, the Senses, Psychophysics"; "Normal"; "Abnormal"; "Dreams, Hypnotism"; "Comparative and Educational." Consequently, at the Munich Congress the word "experimental" was dropped from the official designation of the body.

The work of the general sessions was interesting to a wider circle than that of the professed psychologists, in several respects. The president, Prof. Stumpf, of Berlin, discussed the relation of mind and body in a way which may be profitably read by those moderately versed in philosophy. His address has since appeared in full in the *Revue Scientifique* of Paris, and will also appear in full in the Proceedings of the congress. Prof. Richet, of Paris, discussed "Pain" in a way which did not throw much light on the subject, and his paper has also come out in the *Revue Scientifique*.

Prof. Ebbinghaus presented an interesting new method of testing the mental capacities of school children, which I have already outlined in the Nation for September 10th.

President Hall, of Clark University, was to speak in one of the general meetings, but did not attend. Prof. Preyer, who is known for his excellent books on the child's mind, presented a general treatment of "The Psychology of the Child."

In the sections much exact work was done. It would be impossible, in the space I have, even to cite the different papers; so I shall have to leave the reader to consult them in the Proceedings. There were, besides the regular programme, several things of the nature of "side shows" which deserve comment. In the first place, there was an exhibition of apparatus, containing many interesting and some new things, under the charge of Dr. Marbe. Then the members of the congress were treated to a demonstration of the Röntgen ray effect which has possibly not yet been surpassed anywhere. Led into a dark room, the observer was stationed before a prepared screen about two feet square or more, and behind the screen a boy was gradually passed at the same time that the Röntgen rays made the screen fluorescent. The shadow outlines of the internal organs of the boy were clear—lungs, heart, etc.—and the movements of these organs in regular rhythm were plainly seen. This exhibition excited great enthusiasm among the members of the congress. Another rather sensational "side show" was the exhibition made of an Indian yogi, who went off into his sleep in a private room for the edification of some of the psychologists.

The next psychological congress is to meet in Paris in 1900, in connection with the French Universal Exposition. Prof. Ribot, who is considered the official representative of psychology in France, is again made president, and M. Ch. Richet vice-president. M. Pierre Janet will be secretary. The international committee for the next meeting has four American representatives—Profs. James, Hall, Titchener, and the present writer. There seems to be a general feeling that America should have the congress soon; indeed, the going to Paris for a second session is a matter of special consideration in view of the coming exposition.

The other congress of which I have promised to write briefly is that of "Criminal Anthropology": the fourth, which met in Geneva in the last week of August. This congress has had about the same lease of life as that for psychology, the earlier sessions having been held in Paris, Rome, and Brussels. It aims to be official, and invitations to take part are sent to the different Governments. This year quite a remarkable array of governmental appointees were in attendance. It seems that this policy is somewhat doubtful, from the point of view of science, since the Governments are sometimes disposed to take what representatives they can get in order to save expense; and, besides, their appointees are likely to be men whose interest is rather in the practical and administrative side of criminology than in the purely scientific side. I am far from meaning by this to make any disparaging reference to the Government representatives in the congress of this summer, but only to say that the general policy is likely to give the development of the work of the organization a set in a practical rather than a scientific direction. This, indeed, already shows itself in the work of the congress. Of course, a congress on administrative criminology—there has been a congress on "Prison Reform"—would be a good thing; but what criminology as a science needs the rather is the earnest discussion of the fundamental concepts on which it rests; especially seeing that the origin of the movement which issued in the organization of the present congress—and which gave rise to the phrase "criminal anthropology"—was an extremely one-sided and in many respects extravagant and unscientific one.

This year's congress did not make much progress in settling fundamental questions—such as the real definition of criminality from a psychological point of view, or the classification of criminal classes, or the nature of moral insanity, all of which are necessary preliminaries to the more practical problems of treatment, etc.—but spent its time in sharp, sometimes violent, discussions between the school of criminal anthropologists in Italy, led by Lombroso and Ferri, and the party of doubters who have as yet little to offer in its place. Among the more serious and important papers I may mention: V. Hamel, *L'Anarchisme*; Dallemagne, *Dégénérescence et criminalité*; Tarde, *La Criminalité professionnelle*; Ballet, *Les Persécutés processifs*; Naecke, *La Psychiatrie criminelle*; Legrain, *Conséquences sociales de l'alcoolisme des ascendants*; and Mr. Francis Galton's report on his "finger-print" method of identification.

The next session of this congress is to be held in the Hague, on invitation of the Dutch Government, in 1901.

It is in line with the criticism made above—to the effect that this congress is not sufficiently severe in its devotion to the pure science of the criminal—to suggest that the psychologists of the other congress should give more attention to what is called *criminal psychology*. The psychology of abnormal types of mind has been greatly advanced in recent years, especially in France; and this advance has extended to a great many phases of mental defect. But the particular line of defect which criminology has in view has not been much treated by professed psychologists, although the first determination of criminology—as to whether crime is in its nature really a mental defect at all—is of course a psychological one. I do not wish to disparage the anthropological investigations of the Italian school as far as they have been made with due severity of method—as some of them have not—but, allowing that much has been done and that much more will be done by the investigation of the physical side, it still remains true that the closer approach to the real criminal must be from the psychological side. Suppose, for example, we should admit the results of Lombroso, Ferri, and the rest, and say that there are certain physical "stigmates," or signs, which are found more often singly or together in law-breakers than in any law-abiding group of people, still two very important questions would have to be asked and answered before we should have the first start toward a real science of the criminal as such. First, What proportion of *people who are potential criminals do not become law-breakers ?*—and, second, *What proportion of the law-breakers are not criminals ?* The first question asks us to decide what type of mind is a potential criminal, or what degree of abnormity, social obliquity, etc., a man must have to be a criminal. This calls for a psychological definition of criminality. The second question takes us in exactly the same direction; for to ask how many law-breakers are not criminals is to admit that there are degrees of abnormal defect which the law takes cognizance of simply because more appropriate agencies do not. There are men and women in the jails who ought to be in reformatories, and others in the reformatories who ought to be in the asylums. This, then, calls upon us for a psychological determination of the lower limit of criminality—the limit below which we are dealing with the insane and the irresponsible—as the former question calls for the upper limit, that which sets bounds to the class of criminals who are never caught by the law at all. Both of these are accordingly psychological questions; and the main value of the results of the so-called criminal anthropology, as so far worked up, is to set these problems clearly in the light, especially the latter one. To establish moral atavism for one class of men, and degeneracy for another class, and criminal heredity in this fashion or that, is to throw these classes out of the really criminal class altogether, as far as any psychological definition which is now in sight would seem to indicate.

It is mentioned as a characteristic of Japanese artists that they will not repeat identical elements. They, in fact, understand the difference between the meanings of the terms "likewise" and "also," and they will have none of the latter. Accordingly, of fifty stencils of theirs recently published in an art work, there is not one which in all respects reproduces another, although there are many which resemble one another.

THE SO-CALLED CALIFORNIA "DIGGERS."

By Mabel L. Miller.

TWO years ago I began to collect notes bearing on the settlements, manners, and customs of Indian tribes once inhabiting the country along the banks of the Sacramento and Feather Rivers, from the American River, north to Chico Creek and eastward into the Sierra Nevada Mountains. These tribes have been considered the lowest type of California Indians; but by force of changed environment the few remaining are giving up their wild ways and adopting civilization, even Christianity. They have always been misunderstood and often misjudged: the very name "Digger," by which these Indians are known, is a misnomer and a term of reproach, which they have always resented. It is of uncertain origin. Old settlers say that they did not hear the name until some time after the year 1841, when it was first used by an abandoned type of white men in allusion to the Indian custom of digging camass root for food. Immigrants became familiar with the name, and the appellation soon spread. Without doubt the name originated in the Rocky Mountains; there might have been a band or village of the Shoshones, or of some kindred tribe, that bore a name so closely resembling the word "digger" as to be easily corrupted into it.

White people scarcely ever pronounce Indian names correctly. The miners and immigrants of early days spoke of the Nem-Sā-Win Indians as the Nimshews; the Sulam-Sā-Wins as the Sulamshews; and the Kem-Sā-Wins as the Kimshews. There are mining camps designated after each of these clans or villages, but named in the miner's dialect. The inappropriate name of "Digger," therefore, is not a tribal name. No tribal name has ever been found, although the Ethnological Bureau at Washington has sent men here to study the language and character of these Indians; these men gave them the name of *Midu*, which they understood to mean man, but this is not a tribal name.

There is no tribal name, because there is no tribe. One of the first things that strikes the observer is the fact of the entire separation of these Indians into local units or villages, each bearing its own name and having its own chief. On this point we have the evidence of General John Bidwell, of Chico, who came to California in the year 1841; he has figured largely in the history of the northern part of the State, and has had large experience among these Indians. I have also met other old settlers, companions of such men as Kit Carson, Joe Walker, Pegleg Smith, and Isaac Graham, all men with whom Indian life and experience and the names of Indian tribes were subjects of constant mention and use. They do not believe that these Indians had tribal names, tribal chiefs, or organizations.

These Indians, then, were greatly scattered in villages. Many of these villages spoke the same language, and in this case the group might be said to form a tribe. For instance, one dialect was spoken by the Indians on the east side of the Sacramento Valley, from the American River on the south to Chico Creek on the north, and eastward to the summit of, or perhaps in some places beyond the summit of, the Sierra Nevada Mountains, thus covering a territory of about ninety by fifty miles. From 1840 to 1850 there were from eighty to one hundred villages on that side of the Sacramento Valley, and an Indian population of seven or eight thousand. Yet, though the area and population were large, they had no tribal name, as far as any of the old settlers could ever learn, nor have I been able to trace one in my own researches with Indians belonging to that tribe; I therefore conclude that there was an entire absence of any tribal feature other than language, and that we have here an unconscious, unborn tribe, possibly on the verge of conscious tribal union.

As for the villages, many of them bore the name of the creek on or near which they were situated: for example, Nem-Sa-Win (Nem meaning "good," and Sawin "stream") was the Indian name for Butte Creek, Sulam-Sa-Win for Chico Creek, and Tem-Sa-Win and Kem-Sa-Win for other creeks. An Indian village was situated on each of these streams, and bore the name of the stream.

The majority of the old Indian villages were inhabited between the years 1840 and 1860, and probably a few as late as 1865 or 1870. Most of these villages, it will be seen, had a population of from one to four hundred, excepting *Colus*, which, according to General Bidwell, had, as late as the year 1845, a population of a thousand or twelve hundred, and which would seem to have been a sort of capital city for the Sacramento Valley Indians. Upon the site of this old rancheria is located the present town of Colusa, which took its name from the Colus village. Many instances of this change of population are to be found throughout the State of California. Thus in the particular region above referred to are to be found the towns of Yuba City, Butte City, and Princeton, all built upon the sites of former rancherias. The city of Marysville, situated not far from the above-named towns, is located between two very old Indian villages, and the town limits even now are impinging upon one of them.

The Indians of this region were dependent upon the streams for existence, their villages being found only upon the banks of the Sacramento River and its tributaries. There were good fishing and hunting along these streams while the fertile soil of the valley yielded a heavy growth of wild grains, and the oaks here as elsewhere in California gave their contribution of acorns. It is of historical interest to note that the younger of the rancherias are those farthest from the main rivers, for the reason that, as the white population came in, the Indians retreated to the foothills. These Indians decreased and disappeared rapidly after the white people began to crowd them out of their possessions.

A period of fifty years has seen these villages completely depopulated and almost every trace of them destroyed. Towns and grain fields cover the spots where they once stood.

We can not imagine or realize what the taking away of their free life meant to the Indians. It was the one act of ours which they could understand, and it is no wonder that a feeling of suspicion and hostility arose among them which has only been overcome within the last few years. Because of this suspicion it must have been impossible a few years ago to obtain correct information bearing on their old life: but the feeling, if not forgotten, is at least fast fading from their minds, and many Indians can be found who will talk freely and sensibly of the days before the white man came among them. These tribes were but little inclined to war. At the time of the outbreak with the Modoc Indians, they exposed their fear by crowding about the white people, saying, "That kind bad Indian," "Me no that kind," etc.

Full-blooded Young Indian from Feather River, about Twenty-seven Years Old.

Although they did commit many desperate and awful deeds, these were done secretly, never openly and daringly; they were the easiest tribe in the State to bring into submission.

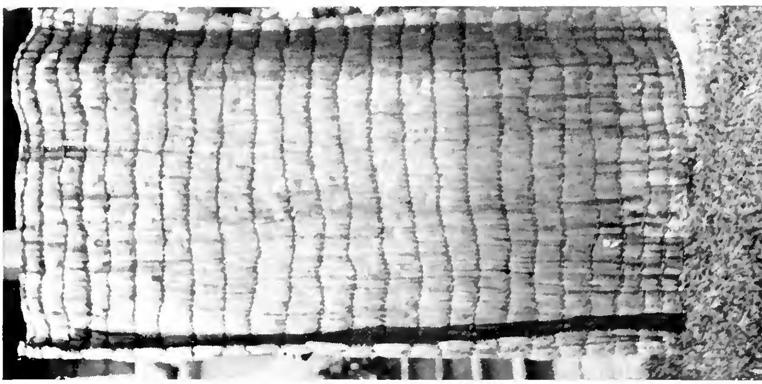
The average "Digger" was of medium height and weight; a few were short and heavy set, but none were tall and thin. They had low foreheads, flat noses, large ears and mouths, and high cheek bones. Many of them had almost black complexions, while others seemed to be sallow or copper-colored. A few had very thin mustaches, or a few hairs here and there on the chin which might have been called a beard; the majority, however, were smooth faced. Both the men and the *mahalas*, as the women were called, had very heavy hair; old age did not thin it or turn it gray to any extent. A bald-headed Indian would have been looked upon as a phenomenon.

I saw two Indians last summer whose ages were given by their people as one hundred and twenty and one hundred and thirty years. Old settlers who have known of them for fifty years do not think the figures are much exaggerated. The wrinkles in their faces were so deep that the skin fell in folds, and their bodies seemed to have shrunken to one half their former size. They were deaf, dumb, blind, bent, and helpless, yet their hair was barely streaked with gray, and so thick that a comb of ordinary size could not be passed through it.

A "Digger" Mahala from Feather River, Full-blooded, and of Finer Physique than the Average.

The manners and customs of these Indians differed but little from village to village. During the summer months they needed only a shade to protect them from the hot sun. The wild, free life in which they reveled at this time of the year needed only food, but as winter drew near they had to build something which would protect them from the severe storms. An excavation several feet deep, and varying in diameter, was made first. Around the edge of this, willow poles or small trees were placed upright in the ground and drawn together at the top until a cone-shaped structure was formed. Bushes and strips of bark were then woven closely about this; lastly, dirt was thrown on and packed solid to the depth of six or eight inches. Only two openings were left—a round one at the top for the escape of smoke, and a square one close to the ground on the side most sheltered from the wind, which was used for a door; this opening was made just large enough for the occupants to crawl through. Furs and strips of matting woven from tule grass were used to sleep on. A fire was kept burning day and night in the middle of the "campoodie" (*Kahm-Poo-Dy*), the Indian name for these houses.

They were usually occupied by a large family, and must have been warm, but close and smoky. In the Sierra Nevada Mountains a heavy fall of snow would change them into white pyramids. A village of two or three dozen campoodies with blue smoke curling from their tops, and a bright morning sun reflected



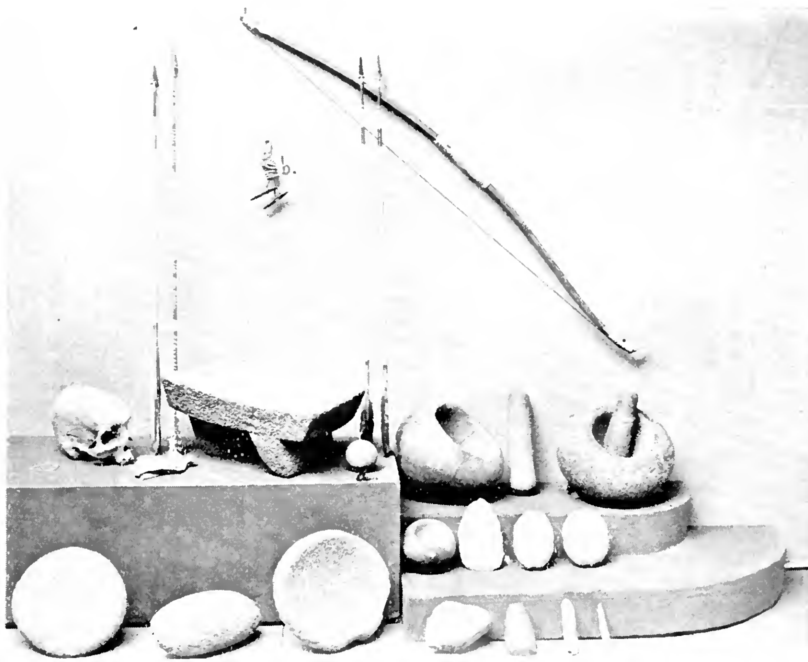
Mat of Tule and Cedar-root Bark, formerly used for Beds, Doors, etc.

in thousands of sparkling crystals in the snow about them, made a scene which I have heard many old settlers speak of as beautiful.

Through the summer the Indians prepared their winter's store, which consisted mainly of dried acorns, used in place of flour or meal; berries, grasshoppers, grass seeds, fish, nuts, meats, and roots of various kinds. The camass (*Camassa esculenta*) was the principal root; it grew in abundance all over California, and is still plentiful in many valleys in the northern part of the State. It is about the size of the little finger, shaped like a sweet potato, and with much of the same flavor. A long, hard winter would cause these Indians to suffer more or less from privation. While in conversation with an old Indian he said: "Long time ago, 'fore white man come, big winter come, Indian no have enough to eat, lots of Indians die; my *mahala*, my little boy die."

Mortars, baskets, and flat rocks were their principal utensils for cooking. The mortars were made from rocks of various sizes, generally somewhat rounded but never uniform. The deep round hole in the center was ground with sharp, rough rocks. It was a slow process and required patience, for it took many days of work to complete one large mortar. These mortars were not only used for cooking but also for grinding food, when a round stone pestle would be required. No household was complete without the large, flat rock, which was generally stationary, and contained a half dozen or more round holes, varying in depth and diameter, used exclusively for grinding, and often surrounded by busy groups of *mahalas*.

Their greatest manufacture was that of baskets; they made hundreds of them yearly, of all shapes and sizes. The larger ones were woven from long, slender willows, the smaller from delicate strips of the willow bark. Some were decorated with beads and feathers, in others indescribable designs were worked with colored



"Digger" Implements, from the Collection of Dr. Jewett, of Marysville.

barks. The baskets that were made for cooking purposes were water-tight. Meats, soup, and so forth, were boiled in them by dropping in hot stones, replaced by others as fast as they cooled. Mortars were also used in this way, as the direct heat of fire was apt to break them. For frying meat, hot flat rocks were used. Large cone-shaped baskets were made to transfer household effects, gather food, and in general to carry. They were bound on the back, fastened by a belt about the waist and by a band from the top of the basket around the forehead.

The *mahala* was invariably the burden-bearer: these great baskets, loaded with all they could hold, were never strapped to the back of the man; he carried only his bow and arrow. Their method of starting a fire was most skillful. Two round pieces of hard wood were used, one tapered to a point at one end. These were rubbed together between the hands until the friction produced a spark, which, thrown into a heap of fine, dry bark, produced fire almost instantly. I wondered how it could be done without burning the hands, so I hired an old Indian to satisfy my curiosity. He started a fire for me, and it was done so quickly, easily, and ingeniously that I was still left wondering.

During the warm months these Indians wore little or no clothing; the men sometimes tied a small girdle around their hips which was woven from grasses; oftener they went entirely naked. The women were never seen entirely nude. They wore a short skirt or apron, also woven from grasses, which, separated on both sides, reached to their knees in front and behind. Children of both sexes went naked, but when a girl reached the age of maturity she put on her grass skirt. Their winter clothing was made from skins.

Earrings of bone and wood, beads of berries, shell ornaments, and feathers arranged in many fashions for the head were their adornments. The bows and arrows used by this tribe differed very little from those carried by other Indians. The arrowheads were made mostly from flint, bone, and obsidian, though some schist was used. There are large ledges of flint and obsidian in the northern part of the State, and this material was widely distributed among the different tribes by trade.

Not every Indian could make an arrowhead, for it required a skillful workman. The process of manufacture was as follows:

"Digger" Implements, from the Collection of Dr. Jewett, of Marysville.

The material for the arrowhead was heated to a certain temperature, when it was chipped as desired with a spikelike stone implement, which was dipped in cold water, placed quickly upon the hot flint, and the necessary stroke given. The drop of water coming in contact with the hot flint and the simultaneous stroke cut the chip off about as desired. A rough stone was used to grind the points and edges into shape. Another weapon was the spear, which was made of hard wood, often five feet in length, and tipped, like the arrows, with flint or obsidian. These heads were from three to nine inches long and from one to four inches in width. The points of these spears, as also the arrowheads, were sometimes poisoned by dipping them into liquid made from a poisonous plant or by the drippings from a putrid deer's liver. The Indian was a sure shot at close range with his bow and arrow. He had many ingenious ways of decoying his game. Sometimes a hunter would disguise himself with the skin and horns of a deer, and in a stooping position crouch about the alkali spots where the deer were in the habit of coming to "lick" until he was close enough to the animal to be sure of his shot, when a flint-tipped arrow just behind the left shoulder was as sure as any bullet. A deer, unless frightened, never jumps anything of any height; it will walk around a very small log. The Indians discovered this trait, and used it to their advantage. They would stretch a buckskin line across a trail that deer were frequenting, and station themselves in ambush at each end. The deer would walk up to the line, pause to sniff at it a moment, then follow it to the end, and generally to his death.

The white man did not teach the Indian to gamble; it was born in him. Men, women, and children were slaves to its fascination. They had all kinds of queer games, in which furs, beads, and any property, in fact, that they might possess could be exchanged in a manner that would do credit to white people. The men often wagered their *mahalas* against a few furs or bows and arrows, and in such cases loss or gain would not seriously affect the commercial standing of the parties involved.

In regard to matters of morality, the general statement may be made that these Indians did not have any set punishments for what they regarded as crimes; the criminal was, however, ostracized by them. Polygamy was practiced to a large extent among them; one man often had two or three wives, and a chief sometimes more. Virtue was not held precious by the women, but the men had regard for it in so far as their own families were concerned. When an Indian had more than one wife he hired each to watch the other. They had no marriage ceremony; when an Indian made up his mind that he wanted a *mahala* for his wife, he went to her home and asked the father for her; if there was no objection he was asked to eat with them, after which he had the right to take his bride away whenever he wanted to. If the girl opposed her suitor she was given one chance of escape—she ran a race with him. She was allowed a certain number of feet the start when the signal was given to run. If she won she was free, but if he caught her she had to go with him without a murmur.

The following story on this point was told to me by a civilized Indian woman:

Her grandmother was a great belle and had many suitors. There was one whom she hated but was forced to marry because he could pay the highest price for her. He was the chief of a village and had great possessions, but he was middle-aged and lame, while Napana was young, strong, and beautiful.

He had asked her father and been invited to eat, and, having turned over the stipulated price, Napana was his. In this case the price was so large that the bride was even denied her chance of winning freedom by the accustomed race. When Captain Lofonso came to take Napana away she refused to go and he had to carry her. Before he reached his home his strength gave out and he was obliged to stop for rest.

Papoose in his Gebelle made of Tule and Soft Tanned Leather.

An Indian woman never had the right to beg for her freedom, but she had the privilege of struggling for it. Napana's strength increased as she realized her unhappy situation, and she fought madly for freedom; for if she could escape from him and get back to her own home before she had entered his she would be free, and he would lose his wife as well as the price paid for her. Captain Lofonso lacked the strength to get Napana on his back again, but he was determined that she should not get away, for his lameness would deprive him of all hope of catching her. Night came on, and still he held her tight by both wrists, while her strong jerks and pushes swayed both bodies back and forth until they sank to the ground exhausted. Toward morning his strength failed and he fell asleep. As she felt his hands loosen their hold on her wrists she mustered all her remaining strength and crawled back toward her home; but she never reached it. Just as the sun rose over the mountain above her home she sank insensible at the threshold. Here Lofonso found her and bore her back to his home with never an opposing struggle.

Childbirth was of no inconvenience to the average Indian mother; a few hours after delivery she was attending to her usual duties, even though it happened to be a walk of many miles. An acquaintance of mine had employed the same *mahala* for several months to do the washing for her family. It finally became evident that she was about to become a mother. She had the washing well started one Monday morning when she said: "Me feel heap bad, me go home; me think papoose come." Early the next morning she came back; the baby had been born and she was ready to finish the washing.

"Digger" Boy of about Ten, from Feather River.

The male child was held in greater favor than the female; frequently a child of the latter sex was destroyed as soon as born.

These Indians, though seemingly strong and vigorous, succumbed easily to disease; consumption and smallpox were the most prevalent and fatal diseases; much of the former was undoubtedly caused from their sweat dance, followed by the cold-water plunge. This dance was a festive event. The sweat-house was an immense cone-shaped structure, built near water, and much in the same way as their homes. All important events were celebrated with one of these dances, and Indians gathered from long distances to take part in them. A fire was built in the middle of the close, smoky house, and around it the naked, face-and-body-painted Indians danced. As the flames darted upward their enthusiasm increased until they leaped and shrieked in a frenzy of excitement. They kept this up until the perspiration poured from their bodies and exhaustion caused them to drop from the ring, when others would take their places, and they hurried to the stream to plunge into the ice-cold water. These dances were also used to cure disease, but more often caused death. The time for these dances, like the time for everything else, was reckoned by reference to the moon and by such natural periodical events as the ripening of various varieties of berries and the emigration of certain species of birds.

Once a year one of these sweat dances was followed by a burning of baskets, at which time the baskets that were not needed by the people of the village were heaped together and set on fire, the Indians dancing, laughing, and howling while the flames destroyed a good part of their year's work. It was a custom for which I have not been able to find their reason. "Indian have good time then," they say, when you inquire into the reason for this ceremony.

This tribe had their medicine men, whose treatment consisted in the use of herbs, magnetic motions, and rubbing, the sweat and cold plunge, and the sucking process—disagreeable enough, one would say, for the operating healer, when it is explained that he claimed to suck from the diseased part all malignant disease, and would spend consecutive hours in this loathsome practice of his art, spitting out of his mouth the poison drawn from the afflicted part.

This tribe of Indians were and are still exceedingly superstitious. If anything unusual took place in their village, such as a number of deaths closely following each other, every Indian would move camp; or, when one of their number met his death in some unknown way, they believed that the Bad Spirit was the cause and they could not leave the place quickly enough.

There is a beautiful fresh-water lake in the Sierra Nevada Mountains which years ago was a great fishing place for these Indians. One day a large party had gathered there to camp and to fish. It was near night when two young Indians fell from their canoe and were drowned without the others seeing them. They saw the empty canoe and the disturbed water, and one Indian saw a face which he declared to be that of the Bad Spirit. They fled from the place that night, not even stopping to search for the bodies of their companions. They have never fished there since, for they believe that if a drop of water from that lake could touch them they would die in the same way.

I was much interested in what we must call their religious belief as shown in their burial customs and the manner of mourning for their dead. Because they were savages shall we call it superstitious imagination? It is certain that they believed in a future life. They also believed in a Great Spirit as well as a good and a bad one, and had distinct personal conceptions of their gods. Thus they worshiped the sun because they believed the Great Spirit was making what they called the happy hunting ground there. After an Indian was dead and buried, if you asked his people where he had gone, they would point to the sun. It was their heaven. Before the white man came among these Indians they burned their dead. Whatever a dead man had owned was destroyed with him, that he might have it when he reached the happy hunting ground. They believed that the smoke was the transferring agent between life here and there. When these Indians first saw the palefaces, as they called the white men, they thought them some of their dead returned to them in a new guise, and one that they by no means liked. After this time they began to bury their dead, explaining the change of custom by saying: "Indians go long way; no more smoke take 'em. Indians have to carry bow, arrows, skins, eberyting; take long time, no more want to come back."

The body was prepared for burial while still warm in the following manner: First, the knees were tied close to the chest and the head pressed down between them; the whole body was then compressed into as small and as round a form as possible, tied securely with buckskin string, wrapped in skins, and tied again. It was then buried in a large, round hole, the face turned upward, as were also the feet. The possessions were heaped upon the body and buried with it. After the Indians had begun to own horses and dogs, these were shot on the graves of their masters and their bodies left there.

This tribe now prepare their dead and bury them as nearly like the white people as possible, even neglecting to give them the accumulated property of this life.

Since obtaining the above information I have made a number of excavations in their old burial places and find that no particular position for placing the body could have been observed. The head sometimes faced the east, but just as often the west, and in several instances it faced upward and downward. These Indians did not make mounds, but selected soft soil for their graves. The bodies were buried from two to three feet deep; earth and sometimes stones were heaped up until something resembling a mound was formed. This, however, only depended upon the amount of work the living were willing to do for the dead.

They had many customs of mourning. The most interesting one was that adopted by a bereaved wife or mother. The hair of the mourner would be burned from the head, a sacrifice which meant as much to her as the laying away of bright colors means to us, and the ashes mixed with charcoal and pitch. With this mixture her cheeks, chin, and forehead would be streaked, and this emblem of mourning would be worn for many weeks. At the time of burial every Indian was expected to moan or howl, while many of them would writhe about on the ground and utter most unearthly shrieks. For a certain number of days after they had burned or buried their dead, the chief mourners would go to the grave a half hour before sunrise and, looking toward the spot where the sun was to appear, would express their sorrow in cries and moans until the golden rays fell about their world, when they would go back to their homes, calmed and comforted—why, they alone know, but can not or will not tell. A half hour before sunset they repeated the visit, remaining until the sun dropped from sight, when the expression of their sorrow often rose to wild screams and shrieks which only exhaustion could calm, for they found no comfort until the sun rose again.

It is difficult to obtain information on what they believe to have been their origin. It is the one thing which they seem to hold sacred and do not care to talk about. One Indian smiled as he said: "Oh, all same as white man; Indians think lots of things 'bout that." However, the following traditions were told to me by one old Indian, and I afterward learned from a civilized Indian woman that they were what the majority of these Indians believe.

The first was that two big mountains, probably Mounts Shasta and Lassen, got mad one day a long time ago and threw up lots of dirt, all kinds of wild animals, one big chief, and two *mahalas*.

The second is best told in the Indian's own language:

"Long time ago, no Indians, no white man, no nothing; all water, one big lake. Sometimes little mountains, little trees, little grass, but no Indians. Lots of deer, lion, bear, wild cat, ebrything like that. Great Spirit come in big canoe, take good deer, good lion, good wild cat, good bear, make Indians; then tell these Indians kill all bad deer, bad lion, bad bear, bad wild cat—they all bad." There is a shadowy relation here to the Oriental idea of the transmigration of the soul, which the student of comparative religions may take for what it is worth.

There is no evidence whatever of any written language among this people. While there is much of legendary lore among them, it is entirely traditionary in its character. It is also pervaded to a great extent with a spirit of mysticism so as to render many of their legends almost unintelligible. The following tribal legend is a fair sample of their poetical stories. It is well known among the members of the tribe, and is related in substantially the same language by all:

A dead pine tree has stood many years in the deep, clear water of Homer Lake, which lies at the foot of Mount Keddie, in the Sierra Nevada Mountains. According to the old Indian tradition, it turns around once every year, when a great Water Spirit imprisoned in its base raises its head to take a look at the world. The legend says that when the Indians first came to the valley where the lake is situated they found it one great body of water. They came in canoes and lived for years on the tops of high mountains. The Water Spirit had full control and made them no end of trouble. One day they gathered in a body and made supplication to the Great Spirit, who answered by commanding the

Water Spirit to fill itself with water and make trip after trip over the mountains until it had emptied all the water into the ocean, after which it was imprisoned in the base of the tree, and the small lake left for its drinking water. It must remain there until the end of time. Only once each year, in January, is the spirit allowed to look out from its prison, and woe to the Indian who is unfortunate enough to be seen by this monster, which possesses a fascinating power that can not be resisted! The Indian is drawn down into the prison and devoured.

This is a crude legend, but many Indians still believe in its truth, and could not be hired to camp near or fish in Homer Lake.

This tribe is fast disappearing. The younger generations have intermarried to a large extent with other tribes, and in some instances with other races. Their enforced association with a superior race has also had the usual effect. These conditions, together with their total disregard of the ordinary rules of health, have brought about the usual result, and it is doubtful if more than one hundred and fifty Indians can be found to-day in the Sacramento Valley who are descendants of this once powerful tribe, and one tenth of this number would easily include those of pure blood.

In Plumas County, which lies in the mountain district and affords somewhat different conditions from the valley in the matter of climate and sparse white population, the proportion of survivors is very much larger, although the same conditions of intermarriage, etc., prevail here as well. It is a significant and perhaps hopeful fact that the population of this mountain region has been increasing within the last decade. Whether this be owing to intelligent appropriation of hygienic ideas gained from association with white people, or to the chance for a slower evolution, or whether it be the expiring flash of the candle in its socket, remains for further examination. It is apparent that they have made a successful effort to lift themselves from their low condition of savagery to a higher plane of civilization, as is instanced by their adopting proper clothing, living in more comfortable houses, using civilized food, and properly cooking the same. They also evince an inclination to Christian worship and education, but with rare exceptions the Indian seems incapable of acquiring a complex education. Reading, writing, and spelling are readily learned by them, and they particularly excel in the imitative studies, writing and drawing.

Whether on the whole these Indians will become civilized before the race becomes wholly extinct remains a problem which time alone will be able to solve.

INDIVIDUALISM *VERSUS* COLLECTIVISM.*

By the Right Hon. LEONARD COURTNEY, M. P.

BY the beginning of the present reign the study of political economy in this country had worked itself free from earlier errors, and it had come to be believed that the secret of social regeneration lay in the utmost allowance of freedom of action to every individual of the community, so far at least as that action affected himself, coupled with the most complete development of the principle of self-reliance, so as to bring home to every member, freed from legal restraint on his liberty of action, the moral responsibility of self-support and of discharging the duties, present and to come, of his special position. Such was the theory more or less openly expressed by economic thinkers when the British Association was founded, and the same theory lay at the base of Jevons's address in 1870. Can we hold it now or must it be recast? Since 1870 primary education has practically been made gratuitous. The legislature had an opportunity for abolishing the mischief of doles, but showed no inclination to make use of it, and there were even traces of a feeling of favor for the maintenance of these bequests of the past. The indiscriminate multiplication of so-called charitable institutions has in no way been reformed, and there is as great activity as ever in the zeal of those who would mitigate or relieve the effects of improvidence without touching improvidence itself. Codes of regulations have been framed for the supervision of the conduct of special industries, and their sphere has been extended so as to embrace at no distant period, if not now, the whole industrial community. The reformed Poor Law, which was regarded as a great step in the education of the workman, especially of the agricultural laborer, in independence, stands again upon its trial, and proposals are at least in the air for assuring to the aged poor a *minimum* measure of support without any regard to the circumstances of their past lives or to the inevitableness of their condition. The suggestions made by responsible statesmen have indeed been more limited and cautious, but it will be acknowledged of those, as of the German system, from which they may be said to be in some measure borrowed, that they involve a great departure from the ideal of individual development. Add to this that there is a movement, which has become practical in many large cities and towns, for the community itself to engross some forms of industrial activity and to undertake in respect of them to meet the wants of their inhabitants.

* From the presidential address before Section F, Economic Science and Statistics, of the British Association for the Advancement of Science.

All these developments and more may be summed up as illustrations of collectivity—an ideal which has its advocates and professors, and which looks in the future for regulated civic and national monopolies instead of unrestricted freedom of individual activity and for the supervision and control of those industries which may remain unabsorbed by state or town. In pursuit of this last conception there have been put forward not only requirements as to hours and conditions of labor, but a demand also for a living wage or a *minimum* below which no workman shall be paid; and this principle has been already adopted by some municipalities in respect of their monopolized industries. The state itself indeed has through the popular branch of the legislature declared more or less clearly in favor of the same principle in respect of the industries which are conducted in its service. We have not only to acknowledge the continued slowness of politicians to adopt and enforce the teaching of economists such as Jevons contemplated, but also the rise of another school of economic thought which competes for and in some measure successfully obtains the attention of the makers of laws. We must therefore inquire whether the failure of former teaching has not been due to errors in itself rather than to the indocility of those who have neglected it. The greatest difficulty which the teachers of the past have to overcome when put upon their self-defense lies in the suspicion, or more than suspicion, of an occupied multitude that their promises have failed. It is thought of them, if it is not openly said, that they had the ear of legislators for a generation, that the course and conduct of successive administrations were governed by their principles; and yet society, as we know it, presents much the same features, and the lifting up of the poor out of the mire is as much as ever a promise of the future. Some quicker method of introducing a new order is called for, and any scheme offering an assurance of it is welcomed. A ready answer can be given to much of the suspicion of failure that is entertained. That freedom of industrial action which is the first postulate of the economists has never been secured. The limitations and restrictions necessarily consequent upon the system of land laws established among us are not commonly understood, but although much has been done to liberate agriculture from their fetters its perfect freedom has not been attained. There may be free trade in the United Kingdom and free land in the United States, but the country is yet to be found in which both are realized, and even if both these requisites were attained the sores of social life would not be removed unless the spirit of self-reliance were fully developed. And how little has been done to secure this essential condition of progress! Nay, how much has been done by law and still more by usage to weaken and destroy its power! The economist of the old school may boldly claim that so far as he has had a free hand his promises have been realized. There has been a larger population with increased means of subsistence and diminished necessity of toil, a people better housed, better fed, better clothed, with fewer relative failures of self-support; and if the teaching which has been partially adopted has brought about so much, everything it promised would have been secured had it been fully followed.

It will be conceded by the most fearless and thoroughgoing advocates of the liberty of individual development that it must be supported by large measures of co-operative action. The freedom and activity of association thus indicated are in no way inconsistent with the fullest theory of individual responsibility. A single workman may be powerless to induce his employer to modify in any particular the terms of his employment, but when workmen band together they may meet employers as equal powers. Such liberty of combination is a development and not a limitation of individual liberty. Another step is taken when the parties to such an arrangement as has been suggested seek to make its provisions compulsory on others, be they workmen or employers, who may enter into similar relations; and the principles of former economists would generally prompt them to condemn such attempts at compulsion. The Factory Acts were opposed in this way, although they rested upon different grounds; for, though in their consequences they affected the labor of adults, they were propounded for the defense of young persons and children unable to protect themselves or to be the parties to free contracts. Legislation has, however, been extended to control directly the employment of fully responsible persons, and this has been defended by three lines of argument. It is urged that, when the unchecked liberty of individuals destroys in fact the liberty of action of larger multitudes, it is in defense of liberty of action that those individuals are controlled. If a sea wall is necessary to prevent a large tract from being periodically inundated, it can not be permitted to the owner of a small patch along the coast to leave the wall unbuilt along his border, and thus threaten the lands of his neighbors with inundation. Again, it is urged that when the overwhelming majority of persons engaged in a particular industry, employers and employed, are agreed upon the necessity of certain rules to govern the industry, it is not merely a convenience, but is a fulfillment of their liberty, to clothe with the sanction of law the regulations upon which they are agreed. Lastly, it is submitted that there are individuals in whom the sense of responsibility is so weak, and whose development of forethought is so hopeless, that it is necessary the law should regulate their conduct as it may regulate the conduct of children. The first plea appears to be sound in principle, though it may often have been applied to cases not properly coming within it. As to the second, the convenience of giving to an all but universal custom the force of law is incontestable, but it is at least doubtful whether this is sufficient to deprive individuals who deliberately wish to put themselves outside it of the liberty of doing so. Unless their action could be brought within the first line of argument, sufficient reason for restraint does not appear.

These limitations of individual liberty are familiar to us, and have obtained a firm hold in our legislation; but we enter upon comparatively new ground when we turn to the proposals that an increasing number of industries should be undertaken and directed by state or municipality, and that a *minimum* and not inadequate subsistence should be assured to all those engaged in such industries, if indeed the principle be not presently extended outside the monopolies so established. The ideas which are clothed in the phrases "the socialization of the instruments of industry" and "the guarantee of a *minimum* wage to all workmen" appear to involve a complete reorganization of society and an absolute abandonment of the theories of the past. This is not enough to justify their immediate rejection or their immediate acceptance. The past has not been so good that we can refuse to look at any proposals, however strange in appearance, offering a better promise for the future. It has not been so bad that we must abandon its methods in despair, as if no change could be for the worse, if not for the better. No one could now be found to deny the possibility, and few to question the utility, of the socialization of some services. The post office is in all civilized countries organized as a national institution, and the complaints that are sometimes heard as to defects in its administration never extend to a demand for its abolition. Some of our largest municipalities have undertaken the supply of water and of gas, or even of electric light, to the inhabitants, and a movement has begun, which seems likely to be extended, of undertaking the service of tramways. Demands have also been made for the municipalization or nationalization of the telephone service.

New considerations of great difficulty arise when we pass to the suggestion of the undertaking by local authorities of productive industries not in the nature of monopolies. In monopolies direct competition, often competition in any shape, is practically impossible; in other industries competition is a general rule; and it is by virtue of such competition that the members of the community do in the long run obtain their wants supplied in the most economical manner. When commodities are easily carried without serious deterioration, the constantly changing conditions of production and of transport induce a constant variation in the sources of cheapest supply—that is, of supply under conditions of least toil and effort—and any arrest of this mobility involves a corresponding setback in the advancement of the economic condition of mankind. It is a necessary consequence of this process that the local production of special commodities should be subject to diminution and extinction, and that the labors hitherto engaged in such local production should become gradually worthless. There would be a danger of pressure to do away with invasive competition—action which would be destructive of the most powerful cause of improvement in the condition of the people. The position thus taken may be illustrated by an experience to which I have elsewhere referred, but so pregnant with suggestion that I need not apologize for recalling it. My native county, Cornwall, was in my boyhood the scene of widespread activity in copper and tin mining. There had not been wanting warnings that the competition of richer deposits in far countries would put an end to these industries in the county, but the warnings had not been realized and remained unheeded. In the years that have since passed they have been gradually and almost completely fulfilled. The mines were abandoned one by one, and the population of the county has steadily diminished in every recent census. What would the experience have been had the mines been a county or national property worked by county or nation ? Can one think that the same process would have been maintained had the collective owner worked the mines directly, and the workingmen looked to county or nation for the continuance of work and wages ? However much we may contemplate the reconstruction of an industrial system, it must, if it is to be a living social organism, be constantly responsive to the ever-changing conditions of growth; some parts must wax while others wane, extending here and contracting there, and manifesting at every moment those phenomena of vigor and decline which characterize life. In the development of industry new and easier ways are constantly being invented of doing old things; places are being discovered better suited for old industries than those to which resort had been made; there is a continuous supersession of the worth of known processes and of the utility of old forms of work involving a supersession, or at least a transfer, of the labor hitherto devoted to them. All these things compel a perpetual shifting of seats of industry and of the settlements of man, and no organization can be entertained as practicable which does not lend itself to those necessities. They are the prerequisites of a diminution of the toil of humanity. As I have said before, the theory of individual liberty, however guarded, afforded a working plan; society could and did march under it. The scheme of collective action gives no such promise of practicability; it seems to lack the provision of the forces which should bring about that movement upon which growth depends. The economist of the past generation still holds his ground, and our best hope lies in the fuller acceptance of his ideas. The economist, however, must feel, if he is to animate multitudes and inspire legislatures, that he, too, has a religion. Beneath the calmness of his analysis must be felt the throb of humanity. Slow in any case must be the secular progress of any branch of the human family; but if we take our stand upon facts, if our eyes are open to distinguish illusions from truth, if we are animated by the single purpose of subordinating our investigations and our actions to the lifting up of the standard of living, we may possess our souls in patience, waiting upon the promise of the future.

POSSESSION AND MEDIUMSHIP.

By Prof. WILLIAM ROMAINE NEWBOLD.

ALL the phenomena of which I have been treating in my past papers can be grouped under the three conceptions of suggestibility, automatism, and subconscious mental states. Suggestibility, in its narrowest sense, denotes an increased tendency on the part of certain mental states to work out their own proper results, without interference from other states, and especially without interference from that innermost essence of our sense of self which we call our will. It applies, therefore, primarily to states existing within the range of the individual's consciousness. The suggestible individual, when he can remember or describe his condition, usually feels his will or self in abeyance, and describes himself as the victim of a power which he can not resist. His body obeys commands which he himself is unwilling to obey; ideas and beliefs possess his consciousness which he himself is unable to expel, even though he recognizes their absurdity; hallucinations of all the senses obtrude themselves upon him, or portions of his conscious realm are withdrawn from him in a manner which he can not but ascribe to the workings of some force foreign to himself. When this sense of opposition is lacking, it is because the suggestion meets with no opposition on the part of his accredited beliefs and instincts, and thus merely augments the stream of his normal consciousness without his discovering its extraneous origin.

Suggested hallucinations and ideas do not differ in any respect from spontaneous hallucinations and automatic ideas, save that the source of the former is apparent and that of the latter is not. In the fields of sensation and ideation, therefore, the conceptions of suggestibility and automatism practically coincide. The case of motor automatism is somewhat different. Suggested movements are controlled through the agency of ideas, the ideas being directly suggested and the movements springing from them. But in automatic movements the patient is not conscious of any ideas controlling his movements; they seem to him to spring from some source outside himself. Some of these movements may plausibly be ascribed to purely physiological causes; others seem to require the assumption of realms of mind dissevered from the normal consciousness of the patient. If this view be correct, these forms of automatism also would fall under the conception of suggestibility, for they also would spring from mental states, although those states would not lie within the range of the patient's consciousness.

We may further conjecture that some of the hallucinations and automatic ideas, which rush cometlike into the patient's consciousness from nowhere in particular, had, in fact, an actual being in the subconscious realm before becoming parts of the upper system; but, from the nature of the case, it is never possible to verify the conjecture beyond a peradventure.

The words suggestibility and automatism, then, do not so much designate distinct classes of phenomena as the same phenomena viewed from slightly different points, while the conception of the subconscious is an inference based upon the relations which we know to exist between mental states and certain complex movements of the body. All these phenomena belong together; they can not be separated in theory, and they constantly occur together in practice; in short, they form a distinct natural family by themselves.

It is only within the last few years that they have attracted the attention of professed psychologists, yet we can not suppose that they never existed before. Even a superficial acquaintance with the literature of occultism, present and past, is sufficient to convince one that they have existed from time immemorial, that they have provided in the past the basis for many of man's most cherished convictions, precisely as in the present they constitute the chief content of our modern "spiritualism."

To get the least insight into these phenomena one must at the outset disabuse one's self of the pseudo-scientific notion that they are due to the "power of the imagination." It represents a rough attempt to get at the truth, but, like many another half truth, does more harm than good. We must clearly grasp the conception that man's mind is in many respects like his body. Like his body, it is the scene of constant struggle and rivalry between competing activities—it might not be far amiss to call them forces—in the ebb and flow of which his being consists. As disease germs occasionally succeed in effecting lodgment in his body and flourish, in spite of the agencies that strive to effect their destruction, so thought germs occasionally take root in his mind, sprout and grow in spite of all that "he himself" can do to prevent it. Where are they to be found? In all that we can see, hear, or think, everything carries with it some suggestive power. Usually the trivial suggestions of the environment pass by unnoticed, but occasionally, under some special circumstances or in some sensitive temperaments, they take root. A friend of mine told me that he was talking with his wife one evening of a recent murder, and, as he talked, his eyes rested on her eyes for a moment longer than usual. He saw her shrink and turn pale, but paid little attention to it at the moment. A little later he fancied she still looked troubled, and tried to comfort her, but she would have none of it; she could not allow him to come near her. She kept thinking of his killing her and was afraid of him. She did not *believe* it at all; she knew how absurd it was as well as he did, but, she said, the moment he allowed his gaze to rest on her while speaking of that horrible subject, she *saw* him killing her, and could not shake the thought off. It wore off in the course of half an hour or so. An isolated suggestion of this kind very seldom gets lodged in a sound mind. The most common source of contagion is to be found in the beliefs of the community in which one lives. We are by nature social animals, and our aptness for social life is largely due to our sensitiveness to the collective suggestions of the social environment. An individual who proves refractory to such influences, and evolves along his own lines without reference to the claims or the standards of his age, soon lands either in Bedlam or the lockup. All the forces which we vaguely call evolutionary have for ages been impressing this trait upon man, and consequently we find it a potent factor in the production of automatisms of all kinds. A suggestible patient often responds to such impressions almost as mechanically as a mirror, and faithfully reflects the opinions and prejudices of his human environment without feeling his voluntary self to be in the least concerned in it. The cases of Mr. B—— and of Mr. Le Baron, which I gave in my August paper, are illustrations in point. Automatisms of this sort are always popularly ascribed to the intervention of some intelligence distinct from that of the patient, but the further definition of the intelligence varies in different ages and countries.

I shall pass over the familiar convulsive epidemics of flagellation, of dancing, of tarantism, the "holy jerks" of the great revival in the Southern States at the opening of this century, the convulsionaries of Saint-Médard, etc. All these have been often described, and I shall assume that my readers are acquainted with them. I shall, however, take a few cases from various periods of the world's history, described by persons of different convictions and in each case differently interpreted, and shall try to show the absolute identity of type in each. The first occurred in France in 1636 in a Roman Catholic community, the second in England a generation later; both were ascribed to evil spirits. The third occurred in China only a few years ago, and was ascribed to the agency of a native goddess. The fourth and fifth are recent cases, one from Switzerland and one from British Columbia; both occurred among Spiritists, and were believed to be due to the spirits of deceased human beings, although one should note that in the last case the patient was not himself for a moment misled as to the true character of the phenomena. In all, the automatic processes manifested themselves, partly by hallucinations of sight and hearing, partly in compulsory ideas and emotions, and partly by more or less significant automatic movements. In all there also appears to be a tendency toward association and systematization of the automatic processes with one another, so that what begins by being a more or less confused medley, in some cases rising to the point of mania, finally becomes a tolerably coherent expression of a characteristic personality which in turn represents the notions entertained by the patient and the community in which he lives as to what the demon, god, or spirit ought to do and say. Especially should one note how the automatic processes invariably present themselves to the patient as being something absolutely foreign to himself—a trait which Prof. James happily hit off in terming such attacks "invasions."

The story of the "Devils of Loudun" has often been told. In 1631 an epidemic of "possession" broke out among the nuns in a convent at Loudun, in southern France, and was ascribed by the sufferers to the machinations of a priest named Urbain Grandier. Grandier, by his dissolute life and overbearing conduct, had made himself many bitter and powerful enemies, chief among whom was Mignon, the father confessor of the convent, and there is good reason for believing that, originally at least, the "epidemic" was nothing more than a conspiracy devised by Father Mignon and the Mother Superior for the destruction of Grandier. It was most successful. Grandier was accused of witchcraft, and, although he escaped several times through technicalities, he was finally tried by a tribunal appointed by Cardinal Richelieu, was condemned, tortured, and burned.

Shortly after his death one of the priests who were trying to exorcise the devils from the nuns, Father Surin by name, claimed to be himself possessed by the devils and has left a vivid account of his experience. He seems to have been a feeble and credulous old man, and whatever the origin of the "epidemic" may have been I am inclined to regard his experience as a genuine invasion of the normal self by a mass of well co-ordinated ideas suggested by the shrieks and antics of the possessed. It finds an almost perfect parallel in the experience of Mr. R. L. Stevenson, which I narrated in my last paper.

In a letter to a friend, Father Surin says*: "Matters have come to such a pass that God has permitted, on account of my sins I suppose, something which has perhaps never before been seen in the Church. During the exercise of my ministry the devil passes from the body of the person possessed and, entering into mine, throws me down, convulses me, visibly passes through me, keeping possession of me many hours as a demoniac. . . . I do not know how to express to you what then takes place within me; and how that spirit *unites with mine* without depriving me either of consciousness or of my soul's freedom, yet acting all the while *like another self*, and as if I had two souls, of which the one is deprived of its body and of the use of its organs, and stands aside looking on the one that has got in. . . . The two spirits struggle in the same field, that is my body, and the soul is as it were divided. One part of it is the subject of diabolic impressions; another, of the motions which are proper to it, or which God gives it. . . . I feel that the cries which spring from my lips come equally from these two souls, and I can scarcely discriminate whether it is joy [*allégresse*] that gives rise to them or the extreme excitement [*fureur*] that fills me. . . . While my body rolls on the ground and the ministers of the Church talk to me as to a devil and heap maledictions upon me, I can not tell you what joy then fills me, *having become a devil*, not by rebellion against God, but by the misfortune which simply but clearly portrays to me the state to which sin has brought me. . . . My condition is such that I have few free actions; when I wish to speak, *my speech is arrested;* at mass *I am stopped short;* at table I can not raise food to my mouth; at confession I suddenly forget my sins, and I feel the devil come and go within me as in his own house. . . . As soon as I wake he is there, at my prayers; he takes away my thought when he pleases, when my heart begins to open to God he fills it with rage, he puts me to sleep when I wish to be awake, and openly, by the mouths of the possessed, he boasts that he is my master."

A parallel case is given by Henry More, the Cambridge Platonist, in his Appendix (page 58) to the second edition of Joseph Glanvil's book, "*Saducismus Triumphatus*, or, Full and Plain Evidence concerning Witches and Apparitions," London, 1682. It is entitled, "*A story of the marvelous condition of one* Robert Churchman *of* Balsham, *some six or seven Miles off from*

* Gauthier. Histoire du Somnambulisme, vol. ii, pp. 164 *et seq.* Italics as there given.

Cambridge, *when he was inveigled in* Quakerism, *how strangely he was possessed by a* Spirit *that spoke within him, and used his Organs in despight of him, while he was in his Fits. And how he was recovered from his Error, and regained to the Church by the devotions and diligence of Dr.* J. Templar, *still Minister of that place, as it is set down in his Letter to a friend, which is as follows.*"

Dr. Templar relates that he found the Quakers "very busie in enticing my people to a compliance with their perswasions in Religion," and among those influenced was this Robert Churchman. While Churchman was still in doubt the wife of a Quaker came to his house to visit his wife, but was refused admittance. "After some Parley the *Quaker's* Wife spake unto him in these words, *Thou wilt not believe except thou see a Sign, and thou mayest see some such.* Within a few nights after *Robert Churchman* had a violent storm upon the Room where he lay, when it was very calm in all other parts of the Town, and a Voice within him, as he was in bed, spake to him, and bad him, *Sing praises, sing praises*, telling him, that he should see the glory of the *New Jerusalem*, about which time a *glimmering light* appeared all about the Room. Toward the morning the *Voice* commanded him to go out of his Bed naked with his Wife and Children. They all standing upon the Floar, the *Spirit* making use of his Tongue, bid them to lye down and put their Mouths in the dust, which they did accordingly. It likewise commanded him to go and call his Brother and Sister, that they might see the *New Jerusalem*, to whom he went naked about half a Mile." This lasted three or four hours, during which "the drift of what was spoken was to perswade him to comply with the *Quakers*," and afterward "he came to himself and was able to give a perfect account of what had befallen him." The spirit returned several times, but finally, after Dr. Templar had prayed with him daily for some time, he was left "perfectly free from all molestation. The *Quakers* hearing of his condition gave it out, that the Power of God would come upon him again, and that the wound was but skinned over by the Priest. Which made me the more importunate with him to keep close to the publick Service of God and to have nothing to do with them or their Writings. Which direction he followed till *November*, 1661, and then perusing one of their Books, a little after upon the tenth day of that Month, his troubles returned. A voice within him began to speak to him after the former manner. . . . The design which he discerned that it did aim at was to take him off from coming to the Church (where he had been that day) and from hearing the Word of God." This continued several days, but he was "very peremptory in his resisting of it. When it began to sollicite him he replyed, That he saw it was a *Spirit* of delusion, which he would not obey. Upon which the *Spirit* denounced a Curse against him in these words, *Go ye cursed into everlasting Fire!* and so left him with a very great heat in his body. After this, he was in his own apprehension in a very comfortable condition, and while he was considering what had happened a Voice within him spake to him saying, That the Spirit which was before upon him was a Spirit of delusion, but now the true Spirit of God was come into him." It then gave him instruction in religious matters, contradicting what the former voice had said. Several times it came, and as Robert Churchman still doubted whether it were a good spirit or no it promised him what sign he would. Upon that he desired it to turn into brass a certain candlestick. "Presently there was a very unsavoury smell in the Room, like that of the Snuff of a Candle newly put out; but nothing else was done towards the fulfilling of the Promise. Upon the Lord's day following, he, being at Church, it came upon him. When the Chapters were named he turned to them in his Bible, but was not able to read. When the Psalm was sung, he could not pronounce a syllable. Upon Monday morning his Speech was wholly taken from him. When I came to him, and asked him how it was with him, he moved his head towards me but was not able to speak; I waited an Hour or two in the Room, hoping that his Speech might have returned unto him, and that I might have gained from him some account of his condition. But finding no alteration, I desired those who were present to joyn with me in Prayer. As we were Praying, his Body with much violence was thrown out of Bed, and then with great vehemence he called to me to hold my Tongue. When Prayer was done, his Tongue was bound as before, till at last he broke out into these words, *Thine is the Kingdom, Thine is the Kingdom;* which he repeated, I believe, above an hundred times. Sometimes he was forced into extream laughter, sometimes into singing; his hands were usually imployed in beating his Breast. All of us who stood by could discern unusual heavings in his body. This distemper did continue towards the morning of the next day, and then the voice within him signified to him that it would leave him, bidding him to get upon his knees in order to that end, which he did, and then presently he had a perfect command of himself. When I came to him he gave me a sober account of all the passages of the day before, having a distinct remembrance of what the Spirit forced him to do, and what was spoken to him by those who stood by. In particular he told me, he was compelled to give me that disturbance in prayer, which I before mentioned, the *Spirit* using his Limbs and Tongue as it pleased, contrary to the inclination of his own mind." Finally, Robert Churchman was "released from all his trouble" through the diligent prayers of Dr. Templar, with the happy result that both he and his wife and "some others who were too much byassed with the Principles of the *Quakers*" acquired "a perfect dislike of that way."

Demon possession is at the present time common in China, and a number of curious cases have been collected and published recently by a missionary who has had forty years' experience among the Chinese.* Most of his narratives are in the third person, but one is given in the patient's own words. His name was Kwo, and he is described as a "hardy mountaineer, thirty-eight years of age, bright and entertaining, with nothing in his appearance which could be regarded as unhealthy or abnormal." His account is as follows: †

"Near the close of year before last (1877) I bought a number of pictures, including one of Wang Mu-niang, the wife of Yu-hwang [the chief divinity of China]. For the goddess Wang Mu-niang I selected the most honorable position in the house; the others I pasted on the walls here and there as ornaments. On the second day of the first month I proposed worshiping the goddess, but my wife objected. The next night a spirit came, apparently in a dream, and said to me: 'I am Wang Mu-niang of Yuin-men san [the name of a neighboring mountain]. I have taken up my abode in your house.' It said this repeatedly. I had awakened, and was conscious of the presence of the spirit. I knew it was a *shie-kwei* (evil spirit), and as such I resisted it, and cursed it, saying, 'I will have nothing to do with you.' This my wife heard, and begged to know what it meant, and I told her. After this all was quiet and I was not disturbed for some days. About a week afterward a feeling of uneasiness and restlessness came over me which I could not control. At night I went to bed as usual, but grew more and more restless. At last, seized by an irresistible impulse, I arose from my bed and went straight to a gambler's den in Kao-kia, where I lost at once sixteen thousand cash [sixteen dollars, a large sum for a peasant Chinaman]. I started for home and lost my way. But when it grew light I got back to my house. At that time I was conscious of what I was doing and saying, but I did things mechanically, and soon forgot what I had said." In this condition he remained for some days, the prey of irresistible impulses, which soon took a homicidal turn, and culminated in maniacal outbursts, alternating with epileptiform attacks. He was chained in bed, and for five or six days raved wildly. "My friends were in great distress. They proposed giving me more medicine, but the demon, speaking through me, replied, 'Any amount of

* Demon Possession and Allied Themes. By Rev. John L. Nevius, D. D. Dr. Nevius is convinced that these phenomena are really produced by demons. † *Op. cit.*, p. 22.

medicine will be of no use.' My mother then asked, 'If medicine is of no use, what shall we do?' The demon replied, 'Burn incense to me, and submit yourself to me, and all be well.' My parents promised to do this, and knelt down and worshiped the demon, begging it to torment me no longer. Thus the matter was arranged, I all the time remaining in a state of unconsciousness." After more prayers and worship Kwo recovered consciousness, and was told what promises had been made in his name. He at once refused to worship the demon, upon which he was attacked again. Finally, he consented, and for some time the demon gave him little trouble, coming only at intervals, and then behaving very well. It promised to heal diseases, but "many diseases were not under its control, and it seemed as if it could perfectly cure only such as were inflicted by spirits"—in other words, those that were due to suggestion and could be relieved in the same way.

In the summer of 1878 a native missionary named Leng heard of Kwo, and persuaded him to tear down the shrine of the goddess and become a Christian, assuring him that if he did so he would be freed from the spirit's power. This he did, and a few days later his child died, which his wife ascribed to the vengeance of the goddess. Then the demon returned once more and said: "If your husband is determined to be a Christian, this is no place for me. But I wish to tell you that I had nothing to do with the death of your child." "What do you know of Jesus Christ?" they asked. The answer was: "Jesus Christ is the great Lord over all; and now I am going away, and you will not see me again." And the demon was as good as his word.

Prof. Forel, of Zurich, has given an account * of a case of this sort which seems to have puzzled him considerably. The patient, K. K., was a German, a wagon-maker by trade, had lived in the United States for some years, and had got interested in "spiritualism." Several times he tried to get the spirits to write by his own hand without success, but at last the hand started suddenly and wrote against his will. The writing was followed by automatic ideas in the form of the inner voice. All the communications professed to emanate from a spirit who, although unknown to him, was interested in him, and desired to improve him and prepare him for the life to come. Its commands were usually simple and reasonable enough. For example, the patient had been an excessive smoker, but at the spirit's command he gave up smoking entirely, and without especial suffering. Sometimes, however, the spirit was whimsical and even malicious. It forced him to smash lamps, break his false teeth, and do other things which caused him no little annoyance. The spirit always claimed that

* Zeitschrift für Hypnotismus, Jahrgang 1894–'95.

these irrational and disagreeable things were imposed upon him to test his obedience or to punish him for his sins. He was entirely unable to resist them. This patient gave himself into custody at an insane asylum at Burgholzi, in Switzerland, and was cured by suggestion in one hypnotic sitting.

It is not surprising that phenomena of this kind are common among spiritists. It would seem that the most favorable condition for the development of automatism would be a state of passivity on the part of the patient or "medium," in which he simply watches the impulses and thoughts that arise within him without attempting to repress any of them. Now, this condition finds its ideal fulfillment in the "developing *séance*" of the spiritist. A group of credulous folk gather in the dusk or darkness, and sing invocations to the spirits whom they believe to be hovering above them and watching for an opportunity to "impress" them. Their sole practical principle is "not to resist the spirits," and consequently the least tendency to spontaneous automatism is fostered and allowed to develop to the utmost. Furthermore, its development is favored by the complex suggestions of the environment and by the direct exhortations of believers. I remember one such "developing *séance*" which I attended some years ago, at which a stout woman rose and delivered an "inspirational" address, purporting to proceed from the spirit of a Methodist minister who had recently died in the neighborhood. As soon as it was concluded she fell heavily on the floor in hysterical convulsions. Three or four excited women at once ran to her, crying, "Don't resist, dear," "Let him take possession of you," "He won't hurt you, don't be afraid," etc., while the victim struggled and moaned: "Oh, I can't, I can't let him! Take him away!" In a few minutes another woman began to speak in the name of the spirit supposed to be controlling the first "medium," and immediately the struggles of the latter ceased. At that time I knew little of these phenomena, and the incident puzzled me a good deal. I never supposed, of course, that it was due to spirits, but I did not see any way of ascribing it to fraud either. With the exception of myself, all present were ardent "spiritualists," and I had every reason to believe them sincere in their efforts to reach the other world. It was not a paid sitting, and most of those present were personal friends of one another. From my present point of view it seems intelligible enough, and is quite analogous to that last described.

But t e best case of this kind that I have yet seen described is that of Mr. Charles H. Tout, of which he has himself written a very acute analysis.* He had become interested in these ques-

* Proceedings of the Society for Psychical Research, vol. xi, pp. 309–316.

tions and took part in some sittings at which no professional mediums were present. Almost from the outset two ladies of the circle were affected with spasmodic twitchings of the fingers and arms. "Sometimes these movements were very violent, causing them to slap and thump the table with such force as to seriously bruise their fingers and hands. . . . With the exception of these two ladies, none of the sitters were much affected on these occasions, though at times an almost irresistible impulse came upon myself to imitate their actions; but though I occasionally allowed the impulse, at the suggestion of the other sitters, to have full play, it never with me took the bit between its teeth and got beyond my control. I could always stop at once any movements in my limbs, or change the attitude of my mind, by an effort of will." At a later sitting a dream-personality similar to that of Mr. Stevenson developed itself. "I seemed to have, as it were, stepped aside, and some other intelligence was now controlling my organism. I was merely a passive spectator interested in what was being done. My second self seemed to be a mother overflowing with feelings of maternal love and solicitude for some one. The very features of my face seemed to be changing, and I was distinctly conscious of assuming the look of a fond and devoted mother looking down upon her child. I even inwardly smiled as I thought how ridiculous I must be looking, but I made no effort to resist the impulse. I now felt I wanted to caress and console somebody, and the impulse was strong upon me to take my friend in my arms and soothe and cheer him. I resisted the impulse for some time, but finally yielded to it. In doing so I had a distinct feeling of relationship to my friend. After a little while I began to be myself again." At another time a lady who was supposed to be sensitive to spirit influences believed that she got for Mr. Tout a message from the spirit of his father who had died of bronchitis and pleurisy some twenty years before. The hymn, "Nearer, my God, to Thee," which had been a favorite with Mr. Tout's father, had just been sung. With practice Mr. Tout seems to have become more suggestible. On another occasion, he says, "I was affected to an unusual degree, experiencing violent twitchings in my limbs, and sensations of painful chilliness that made my teeth chatter again. I sat, as I always did now, passively waiting for what might transpire. All sorts of impulses seemed to be moving me, and I noticed how susceptible I was becoming to the slightest even half-realized suggestion offered by the course of my own thoughts or by the chance remarks made by the other sitters. I presently felt myself being drawn, as it seemed to me, toward the floor on the left side of my chair. I yielded to the influence and fell prostrate out of my chair on to the floor with considerable force, and, though the others thought I must have hurt myself, I certainly felt no inconvenience from the fall. I lay groaning for a little while, and then got up and sat in my chair again.

"Some one now suggested that we should sing, and this being done, I immediately became affected by the music, which moved me in a very extraordinary manner. I fancied myself realizing the whole scene clearly. In a great cathedral I seemed to be the presiding priest at the close of a great function pronouncing the benediction." He then went through several of these dreamlike states, some of which he describes, and says of them: "In all these phases or states I seemed to be two individuals—one my ordinary, critical, observant self, closely watching what took place in and around me, the other the character that seemed to be personating itself through me." Toward the close of the *séance* the hymn "Nearer, my God, to Thee" was sung. "Before the first verse was finished I began to experience strange sensations. . . . I seemed to be far away in space. . . . I seemed to be moving or rather to be drawn downward, and presently felt that I had reached this earth again; but all was strange and fearful and lonely, and I seemed to be disappointed that I could not attain the object of this long and lonely journey. . . . At this point some one said, 'It's his father controlling him.' I then seemed to realize who I was and whom I was seeking. I began to be distressed in my lungs. . . . I was in a measure still conscious of my actions, though not of my surroundings, and I have a clear memory of seeing myself in the character of my dying father lying in the bed and the room in which he died. It was a most curious sensation. I saw his shrunken hands and face and lived again through his dying moments; only now I was both myself—in some indistinct sort of way—and my father with his feeling and appearance."

Mr. Tout then shows in detail that these dreams—for they are no more—sprang from the suggestions which were given him by his friends and from autosuggestions furnished by his own mind. For example, the journey through space sprang from a ghost story which he had once read, told from a ghost's point of view, and describing the return of a restless spirit to earth. He then adds: "I know myself and my susceptibility, even under normal conditions, to suggestion in all sorts of forms, not necessarily verbal, so well that no alternative remains to me but to believe that what I did was due simply to everyday suggestion in one form and another. Building and peopling *châteaux en Espagne* was a favorite occupation of mine in my earlier days, and this long-practiced faculty is doubtless a potent factor in all my characterizations, and doubtless also in those of many another full-fledged 'medium.'" With this sane and rational conclusion all sensible folk will agree.

IDIOTS SAVANTS.

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THE term *idiots savants* is applied to all such idiots, imbeciles, or feeble-minded as exhibit special aptitudes of one kind or another, always out of proportion to their intellectual development in other directions, and often remarkable as compared with similar accomplishments or faculties in normal individuals.

There are many cases of the kind recorded in literature, and it is not at all uncommon to hear of idiots in our newspapers and museums who are exhibited as musical prodigies, "calculating boys," and the like. Beyond the fact of the existence of such curiosities, and the record of their deeds, there has been little or nothing written in explanation of these phenomena. The psychology of the condition is exceedingly obscure, and even were the physiological processes which underlie special aptitudes understood, there would still remain the mystery of the manifestation of particular talents or faculties in minds otherwise blank or defective. It is the aim of this brief paper rather to present the nature of the facts which we have to consider, and to indicate lines of study that might be pursued with advantage, than to add any material knowledge to the psychology or ætiology of the condition.

In the first place, then, let us inquire concerning the kinds of aptitudes which may be developed to an unusual degree in mentally deficient individuals. The aptitudes may be summarized as follows:

Arithmetical faculty, musical faculty, special memories, imitative faculty, modeling faculty, delineative faculty, faculty for painting, aptitude for games (draughts, etc.), aptitude for buffoonery.

This is not a classification, but merely an arrangement for examination of the instances cited under each heading. Some of these captions really include others. Thus, special memories would cover usually the musical faculty. The imitative faculty should include possibly the repetition of musical airs and compositions, drawings and paintings from objects, as well as imitations of gestures and actions. Arithmetical faculty is a qualification which perhaps encompasses too much, since this aptitude in the mentally defective is generally restricted to calculation only. The term "musical faculty" also is to be understood in a limited sense, since the musical prodigies of this description rarely exhibit more than a phenomenal memory for musical compositions.

Under the heading of aptitude for buffoonery, I have thought proper to place such defectives as evince a talent for wit and humor of a low order, as is instanced in some of the historical court fools and buffoons.

After this short preface regarding the nature of the cases it is proposed to include in a description of *idiots savants*, examples of each kind will be cited under the appropriate caption.

Arithmetical Faculty.—Precocity and an extraordinary power of the faculty of mental arithmetic have been frequently noted in idiots.

Dr. Howe described an idiot with little use of language, yet with astonishing power of reckoning. If one's age were told him, he would give the number of minutes one had lived in a very short time.

Guggenbuehl observed an imbecile at Salzburg who would solve the most difficult problems in mental arithmetic with incredible rapidity. At one time the attempt was made to induce him to become a teacher of arithmetic, but as he could not understand his solutions of problems it was found impossible for him to explain them to others.

Atkinson noted an idiot woman with arithmetical faculty in excess whose only delight was to be occupied with questions of number.

Ireland mentions a boy at Earlswood with the arithmetical faculty. He could add and multiply three figures by three figures with lightning rapidity.

In a valuable study of Arithmetical Prodigies in the American Journal of Psychology (April, 1891), E. W. Scripture has collected thirteen examples of this aptitude. Six of these (Ampère, Gauss, Archbishop Whately, George Bidder, Safford, and Wallis) were men of eminence or genius who exhibited extraordinary precocity or aptitude in mathematics. The remaining seven cases are properly classified under the heading of this paper.

Tom Fuller, born in 1710, known as the Virginia calculator, was a native African, never knew how to read or write, but had phenomenal powers in arithmetic. Asked how many seconds in a year and a half, he responded in two minutes, 47,304,000. Asked how many seconds a man had lived who was 70 years 17 days 12 hours old, he answered in a minute and a half, 2,210,500,800.

Jedediah Buxton, an Englishman, born in 1702, was excessively stupid as a child, never learned to write his own name, had not even common intelligence in the ordinary matters of life, and whose mind never reached a development beyond that of a boy of ten years, was a marvelous mathematician.

Zerah Colburn, born in Vermont in 1804, was exhibited from the age of six as a mathematical prodigy. He was a backward child and never able to exercise even ordinary intelligence in other directions or to learn much of anything. He had supernumerary digits on both hands and feet, and was a degenerate.

Vito Mangiamele, son of a Sicilian shepherd, born in 1827, was exhibited as a calculating boy, but was otherwise dull and ignorant.

Dase, a German, born in 1824, extremely stupid and dull in other directions, never able to master a word of any language but his own, was a mathematical genius. As an instance of his power, he multiplied correctly, in fifty-four seconds, 79,532,853 by 93,758,479.

Grandmange, a Frenchman, born without legs or arms in 1836, was another example of a mathematical prodigy.

Mondeux, a Frenchman, son of a woodcutter, born in 1826, possessed an extraordinary arithmetical faculty, although he could neither read, nor write, nor cipher. He could not remember a name or address. He solved this problem in a few seconds: How many quarts of water in a fountain from which a group of people draw as follows: The first person takes one hundred quarts and one thirteenth of the remainder; the second, two hundred quarts and one thirteenth of the remainder; the third, three hundred quarts and one thirteenth of the remainder; and so on until the fountain was emptied?

Dr. Heim cites the instance of a woman of very limited intelligence and deficient in language, who could give the number of minutes a person had lived as soon as the age was told her.

There are other examples in literature of mathematical aptitude in individuals otherwise defective, but these will suffice to illustrate the character of the cases under consideration. When we remember the deficiency of idiots in general as regards even the simplest kinds of calculations—such as counting, addition, subtraction, multiplication, and division—the contrast of powers in the exceptional instances mentioned becomes even more astonishing.

We may deduce from a study of such cases several facts which are noteworthy. First, the mathematical aptitude in idiocy is never of a high order. The faculty consists entirely of excessive powers in mental arithmetic—in simple calculation, which is a better term to apply to it. Secondly, it is instinctive and congenital. It is observed only in the congenital variety of idiots, imbeciles, and degenerates; and on careful examination we shall find anatomical and physiological as well as psychological stigmata of degeneration in such cases. Thirdly, much of the faculty is due to the increased power of visualization—to great development of certain parts of the sight centers. Most of us, in mental arithmetic, compute by means of visual images. We, who have been educated to cipher, see the figures before us in computation. Individuals who have been made to employ objects—such as the fingers, grain, pebbles, or the abacus—visualize these objects in their mental arithmetic. Indeed, the derivation of the word calculation recalls the ancient use of pebbles in reckoning. A psychological analysis of the mental operations required in calculation is a difficult problem, the solution of which is very desirable. Scripture, in his study of arithmetical prodigies, concluded that the faculty of mental arithmetic, as exhibited in his illustrative cases, depended upon—1. Accurate memory for a sufficient length of time. 2. Velocity of memory. 3. Firmness with which long series of arithmetical associations cling together. 4. Mathematical inclination. 5. Visualization.

It will be noted that the fourth, the mathematical aptitude, is the obscure factor, which the author did not attempt to explain, and that the other four points are merely the means of expression of the mathematical inclination.

Musical Faculty.—The susceptibility of all classes of idiots to rhythmical sounds or noises has been frequently commented upon by various authors. Music is the most sensual and the least intellectual of the arts. A musical aptitude in certain idiots is therefore not so astonishing in some respects as the possession of the arithmetical faculty.

One of the most noted examples of *idiots savants* of this class was Blind Tom, a pure negro, born in Georgia, in 1849. Born blind, he showed intelligence only in regard to sound. He learned to repeat words early, though the words had no meaning to him. He could repeat whole conversations, but entirely without comprehension. His own spontaneous language was never much more than inarticulate sounds. He could imitate any sound about him. He could recite with ease anything heard in Greek, Latin, French, or German. It was a species of echolalia. He could play on the piano from memory any piece of music, no matter how intricate, after hearing it but once. He would imitate, note for note, the improvisations of another. He is said to have retained as many as five thousand musical compositions in his memory.

Seguin describes (Idiocy, page 405) a blind male idiot with a remarkable talent for piano-playing, with this same power of repeating anything after a single hearing.

Helat (*La Folie lucide*) tells of a congenitally blind female idiot with great musical talent. Her voice was correct, and when once she had heard a piece she knew the words and the music. This phenomenon excited so much attention that Géraldy, Liszt, and Meyerbeer visited her.

Dr. Paris (Lancet, February 11, 1888) records the case of an idiot, aged fifteen, unable to pronounce a single word, incapable of receiving the most elementary education, able to hum correctly and gracefully a large number of airs, and who did so every day, always the same and always in the same order, without variation. While the family was fond of singing, the idiot had never heard any one sing except the father and mother.

A young woman whom I examined not long ago is an idiot of low grade, without ability to converse or care for herself, yet presenting a marvelous memory for music, reproducing, both by singing and on the piano, numerous musical compositions. Some intricate instrumental pieces she renders accurately with her voice in a high falsetto key. Several of her sisters are musicians.

Dagonet (*Traité des maladies mentales*) cites the case of an idiot girl who began to speak at the age of nine years, but was possessed of a very small vocabulary, and was ignorant of notes. She had a remarkable aptitude for music, and could repeat upon the piano compositions heard for the first time. She was the daughter of distinguished musicians.

Morel (*Études cliniques*) records the history of an idiot boy who, becoming possessed of a drum, made such rapid progress in its use in three or four attempts at playing that he was made drummer in the orchestra at the asylum where he lived. His father and grandfather had been drummers in the army, and a normal brother had always had the desire to follow the same pursuit.

In this class of *idiots savants* also it is to be noted that the idiocy is congenital. We observe, too, that the musical faculty, although well developed in contrast to the general intellectual paucity, is not of a high order. It consists of a remarkable auditory memory, together with the power of expression, by means of the vocal musculature or fingers, of the musical memories stored up in the brain. There is no spontaneous musical expression, no power of invention. An interesting feature is the evident hereditary character of the talent. In some of the instances cited the imitation of sounds heard is not restricted to music, but includes sounds of every kind.

Special Memories.—Winslow records the case of a man who remembered the day of burial of every person who had died in the parish for thirty-five years, and who could repeat with perfect accuracy the names and ages of the deceased and of the mourners at the funeral. He was a profound idiot, and could not reply intelligibly to a single question beyond this, nor be trusted even to feed himself.

Morel cites the instance of an idiot who was unable to count twenty, yet could name all the saints of the calendar and the days of their respective *fêtes*.

In some of the books on these defectives is mentioned an idiot with a wonderful memory for English history. When supplied with the slightest cue, he recounted in measured tones whole passages of it.

Falret noted an imbecile who could give immediately the days of birth and death and the principal events in the life of any celebrated personage mentioned to him.

Such instances of elaboration of special memories where all other faculties are in abeyance might be multiplied. The cases above mentioned were, no doubt all of them, examples of extraordinary development of the auditory tracts and centers. There are other cases in which the visual memories are disproportionately developed, as in idiots with unusual memory for places or faces.* These patients, too, are congenital defectives.

Imitative Faculty.—Under this caption should probably be included some of those cited under other headings, for the repetition of sounds heard, or the delineation of things seen, or the copying of actions all partake of the nature of imitation. Imitation is an instinct in defectives as it is in normal persons. Sometimes it manifests itself in simple forms, such as echolalia or echokinesis; occasionally it is exhibited in a manner so remarkable as to constitute a true talent. An instance imparted to me by a friend is in point. It is that of a young man, congenitally imbecile, but with an astonishing power of imitation of sounds. The multiform notes and noises of birds and voices of every domestic animal, even the peculiar sounds of sawing and chopping wood, the creaking of wagons, and the like, are so perfectly reproduced by him that he is in demand as a partaker in social entertainments.

The Modeling, Delineative, and Painting Faculties.—Examples of *idiots savants* with talents bespeaking disproportionate development of the visual centers, together with the power of reproduction by modeling, drawing, or painting, are occasionally to be met with.

Ireland, in his work on idiocy, describes two cases—one with an aptitude for drawing and wood-carving, and another with a talent for the designing and construction of buildings.

There was a noted idiot at the Earlswood Asylum who made a perfect model of a ship—a vessel ready for the sea—with every block and rope in order, said to be a marvelous specimen of naval architecture. It took him four years to construct it. He was able to speak but a few words, and these imperfectly, and could not follow the meaning of sentences nor write; but he learned

* Thus Drobisch cites the case of an idiot boy whose visualization was so great that he could repeat word for word a page, even if in Latin, after a single reading.

to copy drawings, which were so excellent and curious as to be preserved in the palace. He had seen neither sea nor river nor ship, and had only a representation of a vessel in the middle of his handkerchief as a guide.

Sollier describes an imbecile girl of six years, unable to read or write or understand anything, yet gifted with the power to draw anything she saw. She copied perfectly all the letters of the alphabet without knowing their names or signification. She reproduced thus objects and also scenes of which she was witness, though she comprehended nothing about them.

Gottfried Mind was an imbecile who died in 1814. He was so skillful in the drawing and painting of cats that he achieved distinction and became known as the cat's Raphael. Many examples of his work are to be seen in European art galleries.

Aptitude for Games.—Seguin cites the case of an idiot with extraordinary ability to play draughts, and there are one or two other instances of a similar kind on record. It is probable that such talent depends upon an unusual power of visualization, by which the necessary positions and moves are foreseen.

Aptitude for Buffoonery.—It is not uncommon to meet among idiots, imbeciles, and feeble-minded cases with an aptitude for drollery, and for witty or humorous remarks and actions. Not infrequently it amounts to a true talent, and thus justifies including them among the *idiots savants*. At the present day the sayings and pranks of this class of defectives are seldom heard outside of institutions for their care, but there was a time in history when the quips and antics of the fools took the place of our comic papers of to-day. The dramas of Shakespeare have kept alive our knowledge of the fools of his day, for there are more than thirty of them who flaunt their weaknesses, folly, wisdom, and license through his plays. He depicts both natural and artificial fools, for these were the two classes of buffoons employed to amuse mediæval society. The origin of the custom, in England at least, seems to have been in the legal disposition of the persons and estates of idiots. They were given into the custody of the nobility and gentry, who profited sometimes by their estates, and, clothing them in the familiar livery, made them the butt of ridicule and practical jokes for the amusement of themselves and their guests and retainers. It is instructive and interesting to read in this connection Doran's History of Court Fools and Arnim's Nest of Ninnies. The latter book in particular throws light upon the nature of the custom of keeping domestic fools, and incidentally illuminates the civilization of the time. Here is Arnim's description of a court fool in the palace of the King of Scotland. He was a fat fool, a trifle over three feet high, two yards in circumference, at the age of forty years:

His head was small, his hayre long on the same;
  One ear was bigger than the other farre;
His forehead full, his eyes shined like a flame,
  His nose flat, and his beard small, yet grew square;
His lips but little, and his wit was lesse,
But wide of mouth, few teeth, I must confesse.

His middle thick, as I have said before;
  Indifferent thighs and knees, but very short;
His legs be square, a foot long and no more;
  Whose very presence made the king much sport.
And a pearl spoone he still wore in his cap,
To eat his meate he loved, and got by hap.

A pretty little foot, but a big hand,
  On which he ever wore rings rich and good.
Backward well made as any in that land,
  Though thick; and he did come of gentle blood.
But of his wisdom ye shall quickly heare
How this fat fool was made on everywhere.

This court fool could say bright things on occasion, but his main use to the ladies and lords of the palace was to serve as victim to practical jokes, cruel, coarse, and vulgar enough to be appreciated perhaps in the Bowery.

Any quick-witted imbecile or feeble-minded individual in those days had no difficulty in securing a good livelihood, and sometimes even prosperity and fame. Under such conditions it became common for normal individuals to adopt the calling of the jester or buffoon, and these were known as artificial fools.

CONCLUSIONS.—The aptitudes of various kinds described above as not infrequently encountered in idiots are all of rather low order. They are never found in any but the congenitally defective, who usually present the stigmata of degeneration. They consist chiefly of great powers of memory, visual or auditory, and of facility in imitation. There is no spontaneous invention. The *idiots savants* are mere copyists in music, modeling, designing, or painting; yet at the same time their talents stand out in strong contrast to their general feeble-mindedness. As a rule, the aptitudes are precociously developed, and are frequently lost before reaching adult life. The physical basis of such talents must be a precocious perfection of the cerebral organization in certain areas, together with a true hyperplasia of tissue in such regions and a tendency to early degeneration. There must be an increased number of cellular elements and sensori-motor combinations and associations in definite parts of the brain. Cases have been described in cerebral pathology of misplaced aggregations of such tissues in the brain under the name of heterotopia of gray matter, and it is possible that some such unequal distribution of the structures underlying psychological processes will be found to account for the presence of the extraordinary talents of *idiots savants*. It is questionable whether Heinecken, the "child of Lübeck," should be included among any of the cases described here. He died too soon (at the age of four years) for the fact of mental weakness of any kind to be established; but his precocity made him the wonder of his time (1721–'25). He knew the chief incidents of the Pentateuch at the age of one year, had mastered all of sacred history at two years, and was intimately acquainted with modern and profane history and geography, and spoke French and Latin, besides his native tongue, at the age of three. Surely such precocity as this must have been due to extraordinary aggregations of gray matter in parts of the brain of a truly abnormal character.

IGNEOUS INTRUSIONS AND VOLCANOES.

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MANY geologists have watched the action of volcanoes in eruption, and have gazed into their craters when in a state of mild activity. One of the most striking of the phenomena revealed at such times is that great volumes of steam are given off from the molten lava which rises in the craters. This steam either escapes quietly, as in the case of the Hawaiian volcanoes, or with explosive violence, as in eruptions of the Vesuvian type. It is now conceded by probably all students of volcanoes that the proximate cause of the violent explosions accompanying many volcanic eruptions is the sudden escape of highly heated steam. Most modern theories advanced to account for volcanic phenomena are based on the assumption that steam is the propelling force which causes the lava to rise from deeply seated sources and to be extruded at the surface. Steam contained in the molten lava is thought by Shaler and others to cause the molten rock to rise and overflow, in much the same way that carbonic acid generated in dough causes it to expand, or as the carbonic acid in ale makes it overflow when the cork of a bottle in which it is contained is withdrawn. In these theories, heat is considered as the prime source of energy, and that, given the heat, steam will be generated which will force the lava to the surface.

I do not wish to criticise the theories that have been advanced, or even to attempt to review them, but simply to change the point of view from which volcanoes have commonly been studied, in the hope that the phenomena observed will group themselves in another and perhaps more instructive way. Current theories are based largely on what is seen when one looks down into the throat of a volcano in a state of mild activity; let us supplement such a view by endeavoring to form a conception of the conditions that exist far below the surface.

In many instances volcanoes are known to be situated on lines of fracture in the earth's crust. In all volcanoes it is evident that there is a passageway or conduit, leading from an intensely heated region within the earth, to the surface. These conduits must be several thousand feet in depth. Indeed, it is not unreasonable to assume that they may have a depth of several miles or possibly tens of miles. What one sees, therefore, in looking into a crater of an active volcano is the summit of a column of molten rock, the bottom of which is tens of thousands of feet below.

Judd has compared the mild activity of Stromboli to the boiling of mush in a tall vessel, the heat being applied at the bottom. Steam is generated in the mush, and, rising through it in bubbles, elevates the surface. When the bubbles of steam burst, portions of the viscid material are blown into the air. Such an analogy is certainly sustained by what is seen at the summit of a column of molten lava when we look into the crater of a volcano.

In seeking for information concerning the conditions that exist far below the surface, when a volcano is giving off steam at the top, we may obtain a few facts to guide us by studying the ruins of extinct volcanoes and the nature of igneous intrusions as laid bare by erosion.

Volcanic necks tell something of the conditions that exist within a volcanic mountain. In more deeply eroded volcanic districts one finds dikes and intruded sheets. These are connected, in reference to mode of origin, with Plutonic plugs, laccolites, and what I have termed subtuberant mountains.* These various forms taken by intruded rocks and surface extrusions, as I have attempted to show in the article just referred to, belong in a single genetically connected series. A break in the earth's crust which reaches a region of great heat may be injected with plastic rock and form a dike; if the fracture terminates above in a region of horizontally stratified beds, the magma rising through it may expand widely, at the same time lifting a broad cover to a comparatively small height—that is, form an intruded sheet; or be more restricted in its expansion, according to its degree of fusion, depth below the surface, and possibly other causes, and raise a cover of less diameter to a greater height—that is, form a laccolite; or, if a great volume of plastic material is intruded, give origin to a subtuberant mountain. Should the fissure reach

* On the Nature of Igneous Intrusions. In The Journal of Geology, Chicago, vol. iv, 1896, pp. 177–194.

the earth's surface, molten material may be forced through it and a volcanic eruption initiated. In brief, variations in one process may lead to the formation of dikes, sheets, laccolites, and other forms of intrusion, and to volcanic eruptions. Possibly all these results might follow from the opening of a single fissure.

In all the instances enumerated the magma may be the same, so also the source of the heat and the origin of the pressure which forces the molten rock into the earth's crust, or causes it to be discharged at the surface.

Returning to the hypothesis that steam is the mainspring of volcanic phenomena, it will be conceded, I think, by most observers that steam contained in a magma can not be called upon to account for its rise in a deeply seated fissure so as to form a dike, or, when the conditions are varied, give origin to laccolites, etc. Not only are the rocks composing such intrusions, the densest of igneous rocks, but they are without steam cavities. Besides the filling of a fissure with plastic or fluid rock, and still more strikingly in the production of other varieties of intrusions, a bulk of matter, measured in some instances by cubic miles, is forced in among the solid rocks of the earth's crust. There is thus a bodily transfer of matter, frequently for long distances, from one place to another deep within the earth's crust and against an enormous pressure. All these facts are adverse to the conception that bodies of liquid or plastic rock are moved by the expansive force of the steam contained in them. The energy expended in producing igneous intrusions is in numerous instances so far in excess of that manifest in any explosive volcanic eruption that has been recorded—not excepting Cosequina, Sumbawa, or Krakatoa, but rather combining them all and more in one—that it becomes of a different order of magnitude, and a different origin is to be suspected.

In the case of subterranean injections, it is evident that the source of the *heat* which renders the rocks plastic, and the source of the *pressure* which forces the plastic material into fissures, etc., are distinct and should be separately considered.

The heat manifest in both subterranean and surface igneous phenomena, as is well known, has been variously accounted for, but I do not wish to consider this problem at present. The consensus of opinion, however, seems to be that the heat referred to is mainly and essentially the internal heat of the earth—i. e., the residual heat of a cooling globe. It is conceded also that the matter composing the earth at a depth of a few miles below the surface is so highly heated that it would become plastic or even highly fluid if the pressure under which it exists were removed. The best conception we can frame of the general physical condition of the earth is, that it consists of a more or less spherical mass, which is highly heated and in a potentially plastic condition within, and that inclosing this inner sphere is a comparatively thin shell of solid rocks—the passage from the hot and potentially plastic interior to the cold and rigid outer shell being gradual, one merging with the other by insensible gradations.

The crust of the earth rests on the sphere of plastic material within and exerts a pressure upon it. Contraction of the progressively cooling crust also causes pressure to be exerted on the inner sphere. If the pressure of the crust on the material it incloses were equal at all points, the inner mass, except for the effect of rotation, would be a perfect sphere. Variations in the pressure of the crust at different localities might result from several causes, such as unequal cooling in the crust itself, the transfer of material from the inner sphere into or to the surface of the crust, the shifting of material from one locality to another on the earth's surface, etc. Of these disturbing conditions I am inclined, provisionally at least, to ascribe the greatest potency to the effects of erosion, transportation, and sedimentation on the earth's surface, thus lightening certain areas and loading others.

If we conceive of the earth as a sphere without rotation, it is evident, from our present point of view, that it would remain a sphere only so long as the pressure of the crust on the material within was equal at all points. Local variations in the pressure of the crust would deform the inner sphere and result in a change in the shape of the earth. It is not to the general problems of *isostasy*, as formulated by Dutton, that I wish to direct attention, however, but rather to the results that might be expected to follow should the crust of the earth be broken.

A fracture in the earth's crust would establish a line of weakness, which, so far as the reaction of the crust on the interior is concerned, would be equivalent to a local relief of pressure. Should a fissure reach the highly heated interior, the rocks in its vicinity would become plastic and be pressed into the opening, and tend to widen it both by pressure and by the fusing of its walls. As the magma from a deep source rose in the fissure, the resistance to be overcome would be less and less, thus insuring greater plasticity, and, if it gained the surface, establishing conditions commonly recognized in volcanic eruptions.

Should the plastic rock fail to reach the surface, but cool in the fracture, a dike would be the result. If the fracture terminated above in a region of horizontal stratified rocks, lateral expansion of the magma rising in it might occur, and intruded sheets, laccolite, etc., be formed.

As to the origin of fractures we have but few facts to guide us. It is well known from the study of faults, dikes and volcanoes, that breaks, at least in the superficial portion of the earth's crust, have been of common occurrence. Whether any of these breaks have extended through what we term the earth's crust is unknown, but the fact that fissures have in numerous instances become filled with fused rocks is evidence that the breaks referred to are sometimes of sufficient depth to reach regions of intense heat, and many facts seem to favor the idea that this highly heated region is the potentially plastic interior of the earth.

The principle that areas which become weighted by the shifting of material on the earth's surface subside, while unloaded areas rise, has been advocated by several American geologists, and is now common property. It has frequently been asked, however, why an area that is being unloaded should cease to rise so long as erosion continues, and becomes stable or even undergoes a reverse movement; and why an area that is having material added to it should cease to sink and be re-elevated.

In reference to the first of these questions the nature of igneous intrusions seems to furnish an answer. If the rise of a region of denudation is due to an injection of plastic material beneath it, in response to the resulting relief of pressure, the reservoir of highly heated rock forced from below into the cooler rocks above or a protuberance on the surface of the inner sphere will cool, and consequently become more and more rigid. When the intruded rock becomes solid, the portion of the earth's crust lightened by erosion will be increased in weight by material added from below. For the reason that the intruded magma tends to fuse the rocks with which it comes in contact, it will be welded to them as cooling progresses, and when solidification occurs the crust may have greater strength than before the intrusion. Each of these changes would tend to check the upward movement. Dikes and other forms of injections thus tend to strengthen the rocks into which they are forced in much the same way that fractures in the earth's crust are healed and the strata strengthened by the deposition of quartz and other minerals in them so as to form veins. In the case of subterranean injections the cooling of the reservoir of molten rock will be accompanied by contraction, which would cause a subsidence of the surface.

Stating the ideas that I have just attempted to convey more briefly, we should expect that the rise of a denuded area from the effect of internal pressure causing an influx of plastic material beneath it would be checked by the cooling and hardening of the injected material, and a reverse movement or subsidence of the surface initiated as the injected material contracted on cooling.

I am well aware that in these suggestions we are dealing with a single portion of a complex machine and that other results than those considered may follow. That the sole cause of the rise of an eroded area is not the injection of a molten magma beneath is apparent from the fact that such an injection would cause a rise in temperature in the rocks above, and thus by expanding them increase their upward tendency. The subsequent cooling of these heated and possibly metamorphosed rocks would also tend to renewed subsidence of the surface. In other words, subterranean intrusions are accompanied by an abnormal rise of the isogeotherms and their loss of heat by a return to normal conditions.

In progressively loaded areas, as has been pointed out by Reade, Shaler, and others, there is a blanketing of the earth's heat and a rise of the isogeotherms; the accompanying expansion of the rocks tends to check subsidence and limit accumulation. The processes of erosion, transportation, and sedimentation in special areas are thus limited by conditions within the earth. Erosion favors elevation until the plastic material transferred to the region beneath the lightened area cools and hardens. A decrease in elevation due to contraction then ensues, and is accompanied by a decrease in erosion, which comes to an end when the land is reduced to base level. Loading favors sedimentation by causing subsidence until the thickened sediments become heated and by reason of their expansion elevate the surface to or above base level. There is a mutual interaction beneath the earth's crust also, since, if only one region of erosion and one of sedimentation are considered, the checking of elevation in a region of erosion by the cooling and hardening of injected magma beneath will give greater resistance to the flow of plastic material from beneath the region of sedimentation.

Deep erosion of subtuberant mountains should reveal a central area of igneous rock surrounded by a belt of metamorphosed rocks which on its outer border, in case the injection occurred in ordinary sedimentary strata, should pass into unaltered sandstone, shale, etc. In such an instance a radial section should reveal a gradation from igneous rock through metamorphosed rocks to unaltered sedimentary beds. The breadth of the central core of igneous rock would vary with the size of the intrusion, and, down to a certain limit at least, with the depth of the plane of erosion. One or more generations of dikes might occur in either the central area or in metamorphosed or sedimentary rocks surrounding it. Great intrusions if deeply eroded would thus present the conditions sometimes cited as examples of "regional metamorphism." Some of the features observed in the crystalline region of Canada seem to illustrate the surface features that would be found if a great subtuberant uplift should be pared away by erosion.

The fact that a large majority of volcanoes are situated near the sea has led to the supposition that sea water gaining access to highly heated rocks is the chief if not the essential cause of volcanic eruptions. The hypothesis, however, that the sea is the source of the water which, converted into steam, takes such a conspicuous part in volcanic eruption is open to several objections.

In almost all land areas the rocks below the surface are saturated with water, the source of which is mainly rain. Excepting that the pressure of the sea on its floor tends to force water into the rocks beneath, there does not seem any good reason for concluding that the earth's crust where covered by the sea is more highly charged with water than the portions beneath land areas.

Another argument for the presence of sea water in volcanoes is that after eruption the country about a volcano is sometimes whitened for many miles with salt, and also that some of the vapors arising from volcanic vents are such as might be expected to occur if the substances contained in sea water were sufficiently heated. It is to be remembered, however, that large bodies of salt derived in some instances from the evaporation of sea water occur among stratified rocks, and also that many sedimentary deposits are saturated with saline water. It thus becomes evident that communication between the conduit of a volcano and the sea is not the only means by which saline water can come in contact with molten rocks.

It is well known that volcanoes as a rule are located near the borders of continents, or on the floor of the sea. This fact is more in harmony, however, with the idea proposed by Dana, that the margins of continents are determined by the location of weak belts in the earth's crust, along which maximum movement takes place, than that the presence of surface water bodies is essential to the existence of volcanoes. In support of this conclusion it may be pointed out that volcanoes of recent date occur in the Great Basin, hundreds of miles distant from the Pacific. The Great Basin is a region of faults, and as much a belt of weakness in the earth's crust as if it had chanced to be situated near the sea.

Owing to the increase of pressure with depth, it is evident that cavities in rocks in which any considerable bodies of water can be stored must become less and less frequent as the distance below the surface increases. As has been shown by Van Hise, at a depth in excess of about thirty thousand feet what may be termed appreciable cavities can not exist. Rocks under pressure become compact, so that deeply seated rocks must be less porous than similar material near the surface. These considerations lead to the conclusion that water-charged portions of the earth's crust are superficial. Hence the water given off by volcanoes in the form of steam, and probably also the gases produced by the dissociation of the elements composing water and the vaporization of the various salts it contains, must reach volcanic conduits in their upper portions. These considerations add strength to the conclusion advanced on a previous page, that the primary force which causes lava to rise in the conduit of a volcano is not steam pressure.

How molten lava becomes charged with water can only be conjectured. It is well known that many liquids, especially when highly heated and under heavy pressure, will absorb gases. In a similar way we may conceive that liquid or plastic rock, on coming in contact with water, will absorb the steam produced.

When molten lava rising in the conduit of a volcano passes through water-charged rocks and nears the surface, pressure is relieved and the occluded steam escapes. This escape is either quiet or explosive, dependent on the nature of the magma in which the steam is dissolved. If the magma is highly fluid, as in the case of many basic lavas when extruded, the steam escapes quietly; but if the magma is viscous, as is the usual condition of acid lavas when erupted, violent explosions are apt to occur. The quantity of steam absorbed also influences the fusibility of a magma. Apparently the larger the quantity of occluded steam, the more liquid the molten rock becomes. Greater freedom may thus be afforded for the passage of a magma in the upper portion of the conduit through which it rises than obtains at lower levels. Something of the intermittent character of volcanic eruptions may depend on this cause. Probably, also, the quantity of water present in a magma has an influence on the nature of the minerals formed as it cools. For this reason one would expect differences to appear in the mineralogical composition of rocks formed from magma that have cooled near the surface, and those that failed to reach the water-charged portion of the earth's crust.

The intimate connection between subterranean injections and volcanoes leads to the suggestion that the domes above intruded magmas may become fractured and give origin to volcanoes which would be supplied by local reservoirs. Something like "craters of elevation" may be thus formed.

If two or more cisterns of molten rock should be formed in the earth's crust near each other, or at different levels near the same radius of the earth, and fractures formed above them which would admit of the escape of their material to the surface, the striking phenomena of two adjacent volcanoes erupting independently of each other might result. Such an occurrence is rendered more probable by the fact that reservoirs beneath subtuberant mountains are supplied through fissures from below, which might become closed, thus isolating bodies of injected material in the earth's crust. Even if the feeding fissures were not closed, the large cisterns of fused rock to which they lead might discharge some of their material without immediately affecting the plastic central mass of the earth, which in these suggestions is considered the primary source from which injections are derived.

It has been thought by some who have speculated on the condition of the earth's interior that isolated reservoirs of fused rock exist in the generally cool earth's crust, due to unequal cooling; another origin for such lakes of lava may be postulated if we consider them as injected magmas not yet cooled.

A mental picture of the probable occurrences that give origin to subterranean intrusions and volcanoes, and account for many observed phenomena in this connection, may be sketched in outline as follows:

The earth is hot and potentially plastic within, and cold and rigid at the surface. Unequal cooling and the shifting of material on the surface are disturbing conditions that tend to change the shape of the plastic interior, and to crumple and break the crust. If a fissure forms in the lower surface of the crust, the potentially plastic material beneath will become plastic on account of the removal of resistance to pressure, and be forced into the break, and a dike be formed. Under certain conditions the plastic material rising in a fissure may expand between layers of stratified rock so as to form laccolites, subtuberant mountains, etc.

If a break extends entirely through the crust, molten material forced into it may reach the surface. As the molten lava rises in such a break, it passes through rocks that are more and more highly water-charged, the water is vaporized, or perhaps its elements are dissociated, and the vapors and gases formed are absorbed by the fluid rock. As the lava comes to the surface the steam and gases absorbed under great pressure escape and furnish some of the most striking phenomena of volcanic eruptions. Loss of heat as a magma nears the surface also favors the escape of occluded gases.

In this view of the nature of volcanoes it is evident that an arrest of pressure on the reservoirs from which they draw their lavas would stop their action. If a fissure extends through the earth's crust to the potentially plastic interior, it is difficult to see how an outflow of molten material would be checked unless the conduit should become closed. Under the vast pressure that exists at a depth of several miles it is impossible to comprehend how fissures can exist, but the plastic material beneath is under pressure of a similar order of magnitude, tending to force it out through any opening that may be formed. A near balance between the pressure tending to close a fissure and the pressure on the magma below tending to maintain a communication with the surface may therefore be conceived to exist; when the balance is in favor of extrusion volcanic eruptions follow, and when the reverse is the case the conduits become closed.

The evidence furnished by dikes and other intrusions, as well as by volcanoes, points to the conclusion that the magmas supplied to them are derived from deeply seated sources, but the fact that the material forming intrusions and the products of volcanoes differ widely among themselves has been cited as evidence that they could not have been derived from a common reservoir. This objection is based on the assumption that the highly heated material forming the earth's interior is homogeneous. It has been argued that, if the material within the surface shell was not homogeneous—excepting so far as density increases with pressure or is influenced by the increase of heat with depth—an adjustment would be established by the flow of matter from one locality to another. In reply, it may be said, however, that this conclusion is inconsistent with the idea of a solid but potentially plastic inner sphere. From the point of view assumed in this essay, it appears that what may be termed a local flow of the matter comprising the earth's interior would not occur unless there was a local relief or a local increase of pressure. The idea that the earth as a whole is a rigid body is in harmony with the conclusions of eminent physicists and astronomers, while the assumption of local plasticity due to local relief of pressure is consistent with the observed movements of elevation and depression familiar to geologists.

Returning to the consideration of the passage of the conduit of a volcano through the water-charged portion of the earth's crust, some of the phenomena displayed by dormant volcanoes may perhaps be explained. If the lava in the conduit of a volcano cools and hardens below the water-charged zone, the life of the volcano to which the conduit leads may be considered as ended. If the cooling takes place at the surface or within the water-charged layer, steam will continue to be generated below the obstruction, and, if means for its gradual escape are not furnished, will ultimately lead to an explosion which may blow away a volcanic mountain. In such an occurrence the main explosion would probably be preceded by a breaking of the rocks and possibly subterranean explosions which would bring temporary relief of pressure. The behavior of many dormant volcanoes and the earthquakes that frequently accompany a renewal of their activity might thus be explained.

When igneous intrusions enter the water-charged portion of the earth's crust but do not reach the surface, steam is also generated, and may assist such intruded magmas in opening passages for themselves and in elevating the domes that are raised above them. When an intruded magma meets a large body of subterranean water a violent explosion must result, which, when near the surface, would blow away the dome above, leaving a depression of the type of Coon Butte, Arizona, or Lonar Lake, India.

The suggestions offered in this paper are in harmony with the conclusion that many of the phenomena accompanying volcanic eruptions are due to the escape of steam occluded in molten lava, but are opposed to the hypothesis that the rise of lavas from deeply seated sources is due to the same cause. The source of the heat and the source of the pressure manifest when a magma rises through a volcanic conduit are considered to be distinct, and in the main of different origin.

NATURAL HISTORY IN THE PRIMARY SCHOOLS OF FRANCE.

By FANNY BIGNON.

DURING the last few years instruction in our primary schools has been undergoing an interesting evolution. The authorities have broken away from superannuated traditions, and have arránged courses of a wholly new character. There are no more long analyses, endless conjugations, and dictations of catchwords. While language, according to the tyrant of words and syllables, may be a loser by this change, I wish to show that science, and especially natural history, is a gainer.

The natural sciences have indeed had a place in the primary schools, and, in order to get his certificate of graduation, a child of eleven years was obliged to make a compilation on some such subject as the following:

1. Breathing. What happens to the air in the lungs? A part of this air combines *with the heat of the blood.* Results. (This topic was given at Brest in 1893.)

2. Digestion. Absorption of foods. Stomachic digestion. Intestinal digestion. (Hérault, 1893.)

3. What is an insect? Transformations of insects. (Haute-Garonne, 1894.)

4. A flower. Its composition. The rôle of pollen. Describe the ovary. (Hérault, 1893.)

5. The characteristics of lime. Its function in the soil. Means used to furnish lime to soils which lack it. (Meuse, 1893.)

From these examples it will be seen that all branches of natural history are touched upon, but physiology is treated more fully. We will not stop to criticise the method of putting the questions, and possibly some of the inaccuracies of statement may be laid to typographical errors. They are taken from a work by Messrs. Barreau and Bouchet, the former a supervisor at Paris, the latter a college principal.

But let us consider the methods used to give to our children the extensive knowledge which is expected of them. They listen to lessons which the teacher imbibes ordinarily from a text-book designed for the special purpose of preparing candidates for the graduating examinations. In this new kind of Bible from which the teacher refreshes himself each day, physiology, zoölogy, botany, and geology are methodically arranged by layers or slices, of which a dose of four layers (irrespective of the thickness of the layer) must be absorbed per month. The scholar has a text-book which is a *résumé* of the teacher's, filled with indigestible prose, crowded with scientific terms, where classification follows classification. After learning so many Greek and Latin derivatives, will there be time to observe the dentition of an animal, to analyze a flower, or compare stones? No; the natural-history collections of our schools remain under lock and key; the teachers forget to use them, and the scholars to look at them. But the text-book must be learned. Does the teacher make his own drawings? Usually he contents himself with the more or less exact illustrations of the text-book. How could he possibly find time for drawing, when in one lesson he must describe the whole human skeleton and define rachitis, caries, ankylosis, dislocations, fractures, and sprains, and in another give pell-mell the characteristics of the *Chenopodiaceæ, Polygonaceæ, Euphorbiaceæ, Urticaceæ, Laurineæ, Juglandaceæ, Cupuliferæ, Salicineæ, Betulaceæ,* and *Plataneæ!*

Picture to yourself an audience of youthful Parisians who, for the most part, have never seen hemp except in cloth, or oak except in a chair or table, a prey to this discriminating instruction! Some of them go to sleep or lose themselves in reveries where natural history has no part; others refresh themselves with candy under their desk tops. And this is the best thing they could do. Just as insects, when placed in a deadly atmosphere, resist asphyxia by closing their stigmata and ceasing to breathe, so our children escape the harmful effects of our instruction by closing their eyes and ears. The result is threefold: On leaving the primary school they know nothing about natural history, but sometimes think they know considerable; secondly, this ill-directed study not only has not developed their habits of observation and their judgment, but has accustomed them to speak inaccurately and carelessly of things of which they have no knowledge; and, thirdly, most of these little *savants* hold science in great contempt.

Is this what the reformers in education expect? We do not believe it, and we think that they may rightly hope for something better if the instruction be given by the only method which is in harmony with the subject: that of observation and experimentation. Collections must be made not only of curiosities but of common things; there must be a garden where the seed may grow and the flowers bloom; and there must be a collection of the common stones and rocks.

The teacher should prepare for his lesson by observation of the specimens which he is to show; the children should examine, describe, compare, and classify. They should not consider in one lesson all the apetalous families, but should learn to know the gilliflower, the violet, the blossom of the oak, all which they may gather for themselves. They may perhaps be ignorant of diseases of the bone and the operations they require, but they will know the furnishings of a cat's mouth and the peculiarities of the rabbit's, and what distinguishes them both from ours. At the end of the year they will have a very small burden of natural history, but they will have acquired good habits of mind, their intellectual faculties will be developed, and, what is even more important, they will love science and will have a taste for learning. The habit of observation will be exercised out of school hours, and even after they have graduated they will experience an increased pleasure in their walks which will react upon their physical and moral health.—*Translated from the Bulletin de la Société Zoologique de France, tome 20.*

THE BORDER LAND OF TRAMPDOM.

By C. W. NOBLE.

LAST summer it was my fortune to spend the vacation on a unique trip through Michigan. My chum and I went down to Berrien Springs to try our hand selling books, but a week of this kind of life sufficed to show us that the rapid road to fortune did not lie here, as the advertisements would lead us to believe, and we abandoned books, bag, and baggage and joined the great army of men "on the road." Our outfit was very simple. We bought a coil of steel wire, a pair of pliers, and a wooden frame to bend the wire over to make tidy-holders. This was our means of support. Besides this we had a small satchel containing an extra shirt apiece, two clean collars, and other things which we might otherwise find necessary to buy on the way. When we traveled we commonly shipped our goods by freight to some point about a week in advance on our route and then made our way there as best we could, supporting ourselves *en route* by selling our tidy-holders. On these occasions we varied our costumes somewhat. We buttoned our clean collars to our collar buttons in the back of our shirts so that they hung down our backs under our vests, and carried them there until we needed them, when we made a change. We also wore overalls, which served to keep our clothes clean while traveling and were worn underneath while selling goods. These tricks are common property among roadsters, being the outcome of stern necessity. We soon learned that if a person looked as though he needed to sell his goods it was very hard to do so, but if he looked as though he was simply doing it for the pleasure of the thing it was very easy. By trying successively various ways of selling we soon became experts and could sell at nearly every house we tried.

Probably there exists nowhere a stranger medley of people than the inhabitants of that indefinite place known as "on the road." Their numbers are constantly lessened by desertion and as constantly augmented by fresh arrivals. As far as I could learn by personal inquiry, there are two classes of reasons which throw these persons on the road—one a subjective one, restlessness, and the other an objective one, misfortune.

As for the proportion between the two, my opinion would not carry much weight, as I was with these people only one summer, and hardly learned any more than that the proportion varies greatly. At the time I did not make any classified study of each person, although I learned as well as possible from personal conversation the causes of their condition. The cases which I can recollect now seem to be about evenly divided between those who go on the road from choice and those who do so from necessity. I have reason to believe, however, that this is not the normal proportion, those who had to travel being more numerous than usual. Whenever I found veterans I found them complaining of the great number of recruits. As one tramp expressed it, "It's gittin' so a respectable 'boe [hoboe] can't get a hand out anywhere no more. This whole d—— country is on the bum."

I. *The class who are on the road from preference* is by far the more complicated. Perhaps I could describe it better by dividing it into two subheads—the tramp and the roadster proper. With each of these two classes we had about equal experience. At different periods we could be classed with each; we traveled, ate, and slept with them and were received into their number. I will discuss them separately.

(*a*) Tramps.—The first characteristic that strikes me as I recall my experience with them is their *indefiniteness.* Josiah Flynt, in his articles on tramps, has taken only the *élite* of the "profesh"—the tramp whose habits are born and bred into him and can hardly ever be entirely overcome. Besides these there is another class, last summer more numerous than the regular tramp, who would be placed on the border land of trampdom. They are traveling merely for the time being, and for the time being are no less distinctly tramps. They are men thrown out of work, who go on the road at first perhaps to find work. They get in with the tramps, like their life, and travel with them. Some of them seem to be actuated by a genuine desire to see the country, others by a simple love of adventure and change. This latter class are liable to degenerate into real tramps, but the former are pretty sure to get tired of the hard life and settle down again. They never regard themselves as tramps, and if they beg do so feeling that they lower themselves by it. As a rule they much prefer to work in payment of their meals, or even take two or three days' work and then pay for what they eat until their money is exhausted. They are uniformly recruited from the working population of cities, men under thirty years of age, who though without education have a desire to see the world and have been employed in a situation where they have come in contact with ex-roadsters. Under favorable conditions they would develop into such a type as the average "prominent citizen" of our small towns. They possess energy, skill, and intelligence, but lack woefully in opportunity.

The tramp temporarily on the road from a love of adventure can scarcely be distinguished from the dyed-in-the-wool hoboe. He is in most cases recruited from the same city population, yet all classes of society are represented. One night we were coming home from Cadillac to Grand Rapids in a freight car with thirty-three others, and the question of what to do when we arrived at the Rapids was being discussed.

The day before several of the "lads" had been "pulled" at the Rapids for "bumming the freights," and the news was by this time known to all knights of the road for several hundred miles. Plans for evading the "cops" were discussed, and the question of the legal aspect of the case came up. To my surprise, one of the toughest of the lot dropped his tramp dialect and gave a very good discussion of the case. We began to question him, and when he found that we too had seen college days he began to cite cases, quote State laws from several different States, and, in short, gave a regular lawyer's brief. He afterward told us that he had graduated from a law school in New York city.

Tramps as a class are young men. I do not know what becomes of them when they are old or whether they ever get old, and, as far as I could discover, they do not know either. Their happy-go-lucky method of living leads them to give very little thought to the future, but the fact still remains that an old man can not live as they do. They uniformly travel by night and sleep by day. It is no uncommon sight to see fifteen or twenty of these lusty fellows asleep in the shade of some watering tank, and if you would take the pains to climb up the ladder and into the tank you would probably find a little room over the water occupied by four or five more. They are not so universally drunken as the temperance advocates would have us suppose. One time when we were traveling by freight two of the lads brought on a bottle of whisky, and one of them offered it to several of us successively. Nobody would drink with him and he became abusive. The boys took his bottle away from him and threw it overboard, and compelled him to sit quiet until he fell asleep. But, on the other hand, their private morals are abominable. They seem to have no idea of personal purity whatever. I knew of one instance of a woman tramp who was supported by several male tramps with whom she traveled.

If you ask a tramp where he is going, he will probably answer vaguely, "Oh, down South, I guess," or "Out West," or some other equally indefinite place. If you urge him still further he may mention some State, but that will be as much as he can tell. They are like Wandering Jews, traveling because they can not stop. I saw only one place where any large number of tramps make a point of meeting, and that is the fruit region around St. Joseph. We picked berries there for a while during the season. Tramps swarmed there, together with large numbers of working people from Chicago and a number of ignorant foreign women from nobody knows where. They picked for two and a half cents a quart and boarded themselves—that is, slept on the ground and boiled stolen potatoes in a tomato can. At the little village of Stevensville, the center of the district, dance booths were erected, beer sold at three cents, and each night was made hideous by the squeaking of the fiddles and the drunken songs of the dancers. Finally, a murder occurred, and in desperation the farmers drove the whole gang away with shotguns. I learned from those who had been there that in the hop fields of New York and Wisconsin similar scenes occur. Many go direct from the berries to the hops.

(*b*) The roadster proper is distinguished from the tramp by having a "graft," or in other terms a visible means of support. The graft consists of any method at all to gain money aside from begging or chance jobs. For instance, our tidy-holders were "an out-of-sight good graft." We found one tramp who sold a kind of soap made by himself, which he guaranteed to take out any spot whatever. It really did so, but the spot was pretty sure to reappear the next day. I knew another who sold soap which looked like Castile. A week after it was bought it dried up into half its original size and became absolutely worthless. Another had made a sore on his arm with acid, and begged by showing this sore and telling some pitiful tale. As for such means of exciting sympathy their name is legion.

I found that there are several firms throughout the country who make it a business to supply grafts to tramps. For example, there are publishing houses where the professional beggar may obtain printed cards which will be of great assistance to him. The one-legged man will find a selection of most heart-rending poetry under titles such as The Woodman's Lament or The Railroad Boy's Appeal. The lame, the halt, and the blind are all provided with cards at so much per hundred. Another firm will make a specialty of so-called high-class novelties, and will issue a Mammoth Catalogue, probably advertised with a picture of a cat. Here you will find listed pewter spoons at twenty-five cents per dozen, tied with pink ribbon in half-dozen lots, and each spoon labeled sterling silver and done up separately in white tissue paper. Spectacles may be bought for two dollars and a quarter per dozen for the man who "just found a pair of gold-bowed spectacles down the road, and if they fit you, you may have them for two dollars, as I have no use for them." Not all grafts, however, are dishonest. The sale of pencils, paper, and in fact any article sold by tramps, would come under this definition.

There is also a large number of persons in this class whose employment is not at first sight apparent. Professional gamblers and book-makers are obliged by the nature of their employment to be on the move constantly. When in luck they spend their money lavishly, yet in case of pinch they take to the freight without a grumble. We traveled quite a distance with two such characters. They were dressed in immaculate linen, tailor-made suits, and derbies, and looked entirely out of place. In this class there belong a number of people who are not tramps in any sense of the word. The chronic book agent is an example. They follow the occupation because they have something in their character which will not allow them to remain quiet. Most women on the road might be classed among these—indeed, permanent canvassers are more often women than men.

The women on the road seem to be much more irreclaimable than the men. They have less true politeness, less sense of honor, and if dishonest are much more subtle. In a religious community they are invariably religious, and have uniformly been abandoned by their husbands and have six children dependent on their efforts. Male agents, as a rule, will be fair with each other and have a strong *esprit de corps*, but for the female agent everything is fish that comes into her net.

There are several trades whose members seem condemned to be perpetually on the road. Printers and hotel cooks are a case to the point. We traveled with a hotel cook for a couple of weeks who is a good example of his class. He had at different times been a brakeman, a school teacher, an expert accountant, a bookkeeper, a sailor, an agent, a basket-maker, and a cook. If necessity demanded, he could be anything else on short notice, as we soon found out. It seemed impossible for him to settle down. When he traveled he always spoke to the cook in some hotel at meal times and received a good meal gratis, a favor which he would repay some time if chance offered.

The greater part of this class perform no economic function whatever. Printers do not travel of necessity, but simply because it has become a custom with their trade. Agents of various sorts, of course, do perform a function, yet their work could be done as well if left to the retail stores. They make more profit on their goods than does the average retailer.

All of these classes have one thing in common—a roving disposition—and are divided by the possession or lack of other qualities. If the character we are discussing has the tramp instinct, but lacks both in mental ability and moral stamina, he will be a mere tramp; grant him some degree of mental ability, and he takes up a graft. If we give him a moral stamina without mental ability, we have the man temporarily tramping to see the country, while if we give him both intelligence and moral fiber he becomes a canvasser or roadster proper.

II. *The class who travel from necessity* is one of the most interesting spectacles in the border land of trampdom. Here we see the real tramp in the process of formation. When a young unmarried laborer is thrown out of employment and finds none where he is, he generally stays until his money is exhausted and then goes on the road in search of work. His case is genuine, but he is brought into disrepute because all tramps pretend to belong to this class. If he finds work within a short time, his experience will not result very badly for him, but if he is forced to remain a tramp for a month or so he is quite likely to lose his independence and join the ranks for good. In any case it is easier for him to take to the road in event of another lack of employment, and each time he does so he is more liable to become a permanent tramp.

It is surprising how large a number of men have belonged to this class at one period or another. Many laboring men when traveling prefer to go by freight in order to save expense. They do not think it a disgrace at all. Indeed, they rather regard ability to make one's way rapidly over the country without expense as an important part of their education, and the more I know of the vicissitudes in the lives of our workingmen, the more I am inclined to agree with them.

In dealing with the tramp question we must consider the distinctions just noted. The man who travels simply because he wants to, wastes his energy and ought to be suppressed, both for his own good and the good of society in general. But with the man who travels because he has to things are very different. He *must* travel. It is a critical time in his life. Forces are acting on him which tend to weaken his self-reliance, his honesty, and his self-respect, and bring him to the level of the common tramp. If he is given an opportunity of earning his living as a man and is treated like a man, chances are in his favor, but if he is forced to accept charity like a tramp he is very likely to become a tramp. I believe the establishment of municipal wood yards, run on the plan of those now found in many cities, to be the proper solution of the tramp problem. In these a meal or a night's lodging is given in payment for two or three hours' wood cutting. Then the co-operation of the citizens must be enlisted. They must cease entirely all private charity of this sort and send tramps to the wood yard. In this manner tramp life will lose the attraction of an easy, worthless existence. The wood yard will become abhorrent to the genuine tramp, but will be welcomed by those who are really forced on to the road by lack of work. The tramp who finds himself in this manner paying his way will in some measure regain his self-respect and will stand a better chance of being reclaimed.

SKETCH OF HENRY DARWIN ROGERS.

THE family of which the "Rogers brothers" were conspicuous members furnishes a striking instance of the concurrence of consanguinity and affinity of genius and mental tendencies, and its history affords a marked confirmation of the doctrine of hereditary genius. Instances of sons inheriting the mental qualities and capabilities from their fathers, and of brothers achieving distinction in allied or different lines of effort, are common enough and may be cited by the dozen, but very few can be found where so many members of the family became eminent at the same time and in fields so close to one another. In this family we have the father and four sons, all able teachers, and all becoming distinguished as geologists or chemists, and all—the brothers at least—gaining their fame on so nearly the same fields that they were able to co-operate with one another in experiments and in the preparation of papers. Doubtless the occupation of their father, which made him the academic as well as the parental teacher of the elder brothers, had much to do with shaping their tastes and giving direction to their studies, while the youngest, we learn, was taught under their direction. The relations of this quintet and of their work are admirably set forth in the late Dr. Ruschenberger's memorial sketch, which is our chief source of information concerning all of them.

Sketches have already been given of Prof. William B. Rogers, the second of the four brothers, in the ninth volume of the Popular Science Monthly, of James Blythe Rogers, the eldest of them, in the June number, and of Robert Empie Rogers, the fourth, in October, 1896.

HENRY DARWIN ROGERS, the third of the brothers, was born in Philadelphia, August 1, 1808, and died near Glasgow, Scotland, May 29, 1866. His middle name was given him in honor of Erasmus Darwin, of whose poem, The Botanic Garden, his father was a great admirer. He was educated at Baltimore and at Williamsburg, Va., where his father was Professor of Natural Philosophy and Mathematics in William and Mary College from 1819 till 1828, the year of his death. The first notice we find of Henry's early work is the mention in Dr. Ruschenberger's sketch of a school set up by him and his brother William in the suburbs of Baltimore. In January, 1830, when he was not yet twenty-two years old, he was elected Professor of Chemistry and Natural Philosophy in Dickinson College. During the year in which he held the professorship he edited a monthly scientific magazine, The Messenger of Useful Knowledge, to which his brother contributed a series of short articles on the Formation of Dew, and in which educational, literary, and political articles and selections from foreign journals were also published. He resigned his professorship at the end of the year, and in 1831 went with Robert Dale Owen to England, where, with aid afforded him by his brother William, he studied chemistry in the laboratory of Dr. Edward Turner, and attended other scientific lectures in London, including those of De la Beche on geology. He returned to Philadelphia in the summer of 1833, and in the ensuing winter delivered a course of lectures on geology in the hall of the Franklin Institute. He was made a member of this society, on the nomination of Alexander Dallas Bache, in January, 1834; was a member of its Board of Managers from 1838 till 1843; and resigned his membership in it in March, 1848.

Having received the degree of Master of Arts from the University of Pennsylvania in 1834, he was elected Professor of Geology and Mineralogy in that institution in 1835. This chair he held—giving regular instruction—till 1846, when he resigned. One of the fruits of his labors there was the small publication, A Guide to a Course of Lectures on Geology, delivered in the University of Pennsylvania.

In 1835 Mr. Rogers was appointed by the Legislature of that State to make a geological and mineralogical survey of New Jersey. He published a small preliminary report of the progress of his work in 1836, and in 1840 a larger report, with maps, entitled Description of the Geology of the State of New Jersey. The report of 1836 gave the first descriptive section that was made of the cretaceous formation of that State, and the first published results of systematic field studies of a system which has since been elaborately investigated by other geologists.

The Geological Society of Pennsylvania, though its career was only brief—1832 to 1836—lived long enough and was vigorous enough to secure the institution by the Legislature in 1836 of a geological survey of that State. On the organization of the survey, Prof. Rogers was appointed geologist, with James Curtis Booth and John F. Frazer assistant geologists, and Robert E. Rogers, the fourth of the "Rogers brothers," chemist. Six annual reports of the progress of this survey were made to the Legislature from 1846 to 1852, when it was suspended through the failure of the two houses to make an appropriation for its further prosecution. For the next ten years—1842 to 1851—Prof. Rogers was employed by various coal companies as an expert. During this period—in 1846—he established his residence in Boston. In 1855 the preparation of a final report of the Pennsylvania Geological Survey was committed to him, on condition that he should receive sixteen thousand dollars, should furnish the State one thousand copies of the book, and should own the copyright of it. In order to command the best work possible with the amount appropriated by the State, he had the printing and engraving of the book done in Edinburgh, more cheaply and quickly than they could be afforded in like style in the United States, and removed there in order to supervise them. The report, which embodies the results of eighteen years of labor, brought the author fame and applause, but pecuniary loss instead of profit; for the cost of it exceeded the appropriation by many thousand dollars. The book, in two quarto volumes, contains 1682 pages, is illustrated by 778 woodcuts and diagrams in the text, 69 plates, and 18 folded sheets of sections, and was published by W. Blackwood & Sons (London and Edinburgh), and J. B. Lippincott & Co., Philadelphia, in 1858. The highest commendation was given to this work by Prof. Rogers's successor on the geological survey, who said that, on the reading of the special memoirs at the end of the second volume, there could be "no sentiment but one of admiration for the breadth of his views and the clearness, force, and elegance of his delineations. No geological paper has ever appeared excelling in every good quality his memoir on coal."

In a report of the proceedings of the American Academy of Arts and Sciences, of which Prof. Rogers was a member, dated May 28, 1867, these words appear: "His first systematic geological labor was that of conducting the survey of the State of New Jersey. . . . While thus engaged, a similar survey of the great State of Pennsylvania was provided for by the Legislature, and placed under his direction. . . . During the early progress of this work he produced in conjunction with his brother, William B. Rogers, the well-known memoir, On the Physical Structure of the Appalachian Chain, unfolding certain dynamical laws which have regulated the elevation of mountain chains. About the same time (1842) he published an elaborate paper on the origin of the Appalachian coal strata, bituminous and anthracite, containing much original observation and important speculative views, his brother pursuing a parallel system of investigation in Virginia, where the formations are identical with those of Pennsylvania. The result of the labor of these two brothers, carried on for ten years together, was the grand discovery of the structural unity of central North America, between the Appalachian chain and the Rocky Mountains, the Great Lakes, and the Delta inclusive, a fact of such importance that it must serve in future as a guide to all general researches, since it is not reasonable to suppose that so large a portion of the earth's surface should have been formed in any other than the normal mode. . . . Prof. Rogers was one of the founders and an early president of the American Association of Geologists, which after an active and most useful career expanded into the American Association for the Advancement of Science.

"Although chiefly devoted to geological research, he paid much attention to those sciences of which geology is the extended application—natural history, climatology, and physical geography."

His work was appreciated abroad as well as at home. He received the degree of LL. D. from Trinity College, Dublin; was elected a Fellow of the Royal Society (London), and of the Royal Society of Edinburgh, and of many other important societies. He was also for two years the President of the Philosophical Society of Glasgow. He became one of the conductors of the Edinburgh New Philosophical Journal, and was associated with Sir William and A. K. Johnston in the publication of maps of physical geography and geology, particularly of a geological map of the United States and a chart of the arctic regions in their Physical Atlas.

The anniversary address of the President of the Geological Society (London), in a notice of Prof. Rogers, contains the following estimate of his work as a geologist:

"While employed upon his great survey he had contributed to the Proceedings of this society a paper entitled Some Facts in the Geology of the Central and West Portions of North America. In this address he dwelt especially on those great features which he had elaborated in his survey, the disturbance of the Palæozoic rocks of the Appalachian chain, 'a stupendous undulation or wavelike pulsation, the strata being elevated into permanent anticlinal and synclinal flexures, remarkable for their wavelike parallelism and for their steady declining gradation of curvature when they are compared in any east and west section across the corrugated zone.' To the westward of the Appalachian chain, where this structure is conspicuous, he pointed out that 'the crust waves flatten out, recede from each other, and vanish into general horizontality.' Coupled with these leading features he remarked that the total thickness of the coal measures steadily diminishes from some three thousand feet thick in Pennsylvania to fifteen hundred feet in the Illinois basin, and to not more than one thousand feet in the basins of Ohio and Missouri; and similarly the number of workable seams of coal diminishes from twenty-five on the Schuylkill to probably seven in Indiana and Illinois, and but three or four in Iowa and Missouri. And when we add to this the clearly established facts of the increasing amounts of sea deposits simultaneously with the decrease of land-derived materials eastward and the diminishing effects of metamorphoses in the same direction, from the fully bituminous coals of the Western States to the hard anthracites of the most disturbed region, it must be conceded that Prof. Rogers contributed a noble quota to the unraveling of some of the grandest phenomena which geologists have been called upon to investigate."

In the autumn of 1857 Prof. Rogers was appointed Regius Professor of Natural History in the University of Glasgow, which position he held until his death. A Glasgow paper thus describes his inaugural lecture:

"The hall was densely crowded and the lecture of the learned gentleman was listened to throughout with the most decorous attention, broken only at intervals when some passage of surpassing beauty evoked the spontaneous applause of the alumni. To great scientific attainments Prof. Rogers unites great popular ability. His intellectual faculties are admirably balanced. It would be difficult indeed to say whether the analytic or synthetic faculty is the stronger, so delicate is the poise of power. . . . It would be doing injustice to Prof. Rogers to attempt so much as an outline of the lecture delivered yesterday; suffice it to say that, as far as any lecture could be so, it was an exhaustive synopsis of the wide field of scientific research embraced under his professoriate. The grouping of the varied branches of the general subject was executed with the utmost precision and completeness. The marvels of Nature that were met at every turning in the path of investigation were brought most happily before the imagination of the neophytes of science, while the great practical results of the study of natural history were never once lost sight of, even in presence of its most gorgeous visions."

Prof. Rogers returned with his family to the United States on a visit in the summer of 1865. He went back to Scotland alone in the following April, in order to resume his teaching of the summer classes of medical students in zoölogy. In May, word was received by his family that he was ill. Mrs. Rogers, with two of Prof. Rogers's brothers, took the first steamer to go to him, but when they reached Liverpool they learned that he had died several days before, of erysipelas.

The following notices of Prof. Rogers appeared in Philadelphia papers shortly after his death:

"It is difficult and perhaps impossible in the compass of a notice like the present to convey an adequate notion of the general attainments of Prof. Rogers, or of his peculiar views in geological science. As a geologist he might be termed a paroxysmist, although he preferred to give full weight to the operation of those ordinary causes which are gradually and silently working to bring about the changes everywhere recorded on the surface of the earth. But he believed that many of the more marked cosmical phenomena could not be sufficiently explained without a resort to the doctrine of catastrophes, and he deliberately though modestly announced his opinion in these respects. His acquirements in all departments of physics were considerable, to which he added the accomplishment of a large acquaintance with our own literature and that of other countries. Accustomed to consider closely the important social and ethical questions which engage the attention of enlightened men, he brought to their examination an accuracy and breadth of observation derived from his habits of scientific investigation.

"Prof. Rogers was a member of many learned societies both in Europe and America, and his scientific brethren will amply honor his memory. We may add that, though representing America in a foreign university for many years, his patriotism was fervent, and he was able to defend and maintain the cause of the Union at all times and under all circumstances."

Another paper said:

"As a lecturer Prof. Rogers's excellences will long live in the recollections of his Philadelphia auditors. His calm, impressive tone, thoroughly well sustained and occasionally rising with the swell of his subject to a high pitch of eloquence, his quiet, gentlemanly bearing, his thorough mastery of and deep interest in his subjects never failed to kindle even in the most indifferent listeners at least a temporary glow responsive to the feeling of his own breast. He has passed away, and left a name not soon to be forgotten by the cultivators of science, and a place among his friends and associates that can not without great difficulty be supplied."

"Of him whom we have lost," says the minute of the American Academy of Arts and Sciences, "suffice it to record here in simplest and briefest phrase that he was a most accomplished investigator, a graceful and persuasive teacher, and fascinating companion; that to rare powers and attainments he added a lively sympathy in all the interests of humanity, and a courageous devotion to whatever he deemed just and true."

Besides the reports and books already named and the periodicals he conducted, Prof. Rogers was the author of thirty-seven papers in scientific serial and other publications, he and William B. Rogers of eight, and he and Martin H. Boyé of one paper.

He was chosen a member of the American Philosophical Society, and a member of the Academy of Natural Sciences of Philadelphia in 1835. He was elected an honorary member of the Boston Society of Natural History in 1842, and participated in discussions at its meetings nearly every year from 1845 till 1858, speaking usually on geological facts or theories.

Other societies besides those already mentioned of which Prof. Rogers was a member were the Geological Society of London, the Royal Geographical Society, and the Anthropological Society of London.

M. Albert Gaudry, in a review of the course of development of animate nature through the geological ages, remarks on a curious analogy between the changes experienced by fishes in the Secondary age and those which modern warships are passing through. As soon as the thought of armoring vessels took effect, stronger projectiles were devised, in order to penetrate the armor. Then the armor had to be strengthened, and just as rapidly as the plates were made thicker, more enormous projectiles were cast; so that the race has culminated in the construction of vessels so heavy that they are almost unmanageable, and thought is turning again toward light, swift boats. With the Secondary fishes, too, offensive arms and defensive armor were developed pace by pace. The teeth were modified till they could crush through the hard cuirasses of the ganoids, and the Secondary beds are characterized by marine animals thus furnished. Powerful grinding teeth are found in the bony and the cartilaginous fishes, and even in many of the massive reptiles of the Trias. The fishes, exposed to enemies whose instruments of offense matched their defensive armor, were obliged to seek safety in flight. Their vertebral column became more solid, so as to furnish a strong support to their spinal muscles, and their tails were shortened and broadened so as to become instruments of energetic locomotion. When this transformation was completed, the carnivorous fishes had no more use for crushing teeth, and they have almost disappeared; no more marine reptiles with teeth like paving stones are found in the Tertiary beds or in modern times; and fishes with large teeth working like millstones are rare in comparison to those which have thin cutting teeth; and power resides in agility to reach the goal or escape the danger. Existing fishes are marked by an activity that was unknown in the ancient oceans, and justify the observation of Moquen Tandon, that "the agitation and inconstancy of the sea seem to have impressed themselves on the beings which live in its waves, in the suppleness, rapidity, and vivacity of their movements."

Correspondence.

THE MORAL OF THE "SYMPSYCHOGRAPH."

Editor Popular Science Monthly:

SIR: I was both surprised and humiliated to find on my return from Bering Sea, a few days ago, a large correspondence from persons who had taken the "Sympsychograph" seriously. I had not the slightest idea that any one capable of "reading bound books" would be deceived by the meaningless phrases in that bit of burlesque. I intended it as a piece of gentle satire on the "wizards" and "impressionists" who follow in the wake of scientific work which attracts attention, and who pour their vagaries into the long ears of the daily newspaper.

The important element of one's belief arises from the way in which that belief is formed. No one was capable of understanding my story who did not at once see the incongruity of it. One might as well believe in Mahatmas and Odic forces as in cathode radiation or evolution if he does not have any clear ideas or a clear conception of the basis on which generalizations rest. One writer speaks of the article in question as a hoax upon an innocent public; but a public which has swallowed the alleged experiments of Inglis Rogers and other impressionists as scientific truth, and does not see any difference between the methods of these persons and the methods of Röntgen and Helmholtz, is not an innocent public. A vast amount of suffering in our society arises from the fact that men are ready to follow any notion in medicine, in politics, or in social reform, no matter how absurd, if it contains an element of mystery, or if it proposes to make life a little easier for men incapable of clear thinking.

I had a serious moral in the fable, and this, at the risk of trying to explain a joke, I shall give.

The methods ascribed to the "Astral Camera Club" are those which never have yielded and never can yield any results to science. Scientific investigators are not "wizards," their discoveries are not presaged by uncanny feelings nor green darkness, nor is there anything "occult" about their ways of working. They are simply men of unusual persistence and steady common sense. Everything easy was found out long ago, and additions to knowledge can only come from mastery of past achievements and mathematical accuracy in the registration of small details. The progress of science is not marked by surprises and contradictions. The result of scientific inquiry comes as a surprise only to those ignorant of the steps in investigation which leads up to it.

The discovery that the peculiar rays called "X" by Röntgen could be made to cast shadows on a sensitized plate does not imply that thought can be photographed. One might sooner expect to photograph the songs of birds than "the cat's idea of man."

The great power which exact knowledge gives adds nothing to the probability of the mythology of our own or other times. The "power of mind over matter" is not a form of hysterics. It depends on exact knowledge of the nature of material things. It is no occult influence showing itself in neurotic "adepts" by uncanny lights, under "astral" conditions. It is greatest by daylight, with sane men, with whom science is simply enlightened "common sense."

DAVID STARR JORDAN.

PALO ALTO, CAL., *October* 10, 1896.

SHALL VIVISECTION BE RESTRICTED?

Editor Popular Science Monthly:

SIR: In his interesting and valuable contribution to the literature of vivisection, in the October number of your periodical, Prof. Hodge makes one or two statements which are decidedly erroneous, and which I beg you will permit me to correct. Quoting from an article of my own on the same subject, published over twelve years ago in Lippincott's, he states that "a recent writer has actually cited mortality statistics to prove the futility of vivisection." This deduction is wholly incorrect. The very book from which he quotes, again and again affirms the use of vivisection. Exaggerated claims of potency, such as were rife when this article was written, some fourteen years ago, may certainly be challenged, without being carelessly translated into affirmation of "futility"; just as one may believe in experiments regarding aërial navigation without looking forward to lunar voyages.

With the gratuitous imputation of "unfairness" in the selection of statistics I am more seriously concerned, for no charge more vitally affects the character of scientific work. Prof. Hodge admits, as he is forced to do, that "the figures do show that in England, since 1850, certain organic diseases have been on the increase, despite the slight advance in our knowledge of them." Well, that also is my own conclusion. Such facts as these "afford the strongest possible argument for the side of research." Again I agree with your learned contributor, although I should give the word "research" a wider meaning than he intends. But there was "unfairness" in the selection of diseases; "almost without exception these maladies lie very deep in the hereditary tendencies of the race." Well, I suppose death itself may be said to "lie very deep in our hereditary tendencies"; but, except in some such exceedingly broad sense, I certainly question the accuracy of his assertion. In my tables (see Lippincott's, August, 1884) only fifteen different classes of organic diseases were tabulated, and among them were apoplexy, aneurism, diabetes, insanity, paralysis, cancer, diseases of the heart, the brain, the kidneys, and the liver. From these causes only result the deaths of two thirds of the English race over the age of twenty years; and, as a rule, fatality increases with advancing age. Are these maladies "almost without exception" caused by "hereditary tendencies"? When the Archbishop of Canterbury, in the fullness of years, falls dead from apoplexy, is it because "defectives leave enfeebled progeny"? I certainly differ with your learned contributor on this point. There was no unfairness whatever in concentrating attention upon organic diseases, *provided* it was distinctly admitted—as it was in the same article—that "during later years there has been a diminished mortality in England from the lesser prevalence of zymotic diseases," which nobody in 1884 was pretending to "cure."

One point more. Admitting the justification of vivisection *per se*, are we compelled to adopt the further evident conclusion of Prof. Hodge that it should be free to proceed to any lengths whatever, as in Continental Europe? Because certain forms of vivisection are justifiable, *are all?* It is at this point we part company. He is a brave man who can announce in these days a new theological dogma, that "God clearly gives to man every sanction to cause any amount of physical pain which he may find expedient to unravel his laws." Certainly that is a dogma of the highest import; everything is justifiable; its far-reaching consequences touch humanity itself. With that doctrine I thoroughly disagree, upheld though it be by so eminent a teacher as Prof. Hodge. Permit me rather to range myself with one whose work for science entitles him to even greater respect. On the wall of my library hangs a printed statement of views concerning this very subject, from which allow me to quote. "Within certain limitations, we regard vivisection to be so justified by utility as to be legitimate, expedient, and right. Beyond those boundaries it is cruel, monstrous, and wrong. Experimentation . . . we consider justifiable when employed to determine the action of new remedies; for tests of suspected poisons, for the study of new methods of surgical procedure or in the search for the causation of disease. . . . On the other hand, we regard as cruel and wrong the infliction of torment upon animals in the search for physiological facts which have no conceivable relation to the treatment of human diseases; or experiments that seem to be made only for the purpose of gratifying a heartless curiosity. . . . The practice, whether in public or in private, should be restricted by law to certain definite objects, and surrounded by every possible safeguard against license and abuse."

That statement, sir, is signed by Herbert Spencer. With every word of it I agree.

ALBERT LEFFINGWELL, M. D.

HAMILTON CLUB, BROOKLYN, *October* 15, 1896.

INTERPRETATIONS OF MALTHUSIANISM.

Editor Popular Science Monthly:

SIR: I have been a reader of your periodical since 1873, and naturally during that time I have occasionally met with statements by some of its contributors that I felt were open to criticism—opinions that I thought a little weak. But never through all those years have I met with such a reckless misrepresentation as is contained in Helen Zimmern's first paper, in the September number, on Enrico Ferri on Homicide. In a sentence, about the middle of page 682, she says, "Infanticide, elevated to a custom and a method in Malthusianism." Such a statement would be unworthy a correspondent of a decent newspaper; but, that any contributor to the Popular Science Monthly should, whatever his personal intolerance of the population question, have the temerity to hazard such a false presentment of the theory (axiom I would call it) laid down by the Rev. Mr. Malthus, and the remedy he suggested, is, to say the least, hardly complimentary to the presumable information or intelligence of its readers.

The difference in the ratio of increase of population and that of subsistence, which Mr. Malthus, rightly or wrongly, submitted as being a fundamental law, and the remedy, wisely or unwisely, he suggested of deferred marriages, are all that can be laid to his charge. Surely these are not sufficient grounds to justify the accusation against him of advocating "infanticide"! It reminds one of the old trick of many of the clergy, associating immorality with atheism.

Certainly, there is now a numerous and rapidly growing class, recognizing the irrevocable nature of the law of population, but, at the same time, the impracticability of Mr. Malthus's remedy, who adopt and recommend *preventive* means. Yet, how even such can be accused of "infanticide" any more consistently than others who practice *abstinence* (which is just one method of prevention) it is difficult to perceive.

I feel that this is no occasion for ventilating my own particular views on the population question or Malthusianism; still, I have always been surprised at observing the avoidance of the subject manifested on the part of many men of high standing who yet recognize and accept its truths. It is this sort of neglect or cowardice, I think, which emboldens some minds to gratify their resentment of opinions or views they have a sentimental repugnance to by indulging in the sly thrust; trusting to the perhaps unpopular nature of the matter for their immunity from consequences.

I can not conceive Helen Zimmern being as ignorant of Malthus's writings as the words I quote from her paper would imply; and I am very unwilling to suppose she would *willfully* misrepresent.

Respectfully, ARTHUR F. PALMER.
152 CRAWFORD ROAD, CLEVELAND, OHIO, *September* 30, 1896.

NATIVE AMERICAN POTTERY.

Editor Popular Science Monthly:

SIR: Of course the name "Alaska" is a slip of the pen with Madame Le Plongeon in the September Popular Science Monthly, whatever other locality the distinguished writer may have had in mind. The only pottery to be seen in Alaska is exceedingly rude, perhaps the worst in the world. The Athapascans of the interior boil food in baskets and boxes, with hot stones. The Tlingit (Koloschan) of the coast have no pottery, using boxes of alder and other woods for vessels. The Aleuts have no pottery and no substitutes therefor, except such dishes as they make from driftwood. But the Eskimo tribes about Bristol Bay do mix up mud with hair and blood to form their lamps and grease bowls. Excepting this rude ware, there was no pottery made by the Pacific coast tribes between the Santa Barbara Islands, Lower California, and the Eskimo of Bristol Bay. Thirty-five of the families or stocks of Indians north of Mexico are not known to have ever practiced making pottery.

OTIS T. MASON.
WASHINGTON, D. C., *September* 7, 1896.

Editor's Table.

A THEOLOGICAL VIEW OF EVOLUTION.

ON more than one occasion lately we have had to note the growing liberality of theological thought in relation to scientific questions; and we now have before us another striking example of the same tendency in an address delivered at the recent Church Congress in England by Archdeacon Wilson, of Manchester, on The Bearing of the Theory of Evolution on Christian Doctrine. Thoughtless critics sometimes endeavor to cast ridicule upon the clergy for troubling themselves with discussions of this kind. Their idea is that theologians should expound and develop their doctrines in entire independence of, if not indifference to, what the scientific world may be doing, and that the scientific workers should equally ignore theology. We can not accept such a view. The human mind is not built in thought-tight compartments, if we may use the expression. Every thought honestly entertained claims the privilege of traveling everywhere, and asks for illustration and confirmation wherever it goes. If the scientific man is a religious man he will want to blend his science with his religion, and the religious man will want to know that the doctrines to which he adheres are not contradicted by any portion of his acquired knowledge. If the leaders of religious thought were to withdraw from all interest in the teachings of science, the inference would certainly be drawn that they were conscious of a hopeless antagonism between the principles of science and the doctrines of religion. They would seem to present to the world the alternative: "Science *or* Religion; choose which you will, you can not have both."

Far better is the attitude of those who, believing in both, believing that men have need of religion, and that they can not deny the authority of science, strive to see what measure of agreement there is between the teachings of one and the other. Such is the position of the Archdeacon of Manchester. In examining the theory of evolution he sees, in the first place, that it is no way inconsistent with theism; and, in the second, that it throws no difficulty in the way of recognizing the personality of the Divine Being that theologians were not already aware of and familiar with in connection with their own special studies. That problem would subsist even if no theory of evolution had ever been formulated. To quote the speaker's words: "No cell of a body could interpret the personality of the whole; and similarly we could not grasp the personality of God and his love and Fatherhood when we were thinking of all Nature as the expression of his will." As regards the creation of man, the archdeacon does not consider that there is any conflict between the theory of evolution and any essential Christian doctrine. "It was no part," he said, "of the doctrine of the Church—it was a comparatively modern theory of the naturalists, rashly accepted by the theologians of two centuries ago—that man was a special and underived species. He could imagine no sublimer conception of the nature or the dignity of man than that which saw all Nature as the self-manifestation of God rising into self-consciousness in man. Christian doctrine could adopt the evolutionary view of the creation of man; it was pledged to no other."

Passing to the doctrine of the Fall of Man, the speaker acknowledged that, in the light of evolution, the generally received view required considerable readjustment. We quote again: "Man fell, according to science, when he first became conscious of the conflict of freedom and conscience. Now, this conflict of freedom and conscience was precisely what was related as 'The Fall' *sub specie historiæ*. It told of the fall of a creature from unconscious ignorance to conscious guilt, expressing itself in hiding from the presence of God. But this fall from innocence was in another sense a rise to a higher grade of being. It was in this sense that the theory of evolution taught us to interpret the story of the Fall. It gave a deeper meaning to the truth that sin was lawlessness." Closely connected with the doctrine of the Fall is the doctrine of Atonement, and that, too, the speaker stated, must undergo modification and accept a broader basis. Such is the evident meaning of the following passage: "The theory of evolution is, indeed, fatal to certain quasi-mythological doctrines of the Atonement which once prevailed, but it is in harmony with their spirit. It has become impossible to regard redemption as an afterthought, as a plan devised by a resourceful Creator, in Miltonic fashion, to meet an emergency. It has become impossible to the evolutionist to retain what was once the ordinary view of the supernatural as an interference with the natural, as an interposition from another sphere. Such dualism is repugnant to him. All progress being the result of struggle and sacrifice, the Atonement is God's identification of himself with the human race in that ceaseless struggle, manifested specially in the supreme sacrifice of the sinless Christ, but also in all human life lived in the spirit of Christ. This identification is the Atonement, the reconciliation, and in it the evolutionist, not less than the theologian, finds new hope and power, a release from sin, a real forgiveness and redemption." The speaker did not profess to be able to see his way through all the difficulties of his subject, but he made the broad statement that "thought is being transformed by scientific method, and along with thought theology must change in form on some such lines as these." The following remarks on the subject of sin recall very strongly the views of Mr. Herbert Spencer: "It seems plain that if sin is a transgression and goodness the fulfillment of the law of man's higher nature, the consequences of sin and of goodness are not arbitrary nor external; they are in ourselves. They are the being what we have become, the sinking to the lower or the rising to the higher."

It seems to us that in this address—even in the few extracts we have made—there is much food for reflection. We may each form our own estimate of the success with which the author has applied himself to the task of reconciling the scientific philosophy of the age with Christian doctrine; but it seems clear to us that the effort to give at once a rational basis and interpretation to the accepted teachings of religion and a religious character to the principles of science is in every way commendable. There is not too much science in the world to-day, nor is there too much religion; and it can neither do the religionist any harm to know that the doctrines in which he places faith may be regarded as part of the rational interpretation of the universe, nor the scientist to know that the intellectual aspect of his theories is not all—that they have their moral and spiritual implications to which he would do well to take heed. The final aim of all intellectual effort should be the wise government of human life; and science does not properly fulfill its function, does not do justice to its own mission in the world, unless it endeavors to moralize its message to mankind. There has been too great a willingness, if we may say so, on the part of scientific investigators to fling broadcast crude theoretical conclusions, without any care as to how they may be correlated with the general body of human beliefs and sentiments. Science, under this treatment, loses much of the charm with which it ought to be invested, and arouses a certain instinctive repugnance against itself and its professors in the popular mind. Hard-headed and ambitious men, on the other hand, see in it an excellent road to money-making, and nothing more. Properly presented to the world, it might, as Wordsworth says of duty, wear "the Godhead's most benignant grace"; and it is to the credit of the theologians that many of them are endeavoring so to present it. The Archdeacon of Manchester is not far wrong when he says that "the needs of the human heart are much the same as they were four thousand years ago." A recent writer who, though chiefly known as the author of fantastic tales, is understood to be a strong man of science in certain lines—Mr. H. G. Wells—would carry this statement much further back than four thousand years.* At any rate, there is such a thing as the human heart, and it wants a word now and then. It may be impossible perhaps for science, as science, to speak the word; but it should at least welcome every alliance which, while leaving it due freedom of action, may help to bring it a little nearer to the instinctive needs and higher moral sentiments and aspirations of humanity.

INTERNATIONAL SCIENCE.

It was a favorite dream of the early political economists that the expansion of international trade would gradually unify the world,

* See an article in the October Fortnightly Review—Evolution an Artificial Process.

that it would so educate the nations in the peaceful arts that, at no distant day, they would resolve to learn war no more, so that Astræa, if she were so minded, might return to the plains of earth and find nothing to remind her of the conflicts and bloodshed which, according to the poets, had caused her to take her flight. If things could have gone just as the early economists wished and hoped, something like this might have come, or be about to come, to pass. They thought that commerce was going to shake off its shackles, that trade was going to be free, and that the mutual benefits which it would bestow would, year by year, strengthen the feeling of friendship between nation and nation. They did not foresee such a revival of the prejudice-breeding protectionist system as our eyes have witnessed, or the greed for colonial acquisitions which it has introduced into the world. They magnified unduly the rôle which reason was going to play in the affairs of men, and made inadequate allowance for the measureless floods of popular ignorance which popular education would disengage and set into activity. Still, their dream was no discredit to them, and one of these days, after a greater lapse of time than they counted on, it may come true.

But what trade has not yet accomplished, and does not, as things are at present, seem in the way of accomplishing, another force is silently laboring to achieve. That force is science. It is cosmopolitan by nature ; something more than the world even is its parish. We all remember the story of Goethe, who, when the Revolution of July, 1830, broke out in France, and was creating commotion and trepidation more or less throughout Europe, was so absorbed in thinking of the controversy between Cuvier and Geoffroy de Saint-Hilaire over the theory of development, which had become acute just at the same time, that he completely mystified a friend who had come to see him by talking with the greatest excitement about the intellectual crisis when the friend was thinking of the political one. It seemed to Goethe an enormous descent to come down from the level of a great scientific and philosophical problem to a mere question as to the precise form of monarchical government which was to prevail in a certain country. To him the protagonists on the world's theater were not the Polignacs, the Periers, or the Metternichs of the hour, but the leaders of thought and the representatives of science. Goethe has been accused of lack of patriotism ; but we may put it to his credit that he was free from those sentiments of rancor toward foreigners which constitute so large a portion of the patriotism of the majority. In his predominant interest in large intellectual questions he was a type of the better mind of the future, and pointed forward to the time when science would become a missionary of peace and concord to the jarring nations.

Two generations have passed since then, and science has made advances which, could he have lived to witness them, would have filled the great German with gratification and delight. That it is sensibly drawing the nations together there is no doubt. Scientific workers in every field of research are stretching out, across seas and continents, hands of friendship and help to their fellow-workers in other lands. Literatures are national, broadly speaking, but science is necessarily international. There is but one set of natural laws for the universe ; and, broadly speaking again, the method of science is one. It follows that all who, the world over, are engaged in scientific work form but one army, one band, and move forward under one banner. This fact has been recognized by the formation of many international associations for the prosecution of different branches of scientific work. The physiologists, the psychologists, the criminologists, and several other sections of the great scientific corps have in this way organized for mutual assistance ; and it only remains to form one general international organization which shall in a manner preside over all the scattered provinces of science, and by its existence and activity give evidence to the world that science is one and that humanity should be one. We are glad to know that this important object is in a fair way of accomplishment. Next year the British and American Associations for the Advancement of Science will meet within about two hundred miles of one another, the one at Toronto and the other at Detroit; and it is expected that not only will the two associations contrive to meet and fraternize, but that steps will be taken toward establishing some bond of union between the two, and so preparing the way for a wider international organization. The scheme, it is further expected, will be followed up two years later when the British and French Associations will meet within about thirty miles of one another, one at Dover and the other at Boulogne; and if so a world meeting may possibly be arranged for the year 1900. Let science flourish, and let its influence over the nations increase ! It means love of truth; it means reasonableness and equity; and if these things be in us and abound, there can not be much room for international hatred.

COMPLETION OF THE SYNTHETIC PHILOSOPHY.

The publication of the concluding volume of Mr. Herbert Spencer's Synthetic Philosophy is an event of no small moment in the history of modern thought. No other doctrine of this or of any recent century has revealed so much in regard to the way in which organisms and institutions have come to be what they are as the evolutionary or synthetic philosophy has. Long before its great expounder had completed his presentation of it in the four fields of life, thought, society, and conduct, it had turned violent opposition into eager acceptance, and was being applied in countless researches, and was assumed as the only admissible standpoint for interpreting the past and predicting the future. The concluding division of his system deals with Industrial Institutions, and has been eagerly awaited with the expectation that it would throw needed light upon the industrial ferment of the times. This expectation it amply fulfills. Mr. Spencer's plan for a series of ten volumes in which the principles of evolution should be set forth with sufficient illustrative evidence was first issued in 1860. To do this work as he determined that it should be done was an immense undertaking, and he was further hampered at first by insufficient means, and throughout by seriously impaired health. That he has surmounted every obstacle and reached his goal may well inspire wonder, and notable too is the fact that his exposition has been completed substantially as proposed. Notwithstanding the progress of knowledge during the past third of a century, and notwithstanding, moreover, the widening of Mr. Spencer's own horizon, the plan that seemed good to the man of forty has proved acceptable to his riper self at seventy-six. Mr. Spencer is to be heartily congratulated upon the completion of his task, but more fortunate than he is the world that has received the benefit of his labors.

Scientific Literature.

SPECIAL BOOKS.

The trees, the author of this book * says, may be justly numbered among our best friends. But we need to know them better. "It is not enough to be able to distinguish an ash from a hickory or a fir from a spruce ; it is more important by far that we should become acquainted with the form and character of the leaves, the fruit, and the bark, and thus acquire a fuller knowledge of the way the tree lives. To *know* a tree is to become familiar with the purpose and condition of its life. This is revealed in no small measure by the leaves. The needle of the pine enables the tree to withstand a hurricane on a mountain top, yet its slender figure is perfectly adapted to the task of gathering light and air for the tree's life. The broad-leaved buttonwood would fall before the gale which the pine successfully weathers. Not less plainly does the diversity of character in a leaf reveal the diversity of the tree itself. No two leaves are exactly alike ; no two trees are exactly alike." Although, as he admits, it is not possible to portray all the beauty of a leaf with a pencil, the author has endeavored in this attractive volume to represent in outline the most characteristic features of the leaves of American trees, supplementing his pictures with such descriptions of them, and the trees to which they belong, with their habitat, as has seemed appropriate. Endeavoring to draw the leaves exactly as he found them, his two hundred and odd sketches were all taken from Nature, and only sixty of these from pressed specimens which were obtained at the Harvard Botanic Garden. "Yet I have found the world of truth and beauty, as far as leaves are concerned, so limitless that types and rules seemed valuable only as guide-boards are on a strange path." The botanical names are given, first from Gray's Field, Forest, and Garden Botany ; second, in conformity with a recent system of nomenclature instituted by Prof. C. S. Sargent. An introduction is contributed by Prof. L. H. Bailey. The sketches begin with a chapter on The Leaf as a Builder, in which the leading features of the endless variety in the forms of leaves are briefly described and illustrated, and the functions of the leaf in the tree's life are explained. The leaves as they are singly brought up are classified as simple alternate, simple opposite, and then as with or without teeth and their edges divided or not divided, compound alternate and compound opposite, and evergreen leaves. Of the genera that are portrayed are the magnolias, tulip tree and sassafras, witch-hazel, sorrel tree, elms, birches, alder, willows, poplars, hawthorns, oaks, dogwood, burning bush, maples, ailantus and locusts, sumach, walnuts, hickories, ash-leaved maple and ashes, horse-chestnuts and buckeyes, pines, spruces, hemlock, fir, larch, and arbor vitæ. An intelligible plan for leaf identification occupies one page. A systemat-

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* Familiar Trees and their Leaves. Described and illustrated by F. Schuyler Mathews. Pp. 320, 12mo. New York : D. Appleton & Co. Price, $1.75.

ical index of the trees of the eastern United States gives the common names and the botanical names according to Gray and Sargent, with the family to which each tree belongs.

This book* is not a description of scenery nor an account of Alpine adventures, but an inquiry into the agencies that have made Switzerland what it is. Its scenery, the author says, "is so greatly due to geological causes that it is impossible to discuss the present configuration of the surface without some reference to its history in bygone times. I do not, however, propose to deal with geology further than is necessary for my present purpose." He defines that purpose by remarking that during his holidays in the Alps "my attention was from the first directed to the interesting problems presented by the physical geography of the country. I longed to know what forces had raised the mountains, hollowed out the lakes, and directed the rivers. During all my holidays these questions have occupied my thoughts, and I have read much of what has been written about them." While the book, notwithstanding its somewhat clumsy construction, will be an acceptable one to every reflecting reader, it will be most welcome to one who is interested in geology. He need not be a geologist, nor much versed in that science, for the author has supplied a very good elementary geological introduction to the work, in which those geological points that have immediate application to the matter in hand are sufficiently explained. But he must want to know why such and such features are so, for that is what the book undertakes to tell. With such a mind, every student and tourist will find the book pleasant and profitable. First is given the geological introduction, with especial reference, of course, to Switzerland. Then the origin of mountains is discussed, and the general peculiarities of the mountains of Switzerland are noticed. The phenomena caused by the accumulation and action of ice and snow are considered, the former extension of glaciers, the origin and formation of valleys, the action of rivers, their directions, the character and origin of the lakes, and the influence of the strata upon scenery. Pursuing the study more in detail, attention is directed to the Jura, the central plain, the outer Alps, the central massives, the Lake of Geneva, the massive of Mont Blanc, the Valois, the Bernese Oberland, the upper Aar, Zurich and Glarus, the Rhine, the Reuss, the Ticino, and the Engadine, closing with a general summary of the geological history of Switzerland. A list of works and memoirs referred to is given in the appendix. The work is accompanied with more than one hundred and fifty suitable illustrations and an excellent map.

It is idle to speculate as to whether Herbart could have done the work in education that Locke or Pestalozzi did, but certain it is that, having the work of the older men to stand upon, he accomplished what they could not do. Herbart's service it was to unite into one system the grand isolated principles established by the pioneers of modern education. The volume before us† presents Herbart's ideas as set forth in seven of his essays, two

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* The Scenery of Switzerland and the Causes to which it is Due. By the Right Hon. Sir John Lubbock. Pp. 371, 12mo. New York and London: The Macmillan Company. Price, $1.50.

† Herbart's A B C of Sense-Perception and Minor Pedagogical Works. Translated, with Introduction, Notes, and Commentary, by William J. Eckoff. International Education Series, vol. xxxvi. Pp. 288, 12mo. New York: D. Appleton & Co. Price, $1.50.

of which discuss Pestalozzi's theories, and in his book, whose title is translated as Pestalozzi's Idea of an A B C of Sense-Perception investigated and scientifically carried out as a Cycle of Preliminary Exercise in the Apperception of Forms. In one of the essays he sets forth the insufficiency of empiricism in pedagogy, and draws an instructive parallel between tact and character; in another he insists that success in moral as well as in intellectual education depends on the proper psychologic grading of the training conferred. In still another he advocates many-sidedness in schools while at the same time showing the impossibility of satisfying all the "faddists," and follows this by demanding as much free time for the pupil as can be secured by economy of the working hours. His conception of pedagogy as a whole is laid down in the essay On the Æsthetic Presentation of the Universe as the Chief Office of Education. As to what constitutes presentation of the universe, his own words are "experience, human converse, and instruction taken all together." Conceding that the object of learning is doing, we must know what is right in order to do what is right, and besides this there must be the desire to do right. Knowledge and sympathy, then, are the two ends of the Herbartian pedagogy. In his discussion and extension of Pestalozzi's A B C of Sense-Perception, Herbart affirms that the cultivation of sense-perception falls within the sphere of mathematics, and that mathematical exercises afford the best means of holding the attention of the pupil. In discussing the exposition of mathematics for educative purposes, he declares that nothing seems to lie so nearly at the center of mathematics as trigonometry. Angles, then, should be the first subject for mathematical exercises. A section of seventy-seven pages is devoted to a plan of progressive exercises on triangles, or trigonometry. In a concluding chapter the value of a knowledge of triangles in the study of geography is pointed out, and the transition from the triangular form to the variety of forms in Nature and art is committed to the drawing-master. Wherever in the volume criticisms and expositions of Pestalozzi's work appear, it will be seen that Herbart does not seek to supplant Pestalozzi, but rather to supplement him. In the opinion of the translator, the American school system has had the benefit of Pestalozzianism, and is now ready for the further advance to be had from Herbartianism—in fact, has already entered upon this advance, although, he says, many teachers are guided by Herbart's ideas who never heard of him.

GENERAL NOTICES.

The rapid march of civilization during the past fifty years has left behind many of the old economic and political ideas. The new crop which has sprung up is not, as was perhaps to be expected, of uniform goodness; and many of them, born of demagogy and ignorance, are positively bad. Ill-considered legislation and mistaken notions of trade and finance have brought about conditions entailing much hardship on the poorer classes; and popular discontent, true to its paternal-government fetich, and constantly stimulated by that persevering animal, the social agitator, is loudly clamoring for "new laws." The most striking political fact during this period has been the growth of the democratic idea, and it is not perhaps surprising that this should be blamed for much of the difficulty. Mr. *Lecky's* book, *Democracy and Liberty*,* is a study of the growth of democratic tendencies, the effect which this growth has had on the treatment of the various economic and political questions, its dangers, ad-

* Democracy and Liberty. By William Edward Hartpole Lecky. New York and London: Longmans, Green & Co. 2 vols., 12mo. Price, $5.

vantages, and probable future, and a comparison of it with other forms of government, more especially parliamentary government with restricted suffrage. It is quite impossible in the space allowed a single review to give any adequate notion of the very wide field which is covered by these two volumes. The work opens with a consideration of English representative government in the eighteenth century, which, with a few modifications, seems to be Mr. Lecky's idea of the best form of polity. The growth of Rousseau's doctrines in France and England and a brief study of the French democracy are followed by about seventy pages on "American Democracy," which, while somewhat tinctured by the proverbial English ingenuousness regarding tales about the wild doings over here, point out the most pronounced of our political faults and weaknesses. Mr. Lecky sums up as follows: "American democracy appears to me to carry with it at least as much of warning as of encouragement, especially when we remember the singularly favorable circumstances under which the experiment has been tried and the impossibility of reproducing those conditions at home." Legislative changes in England, the Irish land question, and the various attempts to legalize attacks on property, successful and otherwise, are discussed in the second chapter. The influence of democracy on individual liberty is shown to be not uniformly favorable, and attention is especially called to the great danger of systems of class legislation, such as the income tax. Aristocracies and upper chambers are given considerable space, including an extended survey of the history of the English House of Lords. The changes which the growth of democracy has brought about in international politics are noted at some length, as is also its effect on religious liberty, Sunday legislation, and marriage laws. In commenting on socialism and labor questions, Mr. Lecky says: "But the proposed changes which conflict with the fundamental laws and elements of human nature can never in the long run succeed. . . . The essential difference of men in aptitudes, capacities, and character are things that never can be changed, and all schemes and policies that ignore them are doomed to ultimate failure." The changes which have taken place in the position and education of women are considered in the last chapter. Mr. Lecky thinks that, owing to their special interests, it is impossible to deny their claim to representation, and that if their demand for the suffrage prove growing and persistent, they will eventually obtain it. As is natural, most of the questions are considered mainly with reference to their bearing on the English polity; but they are questions common to all modern civilized societies, and Mr. Lecky's views, while not perhaps always tenable, are always deserving of attention.

Most of those who have tried it will remember that the study of psychology, aided by the ordinary text-books and carried on after the usual methods of the class room, was about the driest and in many ways the least agreeable of their school-day experiences. Indeed, the study was such uphill work, and had so little that was enticing about it, that the subject was usually put off until the latter part of the school or college course, when it was expected that the more mature minds, especially if backed by a fondness for the science, would be able to struggle through its puzzling abstractions. The book before us* is an attempt to place this study on a better footing. After teaching the subject for a number of years, the author became convinced that there are no such serious difficulties in its pursuit as has been supposed. He found that it can be made attractive, and that, when suitably presented, pupils of average intelligence have little trouble in grasping the essentials of the science. His book is the outcome of this teaching experience, and embodies the plan which the author found most successful in arousing the interest and reaching the understanding of the learner. This plan consists simply in an abundant use of familiar illustrations, with so much of anecdote and of the application of principles as will serve to hold the attention and give the mind of the pupil something tangible to work upon. The illustrative matter is drawn from a great variety of sources, and, as a rule, is very apt.

Mr. Halleck presents his subject from both the introspective and the physiological

* Psychology and Psychic Culture. By Reuben Post Halleck. New York: American Book Company. Pp. 368. 12mo. Price, $1.25.

side, and does not make the mistake of pinning his faith exclusively to one while sneering at the other. He begins by describing "the nervous mechanism at the disposal of the mind," for he regards an elementary knowledge of the action of brain and nerves as a necessary groundwork for the pupil's images of mental action. He then takes up the faculties of mind in succession—consciousness, presentation, representation, imagination, thought, emotion, and will. The several ideas that he sets forth under each subject are contained in distinct paragraphs, each with its own heading.

The scope of the book includes applied as well as pure science. The consideration of each of the faculties above mentioned is followed by a chapter or part of a chapter on the cultivation of that faculty. "Laws are of little use," Mr. Halleck believes, "unless they are applied; hence these chapters are of the utmost importance to all who have not passed the plastic age." He aims not only to show his pupils how the mind acts, but to aid them in making their own minds act more efficiently. The volume is indexed, and the chapter on the nervous system is illustrated with several well-executed woodcuts.

There can hardly be a volume in the Library of Useful Stories that will touch everyday life more closely than *The Story of a Piece of Coal* does.* In telling this story the author has so mingled scientific, technological, and general information about a familiar substance as to produce a remarkably readable little book—one that is instructive without being oppressively learned. He begins with an outline of what has been learned about the formation of coal from plants, and then tells how the coal beds lie among other rocks and what sort of animal remains are found between them. In the next chapter he shows the relationship between peat, lignite, bituminous and anthracite coals, graphite, and the diamond. Passing to the industrial side of his subject, Mr. Martin describes the coal mine and its dangers, the making of gas, and the preparation of those many valuable products derived from what was formerly the waste of the gas works. The derivatives of petroleum, which is closely related to coal, are also dealt with. How long the coal supply of the world is likely to last is a question that has been anxiously asked, and we find some interesting computations of the time in a chapter describing the distribution of the deposits. The closing chapter is devoted to the coal-tar colors, which were briefly referred to earlier in the volume. The thirty-eight illustrations show many of the plants and animals of the coal formations, and some of the structures and apparatus used in mining and gas-making.

President *Jordan*, of Leland Stanford Junior University, has collected into a volume * seventeen addresses relating to higher education which were delivered at college commencements and on other occasions. Several of them have already appeared in print in this magazine and other periodicals. In his address to the class of 1895 of Stanford University, which gives the title to the volume, President Jordan declares emphatically in favor of individual education. "A misfit education," he says, "is no education at all." A training that enables each man to give play to his strength is the best safeguard against the seeming predominance of the weak and ignorant in democracies. Among the subjects whose broad aspects are presented in one or another of these addresses are The Nation's Need of Men, The Higher Education of Women, The Training of the Physician, and The Practical Education. We find in these pages stimulating and luminous thoughts following each other in rapid succession. Thus in one place Dr. Jordan says, after giving words of encouragement to the poor student: "It is not poverty that helps a man. . . . It is the effort by which he throws off the yoke of poverty that enlarges the powers." In another place he warns against mistaking the "cant of investigation" for the true thing. As to a young man's chance for a career, he affirms: "If he can do well something which needs doing, his place in the world will always be ready for him." To

* The Story of a Piece of Coal. By Edward A. Martin, F. G. S. Pp. 168, 16mo. London: George Newnes, Ltd. Price, 1s. New York: D. Appleton & Co. Price, 40 cents.

* The Care and Culture of Men. By David Starr Jordan. Pp. 268, 12mo. San Francisco: The Whitaker & Ray Co. $1.50.

any teacher or student who has native vigor to be aroused, the volume can hardly fail to be an inspiration.

Mr. *Brown's* book* is a revision of his practical taxidermy, published some years ago, plus the results of his work at the Leicester Museum, which includes "new methods, most of which are absolutely novel and at present confined to the Leicester Museum." Although many of the processes are somewhat difficult, the aim has been to so arrange the work as to make its practical application by the learner as simple as possible. The introduction treats of the origin and progress of taxidermy, and the founder of taxidermy certainly Pleistocene in age, is shown to have been the man who first appropriated an animal's hide as clothing, the wearing of skins necessitating some sort of preparation, which may be fairly called taxidermy. The tools and methods used in taxidermy and modeling and the collection of specimens occupy the first four chapters. Then follow special chapters, one on mammals, one on birds, and one on reptiles. The remaining three chapters deal with modeling and artistic mounting. A number of excellent illustrations and a bibliography of the subject add value to the volume.

A magazine entitled *Public Libraries*, devoted to library management and news, was started in May with M. E. Ahern as editor and a strong list of contributing editors. It is to be issued monthly for ten months of the year from the Chicago office of the Library Bureau ($1 a year). Part of the first draft of a Library Primer, to be issued by the American Library Association, is printed in the first number for criticism and suggestions. Other features are news of libraries, library schools, and librarians; notes on reference books for library work; and practical hints.

Prof. *McMaster's* special qualifications, both as a historian and a writer, make his *With the Fathers* (Appletons, $1.50) not only very readable but exceedingly instructive. The volume consists of a series of studies in the history of the United States, all of which have appeared separately in the magazines. The topics treated are The Monroe Doctrine, The Third-Term Tradition, The Political Depravity of the Fathers, The Riotous Career of the Know-Nothings, The Framers and the Framing of the Constitution, Washington's Inauguration, A Century of Constitutional Interpretation, A Century's Struggle for Silver, Is Sound Finance possible under Popular Government? Franklin in France, How the British left New York, The Struggle for Territory, and Four Centuries of Progress.

Betrachtungen eines in Deutschland reisenden Deutschen (Reflections of a German traveling in Germany), by *P. D. Fischer*, is a small book but full. It presents in a succession of brief, terse essays outline descriptions of the various attractions which Germany offers to the traveler and student. These accounts are given under the headings of "How we travel in Germany," "What we can see in Germany" (scenery, people, industries, cities, estates, universities, authors, etc.), "Economical, Moral, and Social Conditions." (Published by Julius Springer, Berlin.)

The thirty-first number of the Standard Teachers' Library contains the *Questions and Answers in Drawing* given at the uniform examinations of the State of New York since June, 1892 (Bardeen, 50 cents). The large number of sketches to be copied with various modifications that are presented in these questions forms a notable feature of the book. The regulations concerning teachers' certificates in force August 1, 1896, are prefixed to the volume.

Prof. *F. Berger* claims as an element of superiority of his *French Method* (1896) over its rivals most in vogue that it takes up the verbs and the grammar at the beginning, introducing the pupil at once to the construction and phrasing of the language, as well as to the use of individual words. It does not, however, make the grammar predominant or teach it in a mechanical way like the old systems that lie unlamented in their graves, but, taking up the idea that inspired the systems that followed these, weaves it in with the life of the language as the pupil learns to use it in informal exercises or the informal turning of well-chosen and familiar

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* Artistic and Scientific Taxidermy and Modeling. By Montague Brown. Pp. 452, 8vo. New York: Macmillan & Co. London: A. & C. Black Price, $6.50.

phrases. The book is not large, and will not carry the pupil very far; but, as far as he goes with it, he will be on a solid foundation, and will know what he has learned. (The Author, New York.)

Guns and Cavalry, by Major *E. S. May*, R. A. (Roberts, $1.25), may serve as a text-book for military schools or find a place in the library of any one who has an interest in military affairs. Much of the matter that it contains has been given by the author in lectures at the famous English military school at Woolwich, but little, if any, of it is too technical to be appreciated by the civilian. The work is mainly devoted to the employment of horse artillery, and especially its co-operation with cavalry. The teachings of the book are illustrated by many details of historic battles, some of which are accompanied by maps, and there are sketches of the careers of noted European artillery officers, with portraits of several. In a closing chapter, on machine guns, the author cautions his readers not to expect from any mechanical contrivance what can be accomplished only by courage and skill.

The thirty-eighth volume of the International Education Series is a description of *The School System of Ontario*, prepared by the Hon. *George W. Ross*, Minister of Education for the province (Appletons, $1.50). It includes the general organization of the system, the regulations in regard to school premises, the training and qualifications of teachers, inspection, religious instruction, text-books, libraries, and the special rules concerning high schools and the provincial university. The book is far from being a mere compilation of laws. Thus, in the chapter on the general organization, the policy of having an educational system under the control of a political head is freely discussed, and in various cases the purpose of a regulation or the way in which it has proved to operate is given. Criticisms that have been made upon some features of the system are stated and answered. Since Roman Catholics are more numerous than Protestants in some localities in Ontario and in most parts of the adjoining province of Quebec, denominational schools are a part of the system. The first chapter and the last are historical, describing the rise and growth of Ontario's schools. The volume is offered to educators in the United States in the belief that they will be aided by a study of the plan for popular education that has been worked out by a people of similar origin with ourselves, but who have had a different history.

The *Fifteenth Annual Report of the United States Geological Survey* covers a year following one of reduced appropriations. In the preceding year field work was almost stopped, and the energies of the force were devoted to preparing accumulated material for permanent record or publication. The advanced condition of office work thus obtained and an increase of funds made it possible to prosecute a large amount of field work in the year 1893–'94, nearly all of which was tributary to the preparation of the geologic atlas of the United States. The reports of the director and the chiefs of divisions are accompanied by six papers: On the geology of common roads, by Nathaniel S. Shaler; the Potomac formation, by Lester F. Ward; the geology of the San Francisco peninsula, by Andrew C. Lawson; the Marquette iron-bearing district, by Charles R. Van Hise and William S. Bayley; granitic rocks in the Piedmont plateau, by G. H. Williams; and central Maryland granites, by C. R. Keyes. At the close of the year covered by this volume Major J. W. Powell retired from the direction of the national geologic work which he had carried on for a quarter of a century.

It is an unflattering illustration of the tone of our civilization that President Eliot should have felt called upon to argue seriously in his address at Chautauqua last summer and in the Atlantic Monthly that war is not desirable. The unreasoning outburst of indignation against Great Britain which we have witnessed during the past year does not speak well for the American balance of mind. These facts make peculiarly timely the publication by the Putnams in their Questions of the Day Series of *America and Europe: A Study of International Relations*, which contains three papers bearing directly upon these points by three eminent American publicists. In the first of these papers, The United States and Great Britain, Mr. David A. Wells shows—to our shame that it should be thought necessary!—that we ought not to hate England, and why; in the second—The Monroe Doctrine—Mr. Edward J. Phelps explains precisely what that doctrine is, and how it does not justify the vaporing which has recently filled our atmosphere; and in the third—Arbitration in International Disputes—Mr. Carl Schurz makes a powerful plea in favor of that principle which President Eliot makes the first among the five great American contributions to civilization.

The Home and School Atlas, by *A. E. Frye*, is intended as a reference book for both the student and the general reader. Its extension maps are well engraved and seem accurate. The relief maps, of which there is a full set, give one an unusually clear notion of topography. The differences in temperature, wind, rainfall, and agricultural products between various sections in the United States are also illustrated by means of maps. A useful pronouncing gazetteer and a list of "statistics of the world" add value to the volume. (Ginn, $1.15.)

The Oswego Method of Teaching Geography is the title of a little teachers' manual by *A. W. Farnham*. The method seems to consist in the main of suggestions to the teacher for interesting the children and expedients for making clear the chief elementary difficulties of the subject. Most of them seem such as any bright teacher would think of, and some are calculated rather to hinder than aid her work, as when, for instance, she is directed to explain the meaning of "down" by the phrase "in a descending direction," or "between" by "in the intermediate space of." The book, at the best, seems not a very necessary one. (Bardeen, 50 cents.)

A new edition of Bardeen's *Common-School Law* is at hand. The book is a valuable one for reference, the frequent reissues keeping it up to date. For this last edition the book has been entirely rewritten, some changes being made in the arrangement, and a new chapter on rules and regulations has been added. (Bardeen, $1.)

PUBLICATIONS RECEIVED.

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Fragments of Science.

Mental Overstrain in Education.—In a recent address before the British Medical Association, under the above title, Dr. G. E. Shuttleworth called attention to some of the harmful results caused by the undiscriminating educational methods of the public schools. He says: "With some so-called educationalists, I fear the idea still lingers that it" (education) "consists of cramming a mind with as much of as many subjects as possible. . . . A smattering of philology, however, will serve to show that the word 'education' means not putting in, but drawing out, and, bearing in mind the physiological interdependence of bodily and mental development, we may say that true education consists in processes of training which will produce in a given individual the most favorable evolution possible of all the faculties both of body and mind. A rational educational system will of course recognize the fact that all children are not cast in the same mold; that there are inherent, often inherited, differences in each pupil's powers, and that, to obtain the best results, instruction must be adapted to idiosyncrasies and proportioned to varying capacities. . . . From the medical standpoint we shall reply in the affirmative to the query of Plato: 'Is not that the best education which gives to the mind and to the body all the force, all the beauty, and all the perfection of which they are capable?' Overpressure in education may in brief be described as a neglect of the principles just set forth—a neglect which can not fail to lead to mental overstrain.

Thus a cast-iron code, imposing for each year of age a definite standard of acquirement, heedless of the varying capacities of children, could not fail to produce it. A disregard of physical conditions underlying mental evolution, and of critical epochs of development (especially in the female sex), affecting capacity for exertion, is another efficient cause, and the undue excitation of the unstable nerve cells of a child of neurotic heredity, to such a pitch of activity as might be harmless in a normal child, will, in the case of the former, be apt to constitute overstrain. Overpressure, indeed, is not an absolute quantity, but has to be estimated in relation to the personal factor in each case. It may, therefore, be defined in terms of educational work as that amount which in a given case is likely to produce excessive strain of the physical or mental system, or both. . . . It has been well remarked that puberty with girls is a period of profound nervous and neuro-psychological import. . . . Many a weak woman could, if she only knew, trace back her weakness to an overstrain at this period of life. There is too often a tendency to subject to serious and exhausting study girls of from twelve to fifteen years of age just at the epoch when they should have the minimum of schoolroom work and the maximum of outdoor exercise and recreation. . . . In these three points, then—(1) excessive hours of study, especially during spurts of growth and development, (2) deficiency of systematic outdoor exercise and recreation, and (3) disregard of physiological functions differentiating the capacity for work at certain times of girls as compared with boys—I think the high-school system needs amendment."

Effects of Labor Legislation.—The significance and tendencies of labor legislation are well summed up by Mr. S. N. D. North in his essay on Factory Legislation in New England, when he says that the whole subject has, in recent years, "shown the unhappy signs of a degeneration into a mere trial of strength between the employing classes and the organized trades-unionism of the operative classes. It has become the popular method of exploiting the assumed antagonism between capital and labor"; and the one certain result of the system as now pursued must necessarily be a constant increase in the intensity of that antagonism. There are also other dangers in such legislation, which the author only refers to. "The public at large has no apprehension of the present tendencies of this legislation. The lawmakers who pass these laws seem to have no well formed conception of their true scope, function, effects, and limitations. There is apparent no realization anywhere of the fact that they have profoundly modified not only the conditions of manufacturing, but the whole relationship between the State and the citizen engaged in business under its laws. There is underlying them a new doctrine of paternalism more extreme and more excessive than has shown itself in any other phase of democratic government; and the ultimate consequences of its indefinite development are beyond the reach of human ken." A West Virginia court has described them as laws which "assume that every employer is a knave and every employed man an imbecile. . . . There has never been any intelligent and comprehensive study by or in behalf of the State into the practical and economic effects of these laws; and there exists no exact knowledge on the part of those who make them whether they have not already been carried so far as to defeat the objects they are intended to promote."

The Plague of the Mongoose.—The mongoose (*Herpestes ichneumon*) was introduced into the West Indies several years ago as a remedy against the gray rats. It made way with the rats, partly, but not entirely, and still keeps them from multiplying, but has itself become a greater pest. It has nearly exterminated poultry and birds from the islands, is very destructive of turtles' eggs, and is a terror to young pigs, lambs, and kids; it devours all sorts of fruits, sugar cane, fish, wild game, lizards, snakes, crabs, and even extends its depredations to the provisions in the house. One or two species which the farmers valued as vermin-killers have been exterminated by them; consequently ticks are flourishing and increasing fast. The mongooses are exceedingly prolific, bringing forth five or six young at a litter—sometimes ten or twelve—and six or eight litters a year. They live in the hollows of trees and in old walls. They are very active and very intelligent, but their intelligence and activity seem to work always to the harm of the farmers and housekeepers. A merchant observed a venerable old mongoose in his warehouse, and set a trap for it. He put a hen's egg in a position to be well seen as bait, and under it concealed a spring trap, right in the animal's road. The mongoose burrowed under the trap, threw it out of gear, and managed so that the egg rolled down to him. Yet some mongooses are taken in traps, but not one in twenty of them are females. The females are too busy taking care of their families to be running round; and it is supposed that the males in their depredations, besides satisfying their own wants, provide for those of their mates at home.

The Sympsychograph.—The *Revue Scientifique* concludes a summary of Prof. Jordan's remarkable account of the sympsychograph in the September number of the Monthly with the remarks: "All this is very ingeniously constructed—text and photograph—and falls in no way short in logic and reasoning of the habitual lucubrations of the spirits: it is quite as plausible as a hundred stories that have been told to us in all seriousness. The only difference is that Mr. Jordan has been amusing himself, and his whole account is pure invention. The 'astral cat' exists only in his imagination, as the 'astral body' of the spirits is also undoubtedly imaginary; but Mr. Jordan knows this, while the spiritualists do not recognize it. As a satire the story is very amusing; but it is certain that some persons will take it seriously, and this will be not the least amusing thing about it."

The Fascination of Cycling.—In the effort to account for the absorbing and enduring pleasure of bicycling, which induces men and women to spin for hours every day over the same roads, with no apparent diminution of their enjoyment, M. Ph. Tissier adduces associations of ideas corresponding with the frequent and quick changes of attitude to which the wheelman is subject. There is a limit, however, to these changes of position, and it is not so far off but that they will become tiresome long before the bicyclist becomes in fact tired of wheeling. M. Ch. du Pasquier, in the *Revue Scientifique*, looks for the origin of the bicyclist's delight in the pleasure of motion, augmented by the rider's sense of control and mastery of the instrument and of himself. The experiments of Feré have proved that motion introduces very real effects into our organisms. It gives a kind of new force, and increases the effect of an excitant, in proportions bearing an approximate relation to its rapidity. This force-giving action explains many other things not otherwise accounted for—such as the pleasure of riding rapidly in a carriage, of getting up into a high place, and the delight we take in games of strength and skill, in agile exercises, wrestling, racing, combats, etc. The activity begotten of the exercise operates as a further stimulant; and so the rider goes on, with the breezes fanning his cheeks, his whole organization, as Gratiolet observes, "singing in various tones a hymn of satisfaction and joy," till he is in danger of exhaustion before he realizes that he is becoming tired. In this last condition lies the great danger of excessive cycling, which can not be too carefully guarded against. M. du Pasquier finds a serious defect in cycling in its monotonous character. It is far excelled, in his opinion, in variety of motions and tensions by horseback riding, tennis, and fencing, which, besides bringing all the muscles of the body into play, enforce the participation of the mind—of attention, judgment, and decision. The movement in cycling is stupidly regulated by the mechanism, which permits no further extension or flexion of the limbs or the body; the motions are all alike in infinite repetitions, at least so long as the "spin" endures. It follows that the mental action can not be very elastic and the mental images will not be lively or varied. The impressions the cyclist receives are correspondingly monotonous. Those thoughts can not produce anything of value which are occupied with the road that has been passed over, with the miles that are yet to be covered, and the time when the rider will get to his destination; which are intent on keeping the record he has made, or upon creating a new one. Feré's remark bears upon this point that "the effect of systematized excitation on a small number of ideas is always bad," and that it is not healthy for the mind to be inactive in other directions than that on which it is most intently bent. So much for "excess" in bicycling; for devotion to the machine for itself; for "scorching." But of moderate use of the machine, of its employment as an aid to other exercises and recreations, MM. Tissier and Du Pasquier would probably have, certainly ought to have, quite other views.

Cement as a Fire-proof Covering.—Mr. J. S. Dobie has recently published the results of a number of tests showing the effect of heat on cements. Tests were made upon pure briquettes and briquettes made up of sand and cement in various proportions. The briquettes were heated in a small assay furnace. The first thing noticed on removal from the furnace was a loss of weight, and the pure cement briquettes almost invariably showed extensive cracks. The loss in weight is due to the driving out of the water of crystallization, hardened cement consisting of hydrated crystals of aluminum and calcium silicate. After removal from the furnace, the briquettes were subjected to various tests, and in every case where the water of crystallization had been approximately all driven off the briquettes were unable to resist any load whatever. A high temperature was not necessary to destroy the strength of the cement. The lowest heat which could be generated by the furnace, considerably below red heat, was found to be as destructive as the highest temperature. The conclusions arrived at by Mr. Dobie were: 1. That while there is no doubt that a covering of Portland cement concrete will afford some protection to a metal column or girder, still there appears to be no doubt that the concrete itself will be ruined by the action of the fire, and will have to be removed as soon as the fire is subdued. 2. The concrete covering, if heated, will not stand the action of water. In a case of fire, when the hose is turned on, the water strikes the cement covering, probably red hot, and immediately cracks it off, leaving the ironwork bare. 3. In calculating for the design of the columns and girders, and especially for floors, no allowance should be made for the strength of the concrete, and the cement covering should be considered as so much extra load on the system. 4. That in a fireproof building floors should never be constructed of slabs of cement forming short spans or arches from girder to girder, without any support, and that these experiments indicate that the value of concrete as a fire-protecting material has been greatly overestimated, and that disastrous results may follow, from confidence in a building protected with such material.

Chinese Medicine.—The medicine of the Chinese is described by M. Paul d'Enjoy as being more serious, more widely extended, and further removed from superstitious practices than that of the other cognate peoples of the far East. The doctors concoct and sell their remedies, as well as prescribe them, provide themselves with luxurious shops, and use all the tricks of the trade to make their parcels attractive. Many of their remedies are administered in large, badly tasting pills, only slightly mollified in their flavor by licorice. These pills are inclosed in capsules of wax as large as pigeons' eggs, which preserve the compound from contact with the air, and are broken when the remedy is taken. Special preparations are sent out from the large shops of the principal commercial centers. Among the most popular of the specialties are the little brick-red cholera pills, composed of mangosteen bark and various tropical essences, such as santal, eaglewood, and calumba. The *Dau-nhu y* is a medicinal oil which produces excellent effects in headaches, and generally in cases of brain weariness of every kind. It is rubbed on the temples, and is inhaled by strong breathing, after having been rubbed upon the nostrils. Relief is obtained through the cold which its evaporation quickly produces. The basis of the preparation is camphor; and, as a whole, its effect may be compared to that of the headache pencils familiar in our drug stores. Chinese medicine is chiefly based on plants, and is taught in books which are often very ancient. In his practice the doctor strictly follows the methods of the master by whom he has been taught. With a very grave face, his eyes protected by large spectacles of thick glass, the old physician feels the pulse of his patient, and never fails to make him show his tongue. Next he examines his eyes, and asks a series of questions, the answers to which will help him out in his diagnosis. Then he writes his prescription on a sheet of rice paper and hands it to his pupil, who proceeds to compound it. Generally the prescription is made from the directions in some book, which are simply referred to by name or number. The pupil goes to the book for the directions. The seeds, herbs, leaves, and stems, the essences of which are to be combined to form the remedy, are generally weighed out or measured, and given to the patients with directions to boil them at home with a prescribed quantity of drinking water to a measure which is exactly indicated: "Put all these plants into an earthenware pot with a large glass of water and boil them over a bright fire down to a teacupful; then strain carefully and drink hot." The remedies are all taken in bed, and rest, or sleep, if possible, is recommended The potions as administered have very powerful effects.

Talismans.—The word talisman—a corrupted Arabic term, which has come to us through the Moors and France—means properly a figure or thing endowed with magical powers, which enables its possessor to summon supernatural beings to his aid, whether to defend him in a hard strait or to realize some great wish. The existence of such things is an Arab belief probably older than Mohammedanism, and has for its origin a profound Semitic belief in created beings of a much higher class than man, who might, under certain persuasion or compulsion, be induced to give him the aid of their loftier prerogatives. The superstition of talismans has been made familiar by the Arabian Nights, is probably as wide as the world, and lingers still, even among the cultivated classes of Europe, to an extraordinary extent. It is doubtful "if there is a dynasty in the West which does not possess some article—usually a jewel or a sword—which the vulgar believe to be its 'luck' or source of fortune, and which the owners themselves, while theoretically rejecting the belief as nonsense, would be vexed to the very heart to lose. . . . The relation of the picture, usually the founder's portrait, and the sword to the founders of the house has, indeed, passed into literature, and is one of the few bits of supernatural machinery which do not excite the ridicule of modern readers." Seeking its mental origin, a writer in the London Spectator finds that it is utterly opposed to the spirit of all the greater creeds, which, except perhaps Hinduism, make fortune dependent on conduct or the favor of the Almighty, or both. "There is, no doubt, in Hinduism a lurking idea, to which a profound student of the East like Sir Alfred Lyall attributes great importance, that any inanimate thing which is exceedingly odd or separate must be in some sense divine. The notion is that Nature produces only the usual, and that everything unusual must be the product of special interference from the creating power, and therefore possess some portion of the divine spirit, or at least some influence emanating from an unusual source." This does not account, however, for the prevalence of the idea in Europe and among people of a skeptical turn. There is nothing like the notion of consecration connected with the talisman—it may even be supposed to have come from the devil—nor is there anything in the idea akin to astrology. The writer we have cited suggests that the origin sought for may lie in men's "lingering belief in Destiny as a force apart from Providence, a power having its origin, not in design, but in the very nature of things. . . . If a man thus believing that Destiny pursues him for good or evil once admits the idea, however irrational, that an inanimate substance is connected with his destiny, the substance becomes the 'talisman' of which we have been speaking, and he can not endure either to lose it or to see it injured. His brain may reject the superstition with utter scorn, he may even be angry with himself for giving it five minutes' attention, but an inner faith in it—if we may so desecrate the word 'faith'—as strong as the faith of some men in omens, forbids him to disregard the 'talisman.' The faith again would, of course, like the faith in omens, be greatly strengthened by accidental coincidences, but it survives the want of them, and sometimes, we suspect, the occurrence of events entirely at variance with the secret belief."

Science-Teaching in Secondary Schools.—The summaries of a series of conferences concerning teaching in secondary schools held in 1893 under the direction of the National Council of Education, and published in the last report of the United States Commissioner of that department, contain valuable suggestions on the teaching of mathematics and the sciences. The conferences consisted each of ten members, selected on account of their scholarship and experience, and discussed the questions submitted to them with much thoroughness. The conference on mathematics recommends that the course in arithmetic be at once abridged by omitting the subjects which perplex and exhaust the pupil without contributing valuably to his mental discipline, and enriched by a greater number of exercises in simple calculation and in the solution of concrete problems; that instruction in concrete geometry, with numerous exercises, be given in connection with drawing; and that in demonstrative geometry, as well as in all mathematical teaching, great stress be laid on accuracy of statement and elegance of form, as well as on clear and rigorous reasoning. In physics, chemistry, and astronomy the conference urges that the study of simple natural phenomena be introduced into elementary schools, and that at least one period a day from the first year of the primary school should be given to such study; emphasizes the necessity of a large proportion of laboratory work in the study of physics and chemistry, and advocates the keeping of laboratory note-books by the pupils, and the use of such note-books as part of the test for admission to college. More work, it is held, is required of the teacher to give good instruction in the sciences than to give good instruction in mathematics or the languages. The conference on natural history advises that the study of botany and zoölogy be introduced into the primary school course, and be pursued steadily, with not less than two periods a week, throughout the whole course below the high school. In the early lessons no text-book should be used, but the study should be constantly associated with the study of literature, language, and drawing. Physiology should be postponed till the later years of the high school, and in the high school some branch of natural history proper should be pursued every day throughout at least one year. The value of laboratory work and of the cultivation of exact, elegant expression in description is again insisted upon. The most novel suggestions are given in connection with the teaching of geography, of which the conference takes a far more comprehensive view than the usual one, and which it evidently regards as including the whole physical environment of man, and as requiring a knowledge of many of the elementary facts of the other subjects. Meteorology may be taught as an observational study in the earliest years of the grammar school.

Hereditary Crime.—An interesting investigation is reported by Prof. Pellmann, of Bonn University (Germany). He has made a special study of hereditary drunkenness, which, in the case of a certain Frau Ada Jurke, he followed through several generations. She was born in 1740, and was a drunkard, tramp, and thief for the last forty years of her life, which ended in 1800. Her descendants numbered 834, of whom 709 have been traced in local records from youth to death. Of the 709, 106 were born out of wedlock. There were 142 beggars and 64 more who lived upon charity. Of the women, 181 led disreputable lives. There were in this family 76 convicts, 7 of whom were sentenced for murder. Prof. Pellmann says that in seventy-five years this one family rolled up a bill in the almshouses, trial courts, prisons, and correctional institutions of $1,250,000. With such a record before it, the state seems justified in adopting measures for preventing the breeding of such characters.

The Newspaper and Periodical Industry.—A recent article in the Hartford Times gives some interesting semi-statistical figures regarding the newspaper industry in the United States. It estimates that there are about 2,100 daily and over 1,100 weekly newspapers and periodicals published in the United States, besides the hundreds of monthly magazines, reviews, and trade journals. "It is probably a low estimate to say that there are 100,000 men and women occupied in their production. Adding to these figures the people employed in the various printing establishments and publishing houses, we should have a total of about 250,000, and including those dependent on them, probably more than a million of the population who are thus supported. Nearly every newspaper has one or more presses, costing thousands of dollars each; $50,000,000 would not begin to pay for the printing presses now in operation in the United States. We are within bounds in estimating the daily issues of the newspapers in the United States at more than 20,000,000 copies. If the publishers receive on the average as much as five dollars per year for their circulation from each subscriber or patron, we have more than $100,000,000 paid in from that source. Giving the weeklies an average of only 2,000, and we have nearly 25,000,000 subscribers to them, and at the average price of one dollar there is $25,000,000 more. We should think the total receipts from sales and subscriptions over rather than under $150,000,000. Now we come to the matter of advertising, which is probably nearly twice the amount paid in subscriptions—nearer $300,000,000 than $200,000,000. If it is only $250,000,000, we have an aggregate of $400,000,000 passing over the counters of the newspaper offices of the country each year."

MINOR PARAGRAPHS.

Gelatin has the curious property of becoming insoluble and stiff when exposed to formic aldehyde, while it resists the action of water, acids, and alkalies. In this stiffened condition it is like celluloid without being inflammable. Advantage is taken of this property in making statuettes and trifles of the carver's art. To make these objects, gelatin, having stood overnight in water, is melted in the marine bath, then mixed with formic aldehyde, and poured into molds of plaster, clay, or metal, cooled, and, when taken out of the mold, dipped in a concentrated solution of formic aldehyde, or, if large, painted with it. The transparency of the gelatin is remedied by adding, previous to molding, a little zinc white in water and alcohol, with which, if it is desired, coloring substances may be incorporated.

Twenty or more industries are enumerated in the report of a committee appointed by the British Home Secretary to inquire into the subject as "dangerous trades." Each of them has its special risk, ranging from discomfort that ultimately works harm to immediate peril. In the manufacture of India rubber the constant and all-pervading presence of naphtha, in which all the material has to be dissolved, is an effective agent of mischief. Still, no special illness is known to be produced by the fumes of naphtha, but, besides being unpleasant, they tend to undermine the constitution. The bisulphide-of-carbon process for vulcanizing India rubber is more positively dangerous, and sometimes, according to the report, leads to insanity. Other dangerous trades mentioned are that of "dry cleaning," in which fire and the inhalation of volatile spirits are elements of peril; working in bronze, which induces skin disease and slow poisoning of the system; mica-dusting, at which a boy seldom continues more than six weeks; and the manufacture and use of inflammable paints.

In order to determine whether calm sea air contains appreciable quantities of salt, M. E. Chaix, of Geneva, visiting the island of Jersey, drew air in quantities of one thousand litres at a time and stirred it in a solution of nitrate of silver. The solution was not made turbid in any of the experiments. The air, therefore, held no salt. Hence it seems certain that all the salt that may be floating in the atmosphere is that derived from the spray blown in by the winds and held temporarily in mechanical suspension. It does not volatilize in the air, and never becomes a real constituent of it. Persons going to the seaside "for the sake of the salt air" would therefore do well to avoid the calm, quiet places, and seek those which are more or less windy.

Believing that the current estimates of the velocity of flight of pigeons were not founded on sufficiently accurate data, Mr. C. B. Keene adopted the plan of having the birds released at a given distance away and a given moment, and observing the time of their arrival at their home. He found that, while some birds could maintain a speed of about 1,170 yards a minute, the speed of the majority, or 73 per cent of those observed, was between about 860 and 1,170 yards a minute. The highest speed observed by him of young pigeons was about 1,362 yards a minute. M. Felix Rodenbach, who has also made careful observations, believes in the possibility of pigeons flying 72 miles an hour. Observation shows that they fly perceptibly faster than the best express trains. Their speed, in M. Rodenbach's view, is even much greater than it appears; for they can not fly in a straight line as the express train runs, but are obliged to make zigzags and detours, as they meet or are turned by varying currents in the air.

The Gas Exposition to be held in Madison Square Garden during the two weeks beginning January 25, 1897, will be the first affair of the kind attempted in this country, although such displays are a regular feature of the year's entertainments in some European countries. The exhibition will be managed by a board of directors composed of men well known in the commercial and financial world—many of them connected with gas enterprises, and some distinguished in science and public life—assisted by an executive committee. It is represented that a large and increasing interest is being taken in the project by men and firms whose co-operation is desired, and who might be counted upon to become exhibitors. It would be impossible to name all or even a considerable fraction of the features which could find an appropriate place in such an exhibition. Great improvements are being made in the use of gas for light and fuel and the appliances, and these will, of course, be shown.

Mr. Amos W. Butler, the well-known ornithologist, gives, in his address as retiring President of the Indiana Academy of Sciences, an interesting and valuable contribution to our knowledge of contemporary evolution. The address, published by the Academy, treats of "a century of changes in the aspects of Nature" in Indiana. The disappearance of the great forests, the extinction of the Indian and the large mammals, have been accompanied by corresponding changes among the smaller animals. Especially notable has been the loss of the hosts of passenger pigeons. In the days of Wilson and Audubon the sky was literally dark with these. Now the species is but a memory, so far as Indiana is concerned. The future will record changes as the past has done. "But at no time in the future will the changes in the aspects of Nature be so noticeable, so incomprehensible, because of their vastness, as have those of the century just closing."

Following the protest which some time ago appeared against the illustrations of impossible icebergs comes one against impossible volcanoes. Mr. Oliver C. Farrington writes to Science, sending a reproduction of a school geography's picture of Popocatepetl, and by the side of it an outline of the actual mountain. The difference is quite startling. The slope of Popocatepetl was found by Mr. Farrington to be never more than 30°, while the picture represents a snow-capped peak with a slope of from 40° to 50°. "A tall cross, such as no traveler in Mexico ever saw, and luxuriant palms, such as never grow at the altitude from which Popocatepetl can be seen," furnish a fitting foreground.

NOTES.

The experiment of planting and raising Eastern oysters in the waters of Los Angeles County, California, was tried in 1892, when three hundred pounds of spat or seed oysters were planted at Alamitos Bay, near Long Beach Park, and at the mouth of New River. At the end of 1894 the oysters of this plantation were as large as those of the same age raised in the East. The oyster ground embraced the whole of Anamitos and Anaheim Bays. The outlook for the industry was hopeful, and no starfish or carnivorous shellfish had been detected among the beds. Mrs. M. Burton Williamson, who has published an account of this plantation in the Annual of the Historical Society, suggests that the shipment of Eastern oysters may also result in planting the fry of other shellfish from the East in the bay. *Mya arenaria* and *Urosalpinx cinerea* are now propagated in San Francisco Bay from seed brought with Eastern oysters.

Topazes are found in the tin-bearing alluvions of the river Tjenderiang in the kingdom of Perak, Malacca, absolutely colorless and perfectly transparent, measuring from one centimetre to three centimetres and a half. Sometimes they are rolled, when their faces are dull, but the number of intact crystals is large enough to justify the supposition that their original site is not far away.

The recent conference held in London, for considering the question of forming an international catalogue of scientific literature, should have very important results. Men of science recognize, as Prof. Mach, of Germany, said, no distinction of race or nationality, and they were glad, he added, to co-operate with Englishmen in a work in which all men of science were interested. The cataloguing of general scientific work, as it at present stands, is not at all satisfactory, and the adoption of a general system, by the scientists of all countries, which seems likely to follow the conference, will undoubtedly be a long step in advance.

The excessive cost of the rare earths used in the composition of the Welsbach and other incandescent gas mantles has led to the formulation of a process by which the residues of the old mantles can be reduced, separated, and used again repeatedly in new mantles. The process consists in reducing the mantles with ten times their weight of bisulphate of sodium, taking up the product in water, and adding excess of oxalate of ammonia to redissolve oxalates of thorium and zirconium, while the oxalates of cerium, lanthanium, erbium, and yttrium remain insoluble. The liquor is then filtered, the undissolved oxalates remaining on the filter. The residue is then treated with concentrated hydrochloric acid to obtain the oxalates of thorium and zirconium.

The supposition that by comparing numerous elements in different myths, and thus discovering that many are identical, a common origin is proved, was treated as a fallacy by Dr. Brinton in a paper read before the American Association. The method in question, Dr. Brinton held, does not take into account the essential unity of the human mind, wherever it may be, and the laws that govern its activity. Because of the tendency of the mind, everywhere and in all conditions, to act in the same manner, we find myths of similar character in all parts of the world. They may therefore be very similar, and yet very diverse in origin.

A series of fifteen terminal moraines was described by Mr. F. B. Taylor, in a paper read in the American Association, as lying between Cincinnati and the Straits of Mackinaw.

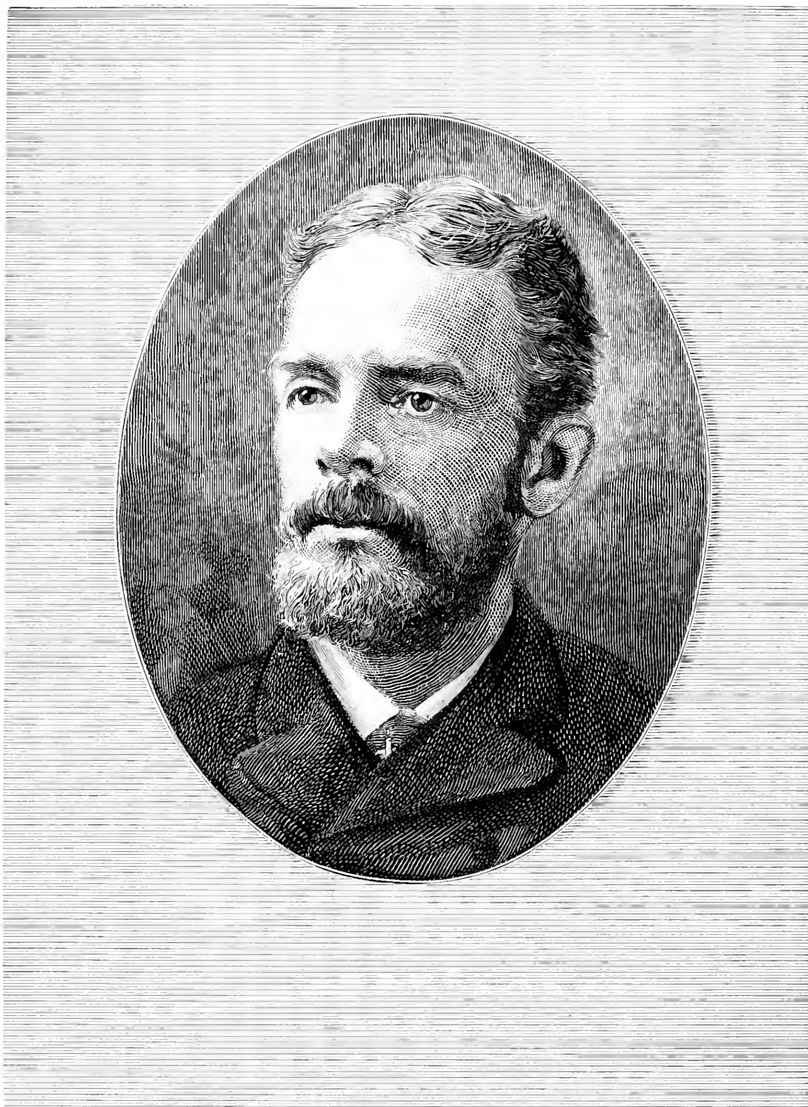
The cultivation of flowers for export and for the perfumery factories at Grasse is an important industry on the Riviera. It is officially estimated that the value of flowers annually exported from Nice, Cannes, Beaulien, and Mentone is six hundred thousand dollars.

Prof. Josiah Dwight Whitney, of Harvard University, one of the most eminent of American geologists, died at Lake Sunapee, N. H., August 19th, in his seventy-seventh year. He was born in Northampton, Mass.; was graduated at Yale in 1839, and, after spending about twenty years in various geological surveys, was appointed Professor of Geology at Harvard in 1864. His geological work began in service as assistant geologist in New Hampshire, subsequent to his graduation, after which he traveled and studied in Europe. In 1847 he engaged, in connection with John W. Foster, in the Government survey of the Lake Superior region, the published result of which, Foster and Whitney's Report, was a famous book in its day and long the chief authority. He next spent two years in the examination of the mining and mineral resources of the States east of the Mississippi, and published The Metallic Wealth of the United States in 1854. He next became State Chemist and professor in the State University of Iowa; made a geological survey of that State; surveyed the lead region of the upper Missouri, in connection with the official surveys of Wisconsin and Illinois; and from 1860 till 1874 conducted the topographical, geological, and natural-history survey of California, publishing the results in more than six volumes. He translated the Use of the Blowpipe of Berzelius, published a Yosemite Guidebook, and contributed much to scientific and other periodicals. Mount Whitney was named after him. He was a brother to William Dwight Whitney, the philologist.

Among the results of the measurements of the velocity of rotation of the planets by the spectroscopic method reported by Prof. J. E. Keeler to the British Association is the observation that the inside of Saturn's ring moves more quickly than the outside, and consequently that the constituents of the ring do not obey Kepler's third law. These constituents are therefore not solid particles, a fact which has been previously established by other methods.

Mr. William Crawford Winlock, assistant in charge of the office of the Smithsonian Institution, died at Bay Head, N. J., September 20th, in his thirty-seventh year. He was a son of Prof. Joseph Winlock, first Director of the Harvard Observatory and Superintendent of the American Ephemeris and Nautical Almanac, and inherited a fondness for astronomy from him. He was appointed curator of international exchanges and afterward assistant in charge of the office of the Smithsonian Institution; prepared the Annual Reports on the Progress of Astronomy from 1885 to 1892; contributed articles on astronomy to various periodicals; and represented the Secretary of the Smithsonian Institution at various scientific meetings, including the centennial anniversary of the American Philosophical Society.

Dr. H. Newell Martin, ex-Professor of Biology in Johns Hopkins University, died in Burley, England, October 29th, in the forty-ninth year of his age. He was born in Newry, Ireland; was a fellow of Christ College, Cambridge, where he received the degree of A. B. in 1879, and that of A. M. in 1877; and was appointed to the professorship in Johns Hopkins on the recommendation of Prof. Huxley. He retired from that position in 1893 on account of ill health.



GEORGE BROWN GOODE.

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PRINCIPLES OF TAXATION.

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V.—LIMITATION AS RESPECTS INSTRUMENTALITIES BY WHICH TAXATION IN A CIVILIZED STATE EFFECTS ITS PURPOSE.

ATTENTION is next asked to the instrumentality by which taxation subserves the necessities of the state and enables it to effect the purposes for which it was instituted. The designation of this instrumentality is "revenue," as is indicated in the phrase "tariff (or taxation) for revenue." But the term "revenue" is abstract and most indefinite, and as popularly used conveys little meaning other than a receipt of something of value. In rude or incipient forms of government, where tribute or taxes were payable in cattle, skins, cocoanuts, salt, grain, and the like, the term might be fairly interpreted as an income of property in general. But in a *highly civilized* state such a meaning is inadmissible. The government of such a state obviously could not defray its varied expenses by payments with various articles of property, even though their value may be unquestioned—as, for example, its executive with fish, fresh or salt; its legislators with distilled or fermented liquors; its judges with boots and shoes; its soldiers and sailors with cotton or corn; and its clerks with agricultural implements—even though the producers of all these forms of wealth or property may be most willing to give them in discharge of their tax obligations.* In such a state revenue has

* In ancient times cattle were regarded among nations of a considerable degree of civilization as standards of value, and obligations to government in the nature of taxes were payable therein. As recent, moreover, as 1758 taxes in Virginia and Maryland were pay-

and can have, therefore, but one meaning—namely, *money;* because money is the indispensable and practically the only means of defraying the expenses of the state and efficiently administering its government; and taxation is the process by which the state obtains money from its citizens, who in turn obtain (as before pointed out—see Chapter III) it in exchange for some product of their labor or for some direct personal service. In short, money is an expedient that finds its sole justification in its adaptation to a special purpose.

At the same time it is important to bear in mind that the raising or procurement of money with the view or purpose of accumulating wealth is not a legitimate function or object of civil government.

This point, which, stated and regarded as an abstract proposition, may seem to the reader as a matter of interest but of little practical importance, finds a very interesting and most instructive exemplification in the recent attempt to govern South Africa by means of a chartered company—"The South African Company." The attempt failed by the confusing on the part of the company of two things which are absolutely irreconcilable and ought never to be associated—namely, the prerogative of governing men on the one hand and the desire of making money on the other. This the company in question attempted to do by taxing the inhabitants of the territory embraced in its charter for the purpose of making dividends for shareholders, who as a rule did not live in the country, but mainly in England. The result has been a thoroughly vicious and intolerable form of government, one which "has operated to deaden the sense of responsibility among the rulers, who are here to-day but are gone to-morrow, and answerable to nobody but the company."

Now, if these premises are correct—and it is difficult to see how they can be disproved—it would seem to follow that to seek to make taxation, which is a fit contrivance only for raising revenue, an instrument for effecting some ulterior purpose, be it never so just and legitimate, to seek to use it for the attainment of any other advantage than the obvious one of raising money, is to lose sight of a fundamental principle of every free government and to forbid all expectation of recognizing any other basis for the exercise of this great sovereign power of the state than expediency, which in turn will depend upon the actions, passions, and

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able in tobacco; and in Massachusetts, Indian corn, musket balls, dried peas, cattle, and beaver skins were made legal tender for the payment of taxes until the early years of the eighteenth century. Ultimately, and in all cases as civilization advanced, such media for the payment of taxes, or the discharge of other forms of indebtedness, have been found to result in terrible currency confusion and to be wholly impracticable.

prejudices of legislators, who may not be the same in any two successive legislative assemblies.

Such a perversion of principle, furthermore, reaches its climax of absurdity in practice when its immediate beneficiaries claim to be the only proper persons by whom the incidence and amount of taxation can be intelligently determined—a claim that is practically equivalent to the assumption that privilege should take precedence of rights in the theory of government.* And yet there have been but very few of the revenue enactments in recent years of the Federal Government of the United States that have not only indorsed the rightfulness and desirability of such claims, but have made them the basis of most important legislation.

As this subject has hitherto received but little attention from legislators and the legal profession in the United States, the following citations from recognized American authorities are most pertinent in this connection:

"A burden laid not for the purpose of producing revenue, but in order to accomplish some ulterior object which the General Government lacks the power otherwise to accomplish, comes under no definition of the word "tax" which is recognized in public law. It demands no contributions for the service of the state; it adds and is expected to add nothing to the public revenue. It annihilates that upon which it is levied, and it differs from confiscation only in this: that confiscation seizes something of value and appropriates it to the needs of the Government, thus making it useful, while this seizes it for the purpose of destruction."—*Cooley, Law of Taxation, p. 75.*

"One grievous invasion of property—and of course ultimately of labor, from whose accumulations all property grows—is by Government itself, in the shape of taxation for objects not necessary for the common defense and general welfare. Men have a right not only to be well governed, but to be cheaply governed—as cheaply as is consistent with the due maintenance of that security for which society was formed and government instituted. This, the sole legitimate end and object of law, is never to be lost sight of—security to men in the free enjoyment and development

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* In popular discussions of tariff revisions in the United States such a claim has actually been advanced by the representatives of interests in whose behalf certain imposts had been specially enacted, and which were not for purposes of collecting but rather for the prevention of revenue.

"It is not claimed that this statute [McKinley Tariff Act], any more than any other human ordinance, was perfect in its details, nor that all its rates of assessment of duties should have been maintained, but the modifications suggested by time and experience should have been left to the friends of the measure."—*Letter of the Hon. L. P. Morton, accepting nomination for the office of Governor of New York, October 9, 1894.*

of their capacities for happiness—security: nothing less, but nothing more."—*Sharswood, Legal Ethics.*

"To the extent that the mass of our citizens are inordinately burdened beyond any useful public purpose and for the benefit of a favored few, the Government, under pretext of an exercise of its taxing power, enters gratuitously into partnership with these favorites, to their advantage and to the misery of a vast majority of our people."—*Message of Grover Cleveland, President of the United States, December, 1888.*

Taxation for Revenue only. What does it mean?—It is essential to the completeness of this discussion to call attention at this point to the circumstance that a full recognition and rigid adherence in practice by a Government to the principles of taxation above shown to be fundamental, will not interfere with or impair the efficiency of its administration. The raising of revenue (money) by taxation is one thing; the determination of how the revenue collected shall be used or expended is quite another thing; and the danger line to the liberties of the people is crossed when these two functions are confounded. The exercise of the first, as already pointed out, is subject to limitations growing out of the conditions essential to the existence of a free Government. The determination of the second rests primarily in the legislative department of such Government, and is subject to no legal limitations in the United States other than what flows from the oft-repeated *dicta* and decisions of its highest judicial authorities, that money taken out of the pockets of the people by taxation can not be used (expended) for any other than a public purpose; but what constitutes a public purpose is so indefinite that one eminent jurist, especially versed in the subject, has declared that "there is no such thing as drawing a clear line of distinction between purposes of a public and those of a private nature." *

If a state, therefore, in the plenitude of the wisdom of its legislators, desires to interfere with the operation of the laws of trade, domestic or foreign, control the preferences of its citizens in respect to production or consumption, repress one form of industry and stimulate another, and discourage even to prohibition the indulgence of such tastes and passions as it may judge to be detrimental to itself or the individual, it may legitimately exercise functions entirely different from that exercised in raising revenue and governed by entirely different principles. The right to regulate trade and commerce and the power of police are entirely independent of the right to raise revenue.

If the state, in providing itself with what it regards as necessary revenue, levies its taxes in such a manner that no citizen is

* Cooley, Law of Taxation, p. 70.

required to pay more or allowed to pay less than his just proportion, then there is no tyranny in taxation, even if the methods employed, without any such intent, may incidentally promote private interests and sumptuary purposes. But if, on the other hand, a just and equitable method of taxation will not promote these purposes, and, as usually the case, the state resorts to methods that are not just, not equitable, and imposes upon some citizens an undue share of the general public burden, then to that extent taxation becomes tyrannical, and can not be justified except upon the assumption that there is no limitation on the right of a state to interfere with individual rights to property; which is the same thing as asserting that the state in question is not "free," but is a "despotism." In short, the proposition would seem to be clear that the state can not, without violating that simple principle of justice which prescribes equality in taxation, use its taxing power for effecting any other purpose whatever except to raise money.*

The principle here involved may be further illustrated by reference to a curious chapter of railroad experience. Some years ago the managers of one of the great railroads of the United States appropriated a part of its receipts from the carriage of freight and passengers to the support of an opera house and a corps of ballet dancers. Extraordinary as was this procedure, there was no question that the directors, who were trustees for the stockholders, had the right to determine how the earnings of the road should be applied, so long as the stockholders failed to restrain them or prevent their continuance in office; and as they did not, no legal action or restraint of their singular use of the receipts of the property was attempted. But if these same directors had decided not to take money directly from the aggregate earnings of the railroad for the furtherance of their peculiar views, but that in addition to certain rates for transportation all passengers and freight should pay a special sum (tax) for the support of the opera house, the state would have undoubtedly and properly intervened and forbidden its collection, on the ground that the railroad was not chartered (called into existence) for any such purpose, and that the attempt to use any power other than what was granted or contemplated in its charter was illegal and unwarranted.

Again, if the legislative department of the state decides that

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* A legal writer of eminence (Justice Cooley) has recently contended that this is not a correct view, for the reason that it is one which finds no "countenance in the practice of our Government, or indeed that of any other." But if this contention is valid, then it may be pleaded with equal effect for the justification and continuance of every practice which old-time views and long usage have tolerated, but which a higher civilization or a broader culture demands shall be abrogated.

it would be expedient to establish or stimulate the manufacture of certain commodities, no one under a free government would venture openly to justify such action, except on the ground that public welfare would be thereby promoted, although practically such justification in the United States has long since ceased to be other than a pretense and a cover for the promotion of private interests. Suppose, for example, that the manufacture of the commodity which it is proposed to stimulate is tin plate, and it is decided that the desired result can be best attained by giving the domestic manufacturer the difference between what his product will sell for in a free market and what he can make it for—say fifteen million dollars per annum—it would seem to be only simple justice that the state should fairly and honestly pay the sum representing this difference, and raise the money,* not by a tax on the consumers of the product artificially maintained, who are no more interested in the matter than all other citizens, but by a levy upon the community at large, in the same equitable manner as it raises money to defray its other expenses. In short, if any industry can not live without state aid, and it is for the public welfare that it should live, let the state directly subsidize it, and not maintain it by allowing private interest arbitrarily to exercise the great sovereign power of taxation.†

* A written public statement made by a Senator of the United States (George F. Hoar), in 1892, that an assertion by the National Democratic party of the United States in its presidential platform of that year that "the Federal Government has no constitutional power to enforce and collect tariff duties except for the purpose of revenue only," was equivalent to an unveiling of an opinion that "the American people alone, of all civilized nations, have no power to do anything for the encouragement of their own industries," displayed an amount of ignorance and misconception of the powers and objects of the Government he served which, to say the least, was discreditable to its author.

† "Granting that it is expedient for the Government to spend money in the maintenance or the promotion of the iron manufacture, for example, it must be expedient also that the public should know the exact amount which it costs annually, just as it is expedient that the public should know exactly how much the army and navy costs, or how much the annual improvement of rivers and harbors costs. No view, however broad, of the province of government can furnish an excuse for concealing the expense of any great national undertaking. . . . But there is no trace of this expenditure in the national accounts. . . . Next, it must be said that any fund of large amount, raised and distributed in this way, must of necessity prove a corruption fund. By this I do not mean a fund distributed in bribes to individuals or organizations, but a fund the existence of which must be constantly present to the mind of the lazy, the improvident, or incompetent, as something to fall back on if the worst come to the worst. Suppose the national appropriations for the purpose of protecting manufacturing industry were made in the ordinary way by a distinct vote of Congress; were made, for instance, as the appropriations for the promotion of the carrying trade—the steamship subsidies, as they are called—are made in the shape of an annual maximum sum. Suppose this sum were paid over to the corporations or individuals engaged in each manufacture on their giving proof that they were carrying on a *bona-fide* business. Suppose that to each were given as much as would meet the loss, as shown by his books, incurred by him in competing with foreigners in the home markets. . . . The

This was the idea of Alexander Hamilton, who in the early days of the republic favored state interference with the pursuits of the people to a large extent, as the best method by which domestic manufacturing should be stimulated by the state. This idea, however, found no more favor with the parties specially interested at that time than it would at present; inasmuch as a brief practical experience would so soon demonstrate the smallness of the revenue necessary to be raised by honest taxation for the direct maintenance of an industry by the state, in comparison with the amount raised, for the most part by inequitable and unjust taxation for the support of that form of interference by the state with production which goes under the name of "protection," as to make any long toleration of the latter policy by a free people exceedingly unlikely.

Generic Difference between the "Taxing" and "Police" Powers of the State.—Attention is next asked to the generic difference between the "taxing" and "police" powers of the state (to which a brief reference has been made already), and to the incongruities and governmental abuses that inevitably result from a lack of full recognition of this fact. The object of the taxing power is to raise money to defray the expenditures of the state, and proof and argument seem conclusive that it can not be legitimately used for anything else. By the power of police is understood the internal regulation of the affairs of the state in the interest of good order. The idea, therefore, of resorting to taxation for the purpose of protecting individuals against their own foolishness, enforcing morality, preventing social evils, or as an instrumentality for the punishment of crime, is to pervert an agency from the one sole purpose for which it can rightfully exist to another less fit and not warranted by necessity, and presupposes an entire misconception of the principles of a free government; and all perversions of this power are certain to entail evils greater than the abuses which it is devised to remedy. If the prosecution of any trade or occupation, or the manufacture and use of any product constitutes an evil of sufficient magnitude to call for adverse legislation, let the state proceed against it directly, courageously, and with determination. To impose taxes upon an evil in any degree short of its prohibition is in effect to recognize and license this evil. To demand a portion of the gains of a person practicing fraud, may be an effectual method for putting an end to his knavery by making his practices unprofitable; but it would be, all the same, a very poor way for a state to adopt as a means

political objections to the protective system can not be made so clear as by inquiring how the plan of distributing the money directly by the public Treasury would work."—E. L. Godkin, *Problems of Modern Democracy*.

for suppressing fraud. If absolute prohibition is the object, then such result should be attained through the police force of the state, and through its legislative enactments making the act, powers, or products which it is desired to suppress, misdemeanors or felonies. The manufacture and sale of spirituous liquors, in common with all other branches of business, is a legitimate subject for taxation, but there is a broad distinction—indeed, nothing in common—between taxing this business for revenue and in levying taxes with a view of preventing the business from being transacted at all, and so preventing revenue.

Again, if the above analysis of the origin, justification, and limitations of the power of taxation is correct, it would seem evident that to seek to make the occasion for the exercise of the power other than necessity, and the object anything else than the raising of money for meeting the expenditures of a government economically administered, is to strike a blow at not only good government, but also at free government. It is also a flat denial of the authoritative statement of the United States Supreme Court that "there are rights in every free government beyond the control of the state," and that the theory of our Government, State and national, admits of no place for the deposit of unlimited power. For the deliberate recognition and indorsement of the right on the part of the state to disregard these limitations in a single instance, is equivalent to a denial that there are any such, and certainly in this one department makes the Government despotic rather than free. Once recognize the principle of inequitable taxation, and no one can foresee how far it may be carried.

If it is contended, as it is, that the use of the power of taxation for purposes other than the collection of revenue finds justification in the fact that "the law-maker must look far enough beyond the general purpose to satisfy himself how any proposed levy is likely to affect the general good," a sufficient answer to such contention would seem to be that the general good is always best subserved by doing what is exactly right, and not what is expedient.

There is no question that the Federal Government of the United States, under its peculiar organization, is excluded from all responsibility for the internal order or morality of the States that make up the Union, and under such circumstances it follows that where Congress assumes that the consumption or use of certain commodities is prejudicial to the interests of the people (as it has done, as will hereafter be shown), and attempts, when providing means for the support of the Federal administration, to embody such assumptions, with a view of prohibitions or restraints, in measures of revenue, it is also enacting sumptuary laws* and imposing taxes, not in accordance with any rule of equity, but by reason of some arbitrary and sentimental notions of how a citizen ought to live, dress, eat, and drink. In the case of the several States of the Union, whose power of taxation is practically unlimited, such action is in the nature of oppression; but in the case of the Federal Government, whose powers of taxation are carefully limited by its Constitution, it is clearly an act of usurpation. In further elucidation of this matter, it is interesting to note, that probably no example can be found in history in which an attempt has been made to continue the raising of revenue with the regulation of popular consumption, that has not resulted in failure as respects the attainment of both objects.

One of the most notable perversions of the correct principles of taxation for the purpose of affecting the popular consumption of a commodity, has been the comparatively recent attempt of the Federal Congress (act of August, 1886) to prevent the use of one of the great discoveries of the age—namely, the manufacture of artificial butter, which, when properly prepared, is a most valuable and perfectly healthful addition to the food resources of the people. The practical results of this attempt are exceedingly curious and ought to be in the highest degree instructive. The burden of the tax—two cents per pound and special taxes on manufacturers, wholesale and retail dealers—which was intended to be prohibitory, has not been sufficient to accomplish the object of its levy; for the annual production, sale, and consumption of oleomargarine in the United States have continually increased (from 34,325,000 pounds in 1888, to 48,364,000 in 1892, and 69,622,000 in 1894). The Federal courts having decided that it is merchantable, the States may to a certain extent also regulate its sale, but can not prevent its importation. The Federal Government furthermore derives a considerable revenue from its domestic manufacture and sale ($1,409,211 in 1895); and also exports an annual large and increasing quantity for the consumption and use of foreign countries (127,193,000 pounds in 1894); and clearly, if such production and sale are fraudulent and wrong, the Government has become a partner in such fraud and wrong and in effect licenses them.

It is also an interesting fact that this idea of resorting to taxation for the primary purpose of enforcing morality and preventing social wrong is a comparatively modern idea, and finds its chief exemplification in the United States.

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* "Sumptuary: Relating to expense. Laws or regulations which restrain or limit the expenses of citizens in apparel, food, furniture, etc. Sumptuary laws are abridgments of liberty and of very difficult execution. They can be justified only on the ground of extreme necessity."—*Webster's Dictionary.*

The lesson of all history is to the effect that, save in the case of war or invasion, nations have rarely or never lost a freedom once possessed, except through the tolerance (born of indifference) of a succession of gradual and insidious perversions and weakening of those fundamental principles which must be maintained unimpaired to make popular liberty possible. And it is alike startling and discouraging to note how rapidly, in recent years, the United States, as a political entity, has been traveling in this direction.

Theory of the Power of Taxation originally entertained by the American People.—The idea of using the power of taxation for other purposes than that of obtaining revenue for defraying the necessary expenditure of the Government, was one hostile at the outset to all the beliefs and habits of thought of the American people; was totally incongruous with the social and political system which they instituted and expected, and was reluctantly admitted under the idea that the industries of a new country might need some temporary stimulus and assistance at the outset.* The party (old Whig) that in subsequent years specially advocated the policy protection to domestic industries, always also admitted that the Federal Government had no original right to exercise the power of taxation except for revenue, but it claimed that taxes on imports might and should be so adjusted as to afford protection for our infant industries. And in this they were joined by some members of the other great national party—the Democratic—who argued in favor of what was called "incidental" protection, or the protection which inevitably results in a greater or less degree from the imposition of duties without any such premeditated purpose.

Theory and Practice of Later Days.—But it was not until after the termination of the war in 1865 that anybody in the United States ventured to openly maintain or defend the proposition that protection was other than the incidental, and not the main object of the exercise of the taxing power, although this perversion of principle was tacitly recognized by the imposition and continuance of taxes which had for their intent, or resulted in a prevention of the raising of revenue.

Illustrative Examples of the Practical Perversion of the Theory and Principles of Taxation.—One of the most instructive examples of this kind was afforded by the imposition of a tax in 1869 of five cents a pound on the importation of crude or unmanufactured copper; which proved so prohibitive that in

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* The doctrine of Hamilton was that while the payment of bounties for the encouragement of new industrial undertakings was justifiable, their "continuance on manufactures long established was most questionable."—*Report on Manufactures, 1791.*

one year (1878) revenue to the extent of only five cents, accruing from the importation of only one pound of copper, was collected. The legislators who enacted the law productive of such a result might have pleaded in justification that revenue was their intent;* but when a brief experience had proved that the taxing power had been used to prevent the raising of revenue by the state, and for a different purpose, it was evident that a continuance of the policy (and the tax was long retained) was in effect a justification and an indorsement of it. To complete the illustration, it should be further pointed out that the result of this perversion of the taxing power was to enable the owners of copper mines in the United States, especially certain ones of unprecedented richness—formerly the property of the United States, but sold for a mere song—to extort for a period of years from the people of the whole country the sum of five cents for every pound of copper they consumed, but from which exaction (aggregating millions) the people of other countries, who consumed the large surplus product of American copper exported, were exempt, as the tax laws of all countries have no extra-territorial jurisdiction. During the discussion and defense of this tariff enacted in 1890, however, all pretense and evasion were discarded, and the position openly taken that the Government could rightfully levy taxes, not for the purpose of raising revenue, and not to subserve any necessity of the state, and under the name of protection delegate to private or corporate interests the right to collect and appropriate them.

It has been contended by authorities worthy of all respect (the late George Ticknor Curtis, for example) that there is no perversion of the taxing power in the levy of duties on imports by the Federal Government for purposes other than revenue, for the reason that "duties are not taxes, but assessments, in the nature of tribute imposed on merchandise imported from other countries," and that "when the Government levies duties on foreign products," under the provision of the Constitution that "Congress shall have power to lay and collect taxes, duties, imposts, and excises," "it does not exercise or pretend to exercise its taxing power."

In answer to this it is to be said, first, that the application of different names to one and the same act does not alter the nature of the act; second, that usage and authorities among all nations and at all times are in unison in regarding such terms as imposts, duties, excises, customs, tolls, gabbele, talliage, tribute, and the like, when

* The United States Supreme Court has held that the judicial power can not inquire into the intentions of Congress in imposing a tax; and that, if injustice is done, the only remedy is an appeal to the legislative power that has inflicted it.

used in respect to the fiscal functions of a government, as expressive simply of different methods of effecting one and the same object—namely, the compelling of contributions from persons, property, or business for the use or support of the state. The contention, then, thus far is simply a quibble as to the meaning of words. Third, the authority given to Congress by the Constitution "to lay and collect 'imposts,' in connection with taxes, duties, and excises," does not warrant the assumption that any of these acts of levying and collection are to be by methods that are not primarily for the purpose of raising revenue (money) for the service of the state, or are antagonistic to the structure of a free government. Following the precedents before noted, a measure known as the Anti-option Bill has been introduced and found favor in Congress, which is nothing more nor less than an attempt to make people dealing in certain staple agricultural commodities honest by the exercise of the taxing power; a measure devised for effecting indirectly that which it would be unconstitutional to do directly—namely, to prevent trading in cotton, grain, hops, meats, etc., for future delivery, by first assuming that all such sales are "immoral, unnatural, unjust, and injurious," and then attempting to put an end to them, not by the exercise of the police power of the several States, but by licensing and taxing them by the Federal Government under pretense of collecting revenue, when by the very terms of the bill no taxes productive of revenue are likely to accrue from its provisions. It is difficult to see why, if this extraordinary measure is made law and obligatory on all citizens, the policy of restraint involved should not be made also applicable to the buying and selling of all articles other than cotton and cereals—as cloth, stoves, boots and shoes, securities—and even personal service; and why, if it is right to extinguish one trade or calling *by taxing it*, every other may not be uprooted and extinguished in the same way.*

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* As pertinent and most instructive on this subject attention is asked to the following extract from a speech of Hon. Edward D. White (then a Senator of the United States from Louisiana, and now a judge of the United States Supreme Court), in the course of a debate in the Senate in July, 1892, on the so-called Anti-option Bill: "No power as to imposts was reserved in the States by the Federal Constitution. All the lawful powers of government which could be exercised in that particular passed into the life and being of the Federal Government by the lodgment in that Government of the power to levy imposts. In my judgment, if complaint is made of impost taxes by the Federal Government, levied not for the purpose of revenue, but for protection or prohibition, the complaint is not that the Federal Government violates the Constitution or the limitations of the Constitution, because as to that all authority is granted by the Constitution. When I say this I mean no limitation by the Constitution by express provision of the Constitution. The complaint of undue or prohibitory external imposts is not that the Constitution has been violated.

"No, but that there has been a violation of the great fundamental and elementary principle of all government, which underlies all constitutions, which affect this Government and

Another proposition which has received the indorsement of high judicial authority in the United States * is to employ Federal taxation for the crushing out of State lotteries, with the absurd accompaniment of no revenue (taxes); for if the desired object is attained, the payment of taxes and the procurement of revenue will be prevented. It seems clear, also, that if such a measure was once adopted it would constitute a precedent and authority for the destruction by the Federal Government, through the exercise of the taxing power, of nearly every faculty or power now belonging to and exercised by the several States; and that houses of prostitution, gambling and liquor saloons, opium "joints," and other haunts of vice now under the control and supervision of the police powers of the States might be regulated or suppressed by Federal taxation, as well as lotteries.†

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every other government, and which would affect the most unlimited government in the world. These principles are that government is created with limitations flowing from the nature of its being, which teach that no government shall use its power for the benefit of the few to the detriment of the many. Therefore, all the arguments which have been made on the subject of the abuse of the impost power in the Federal Government are arguments addressing themselves not to the limit of delegation under the Constitution as to imposts, but to the want of power arising from the very nature of government itself. The usurpation of power by Congress, not vested by the Constitution in Congress, is unconstitutional."

The point here at issue was also clearly recognized by President Cleveland, in his message in 1886, announcing his signature to a bill (above noticed) for taxing oleomargarine, where the real intent of taxation was popularly assumed to be prohibitive of production and sale and not revenue. "It has been urged," he said, "as an objection to this measure that while purporting to be legislation for revenue, its real purpose is to destroy, by the use of the taxing power, one industry of our people for the protection and benefit of another. If entitled to indulge in such a suspicion as a basis of official action in this case, and if entirely satisfied that the consequences indicated would ensue, I should doubtless feel constrained to interpose executive dissent." In other words, the President took the bill as it came to him as ostensibly a revenue measure, and in the exercise of his executive prerogative passed upon it as such, but at the same time he was careful to say in this message that if that bill had not presented that aspect to him, he would have been constrained to exercise the executive veto.

In the course of the debate to which reference has been made, Mr. White, in response to a question as to what he would as a Senator consider his duty in respect to a bill proposed to Congress for enactment which, while undoubtedly productive of revenue, was intended for some other purpose, made answer as follows: "I would have two questions to ask myself: Is this a bill raising revenue? That is the first question. If I determine that question in the affirmative, the lamp of my duty might lead my mind toward supporting that bill, but it could not carry me to that point unless another question were also answered: Is it an honest exercise of the taxing power, or is it a dishonest scheme to raise revenue and accomplish another purpose? If my mind, in the exercise of my duty here, found that either of these things existed, then, although it was a bill raising revenue, I would not vote for a dishonest bill raising revenue."

* Judge Cooley, Atlantic Monthly, April, 1892.

† "Congress is not empowered to tax for those purposes which are in the exclusive province of the States."—*United States Supreme Court, Gibbons vs. Ogden, 9 Wheaton, i, 199.*

It should also be remembered that lotteries, if they exist at all in the United States, must do so under the authority of State laws; that Congress can not take from a lottery company the charter which a State Legislature has granted; or make the issue of its tickets illegal, or punish as a crime the action of the managers by whom the business of a lottery is carried on; and further, that any legislation to make lotteries illegal should inferentially pertain to the State; first, because no jurisdiction has been given under the Constitution to Congress, except by remote inference to interfere with this matter; and, second, because there is no doubt that there was a complete unanimity of opinion among its framers that lotteries were legitimate and unobjectionable instrumentalities of society, inasmuch as at the time the Constitution was framed they were authorized by the States and extensively employed throughout the country for the founding of schools and colleges, the erection of hospitals, and the construction of roads, bridges, and ferries. On the other hand, it does not admit of contention that under the exclusive power vested by the Constitution in the Federal Government to "establish post offices and post roads," the use of the mails for the transmission of lottery tickets and correspondence may be legitimately inhibited, or that the general business of lotteries may not be rightfully made subject to Federal taxation for the sole purpose of revenue. When the Provincial Legislature of Canada recently decided to suppress lotteries in the Dominion, the measures which it instituted for so doing were not made contingent in any way upon the power of taxation, but by the imposition of heavy fines and penalties, not only on those engaged in the business, but also upon those having lottery tickets in their possession.

During the early years of the late war, taxes were imposed on the circulation of the State banks, "manifestly with a view to raise revenue and inform the authorities of the amount of paper money in circulation, and for no other purpose." But in 1865 these taxes were greatly increased, not for revenue, but with the admitted intent of destroying all banking institutions chartered by the States, leaving only similar institutions chartered by the Federal Government in existence. The result sought was fully attained, and the constitutionality of the legislation by which it was achieved was subsequently affirmed by the United States Supreme Court, which in the case of Veazie *vs.* Fenno (8 Wall., p. 552) nevertheless held that "the States possessed the power to grant charters to State banks," that "the power was incident to sovereignty, and that there was no limitation in the Federal Constitution" of such power. But in delivering the opinion of the court, the Chief Justice (Chase) declined to enter upon an inquiry whether the tax imposed on the State banks was so excessive as to divulge the legislative intention to prohibit banking on their part, but he argued elaborately that for another and stronger reason the tax could be constitutionally imposed because it was a tax levied for a lawful purpose, which lawful purpose was to restrain a State from interfering with the Federal control of the currency and the right of the national Government to emit bills of credit, and it was upon that point that the decision of the Supreme Court was in fact rendered.

The point of interest in this decision, however, is not the right of the Federal Government to regulate, especially under the original admitted necessity for the exercise of war powers, the currency of the country, but whether, having regard to the limitations on the exercise of the taxing power growing out of the nature of a constitutional government, the Federal authorities were justified in employing it as an instrumentality not to collect revenue but to prevent revenue, and when the desired end could be effectually achieved by other and unobjectionable methods; and on this point the court, following a well-established precedent of avoiding as far as possible all conflict between the judicial and legislative powers of the Federal Government, avoided any direct expression of opinion. As the case now stands, and as Congress has refused to discontinue the tax, it must be regarded as equivalent to an assertion that the Federal Government has the constitutional right to exercise the taxing power not for revenue and not by reason of any necessity that can justify it.*

During the recent discussion of the silver problem, an eminent American writer on economic questions recommended that a

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* Concerning the legitimacy and constitutionality of this procedure, a minority of the Finance Committee of the United States Senate, in a report in May, 1892, on a proposition to repeal this tax, expressed themselves as follows: Prior acts imposing taxes of one or two per cent on the notes of State banks, imposed for revenue purposes, the committee regard as entirely justifiable; but in respect to the ten-per-cent tax, which neither produced nor was intended to produce revenue, the committee say:

"This is flagrantly obnoxious in its manifest perversion of the taxing power conferred upon Congress by the Constitution. . . . We think also that a reasonable construction of the taxing power clause in the Constitution, to wit, 'the Congress shall have the power to lay and collect taxes, duties, imposts, and excises to pay the debts and provide for the common defense and general welfare of the United States,' would mean that Congress shall pay the public debt, provide for the common defense, and promote the general welfare with the money arising from such taxation, and not that Congress shall have the power to discharge these public duties by the mere framing of a statute without any revenue resulting therefrom. Surely it would be an absurdity for the Constitution to say that Congress shall have the power to discharge the debt of the United States by the mere framing of a statute or the wording of a law. The payment of money or the transfer of things of value is the only way by which a debt can be paid. Therefore the enacting of a law in the name and under the pretense of revenue which is intended to raise no revenue in fact, but which has another and entirely different object, is a gross and fraudulent perversion of the taxing power conferred by the Constitution."

Federal tax should be imposed on silver, varying from month to month according to the changes in its market price as bullion, with a view of establishing and maintaining a parity of value between gold and silver, with, of course, a total disregard of the sole object and justification of taxation—namely, revenue.

But the most curious illustration of the extent to which an entire misconception of the nature and functions of taxation has obtained favor in the United States is to be found in a pamphlet entitled Rational Principles of Taxation,* recently published by a Professor of Political Economy in the University of Pennsylvania, and included among the authorized publications of the university. In this the author advocates the levying of taxes by the national Government for the purpose of effecting "stability in prices"; and on the assumption that a large and increasing percentage of the national wealth is consumed in the expenses of the retail distribution of commodities, proposes to remedy the evil by imposing a discriminating tax on retail dealers so heavy as to crush out all such whose business and profits in a given time do not exceed a certain amount to be prescribed by statute. Among the anticipated advantages enumerated by the author of the adoption of such a scheme would be the saving of rent "on one half the stores" of cities and a great reduction of rent on the other half. "There would be little need of advertising; . . . the stocks of goods carried by the whole trade would be greatly reduced, from which there would be great saving of capital." But "perhaps the greatest saving of all would arise from the reduction of the force of salesmen and in the cost of delivering goods." And finally, carried away apparently by a beatific vision of the glories of such a tax millennium, the professor exclaims, "Think of all the elements of economy in conjunction, and an idea can be formed of the amount of taxes that could be levied on retail dealers without putting the public to any inconvenience!" † and "would not the unnecessary capital now absorbed in business be fully sufficient to furnish us with pure water, lovely parks, fine-art galleries," etc.?

Prospective Evils of the Perversion of the Taxing Power.—In view of such experiences and propositions, the questions are most pertinent: How much further is such a perversion of the taxing power to be carried? And is not the entire recent experience of the nation in this respect in the direction of

* Rational Principles of Taxation. By Simon N. Patten, Professor of Political Economy, University of Pennsylvania, 1890.

† Obviously the author of this scheme supposed that the retail dealers of this country are such simple-minded people that they will cheerfully pay their proposed heavy taxes out of their capital, and not transfer them, through increased prices of their goods, to their consuming purchasers.

supplanting a "free" by a "paternal" government, which last in turn finds its highest expression in the enactment of sumptuary laws for the control by government of the private life of its citizens? All despotic power is alike in its nature; and, once indulged in, the results are always the same. Once let it be fully accepted as a legitimate feature of public policy that the great public power of taxation may be intrusted to individual hands for private purposes and the power of life and death will be promptly seized to make the former effective. Once confer upon government the power of dealing out wealth, and the day is not far distant when its recipients will control the Government, and by the use of money elect their magistrates and legislators to perpetuate this policy.

Had the framers of the Federal Constitution even so much as dreamed that the Government to be established under it would ever practically refuse to acknowledge any limitations on its right to interfere with the property of its citizens, would use the taxing power with undisguised intent for promoting private rather than public purposes, and would levy taxes to prevent the payment of taxes, the Constitution itself would never have been called into existence, and the great American Republic would never have had a history.*

AN OBJECT LESSON IN SOCIAL REFORM.

By FRANKLIN SMITH.

NO error is more prevalent among intelligent and well-read people than that the social philosophy of Herbert Spencer has little or no practical application to the modern problems of social reform. So deep-rooted is this error that the ablest religious journal in the United States, which gives much attention to these problems, once advised him to throw it away. Because he does not favor recourse to the state for purposes outside of the maintenance of justice, it could not conceive that his social philosophy provided in a more effective way for the solution of social problems. By an account of a homely instance of the application of this philosophy, I purpose to show how practical it is in the ordinary as well as extraordinary affairs of life—how it has no rival in the important and beneficent work of bettering the condition of mankind. The instance to which I refer is the method adopted

* The economic student and writer (and indeed almost the only one) who has discussed this subject in the English language with originality and cogency that is most potent for conviction, is Mr. Theodore Bacon, of Rochester, N. Y., in an article contributed to the New-Englander in 1867, and to which the author acknowledges his indebtedness both in respect to ideas and language.

in the city of Rochester, N. Y., to provide side paths along the country roads for bicyclists.

I.

In the early part of the present year the newspapers of the city made the surprising announcement one morning that there had just passed the State Legislature and been placed in the hands of the Governor for approval a bill to tax all bicyclists in Monroe County one dollar each, the fund thus raised to be devoted to the construction of side paths. I say surprising advisedly. Although it was afterward learned that seven or eight thousand bicyclists out of the twenty thousand in the county had signed petitions for the bill, scarcely any public mention of it had been made, and no public discussion of it had taken place. The newspapers went so far as to charge that it had been "sneaked" through the Legislature. While the charge was false, it illustrates for the thousandth time how important legislation may be had without the knowledge of the community it affects.

Besides an indiscriminate imposition of the tax on all bicyclists, whether living in the city or country, or whether they would have occasion or not to use the paths, the bill called into existence the customary political machinery to execute it. There were to be five side-path commissioners, appointed by the Board of Supervisors, and to serve five years. They were to determine the paths to be built, to decide how they should be built, to let contracts, and to issue orders on the county treasurer, the collector of the tax, for the payment of work. The most odious feature of the bill was the provision that the tax "should be a lien on the cycle taxed"; that in case of nonpayment the collector should "proceed to enforce said tax by seizing the cycle" and "selling the same at public auction to the highest bidder"; that the proceeds of such sale should be applied toward the payment of the tax and the incidental expenses, including the two-dollar fee to the collector.

In the heated discussion that followed the publication of these provisions, the usual arguments in favor of such legislation were brought forward. The most comprehensive as well as the most familiar was the "general-welfare" argument. This was the fine product of a clerical mind unable to appreciate the full significance of the golden rule and the commandment against covetousness. The argument of a distinguished physician, equally destitute of a keen appreciation of the rights of those bicyclists that might never have time to take an excursion into the country, was that "this plan is the only feasible solution of an extremely difficult problem." He said that it was "the outcome of careful consideration by the older and conservative wheelmen of the city, and not the scheme of the road riders, so called." He went to the extent of claiming most erroneously that "the opponents of the bill admit that the raising of such a fund by voluntary subscription would be impracticable, and only through legislative action, authorizing the construction of such paths along our common highways by a small annual tax, can this much-needed public improvement be consummated."

A curious feature of the discussion, one common to the arguments of the most enlightened as well as the most ignorant that took part in it, was the amazing exhibition of selfishness, and of indifference to the rights of others. "The millennium is too far ahead," wrote another defender of the bill, impatient with the delay involved in voluntary enterprise, and convinced of the perfect propriety of coercing the bicyclists that did not care to contribute. "Only a few of the present generation of riders will be able to enjoy the full benefits of that network of good roads promised when that time comes. Our largest interest is in the present. We are selfish enough to want a few of the good things now that are sure to come in abundance hereafter." Then, to show how just the tax was, since it was levied on bicyclists only, and how glad they would be to pay it, since all were taxed alike, he added: "We only ask those interested to contribute their mite. Every wheelman will be willing to pay his tax if he knows that his neighbor, who is a wheelman, will do the same. When a rider tells me he is against the bill because he is paying for something he does not use, I know that it is the one dollar, not the man, that is kicking. Every rider will use the best path, whether it be a side path or a road. This is human nature." Alluding, finally, to the people willing to avail themselves of what he was pleased to call, with infinite scorn, "the free-lunch way of going through life," he said: "Could we get the free-lunchers to pay a dollar if they were not forced to? No; but they will use the paths just the same, and kick if they are not kept in good repair."

How often have these arguments been made to do duty for all sorts of schemes to promote "the general welfare"! How forceful and admirable they appear to the excellent persons that frame them! In the first place, the tax was such a little one; no one could be too poor to pay it. In the second place, people would be so delighted to pay compulsorily what they would not pay voluntarily! In the third place, could anything be more commendable than the suppression of "the free-lunch way of going through life," and the forcing of these odious "kickers" to pay for the paths they would be glad to have at other people's expense? Only one thing could be more commendable, and that is for those good people that want something done for their own benefit to pay for it themselves; only one thing could be more odious, and that is for these same people to get a law enacted to compel others to help them pay for it. The philanthropists that advocated the bill could not see that they, in reality, were the "free-lunchers"; for they were not so much interested in the encouragement of generosity as they were to profit from it after it had been encouraged. It was not "the kickers" that needed reformation—it was the reformers themselves.

What such excellent persons need most is not more knowledge, as many reformers suppose, but, as Mr. Spencer has often pointed out, a livelier imagination and keener sympathies. Had the training of these faculties been more perfect, the proposed tax would have called to mind the hundreds, if not thousands, of poor owners of bicycles that had been forced to practice the most rigid economy to buy them—the shop girls, the mechanics and laborers, the servant girls and messenger boys, and the impoverished invalids advised to take exercise to restore health shattered by long hours in shops or stores. There would have been the feeling that to these unfortunates a dollar was a considerable sum, and that if it could not be paid, as the bill required, the cost and annoyance of the legal proceedings authorized for its collection would be a serious hardship. The possible sufferings of unfortunate delinquents, rather than the advantage of paths and the suppression of "free-lunchers," would have filled the mirror of consciousness. With feelings stirred by pictures of injustice and suffering, not unworthy of the best days of a feudal despot, the benevolent advocates of the bill would have opposed it with even greater energy and skill than they defended it.

Another curious fact brought out was the ignorance of many of the petitioners as to the true character of the bill. Until the objections to it had been set forth in the newspapers, they did not realize what they had petitioned for. Even then it was impossible for some intelligent persons to comprehend that the bill was an outrage. I remember talking with two or three lawyers about it. Both from a legal and moral point of view they thought it an excellent measure. Another professional man, one of the brightest I ever knew, pronounced it the most just and practicable that could be proposed. But in spite of these perverted opinions, the discussion evoked such indignation and opposition that the bill was rejected by the mayor and common council, whose approval was required to make it law.

II.

Now that the bill had been defeated in accordance with the social philosophy of Mr. Spencer, what, in accordance with that philosophy, was the next thing to be done? Was the construction of side paths to be opposed altogether? Were bicyclists to be deprived of this means of pleasure and rapid communication between the city and country ? If the view taken of Mr. Spencer's social philosophy by the journal mentioned had been correct, these two questions would have to be answered in the negative. Nothing would have remained for the bicyclists to do but to get along as best they could with the bad roads and shoestring paths that fringe them.

Happily, however, the view in question was incorrect. Mr. Spencer's social philosophy enjoins the importance of taking advantage of every improvement, whatever it be, that will promote human welfare. That bicycle paths are an improvement of this kind needs no argument. As already intimated, they facilitate communication; they encourage people that live in the city to visit the country, acquaint themselves with its charms, and take the exercise that the preservation of health requires. But Mr. Spencer's social philosophy teaches that the improvement shall be undertaken voluntarily by those alone that desire it. Not only shall they undertake it themselves, but they shall seek to persuade others to join with them. What Mr. Spencer's philosophy forbids is that they shall ever resort to the argument of coercion to secure the aid of others.

Hardly had the bill been defeated before its opponents began work in accordance with this salutary principle of social reform. Through their efforts there sprang into existence, as in physical evolution, the social organs required to meet the new social wants. Voluntary associations were formed in different parts of the city to collect money from those that wished to give, and use it in the construction of paths. But the first step was not encouraging; it was decidedly discouraging. The meeting called to form the first Side-path Association was not attended by more than six or eight persons. But they were interested in the cause, and they were determined to do what they could to further it. They organized, elected a president, a vice president, a secretary, and a treasurer, collected a small sum from those present, and decided to go to work at once. The discussion that took place disclosed the conviction that it was inadvisable to wait until a larger fund had been collected. A previous experience was a warning against it. A bicycle organization in the city had collected six hundred dollars for paths, but, instead of beginning work at once with this sum, it waited to raise more money, and while waiting the money already in hand went for other purposes. Another reason for immediate action was the belief that as soon as bicyclists saw that the new association "meant business" they would contribute. Each foot of path constructed would be convincing evidence of the sincerity and enterprise of the association and of the value of the work undertaken. It was not long before money enough came in for a mile of path. Soon, too, two other associations were organized and began work in the same way.

The supreme merit of voluntary effort, as every careful student of Mr. Spencer's social philosophy knows, is the powerful stimulus it exerts both upon the generous emotions and upon the intellectual powers. People brought together by their interest in a common cause not only feel friendly toward one another, but by their desire to interest others in the same cause they are moved to be friendly with them. Most marked was the growth of this feeling among the bicyclists of the city and country after the defeat of the tax bill. It was often mentioned and commented upon. As a result of the desire to promote a common cause, contributions came in freely. They were not limited to the dollar fixed by the tax bill. There were several sums ranging from twenty-five to one hundred dollars. Nor did they come from bicyclists alone. People that never rode a wheel gave. Nor were contributions confined to money; they included cinders, ashes, and gravel for the paths and team work from farmers.

The invention of ways and means was quite as marked as the moral effect. Had the tax bill been passed, the bicyclists would have been just as indifferent to this subject as they would have been to one another. But the necessity of raising money by voluntary effort stimulated them to the discovery of the most effective ways. The women riders held a lawn festival, and raised some money; they gave an entertainment in a public hall and raised more. A newspaper was induced to undertake the collection of a fund. It was so successful that it obtained more than a thousand dollars. At the suggestion of a physician much interested in bicycle riding as a healthful exercise, a callithumpian parade was held in the driving park. Although the admission was only twenty-five cents, nearly twenty-five hundred dollars more were obtained. The result of the various methods for raising money was over five thousand dollars.

The best part of the defeat of the tax bill was the deliverance from politics and politicians. Here, too, was another application of the social philosophy of Mr. Spencer. How often has he shown that a more cumbersome, ineffective, and wasteful way of doing business could not be devised! Had the wit of man set about to invent something to dissipate energy, to stir up contention, and to produce the least satisfactory results, it could have hit upon nothing better adapted to this end than the tax bill. There would have been the intriguing for the appointment of the side-path commissioners; the scheming to get contracts for the construction of the paths; the pulling and hauling to have them constructed in some particular locality first; and, finally, the certainty that they would not have been built in the best and most economical way.

But in place of this mass of politics, inseparable from the state conduct of business, there was the natural selection of the most reputable and fit men to take charge of the work. One of them was an engineer of long experience in municipal works. Another was a contractor of more than usual character and ability. Still another was a banker, who was made treasurer, and who personally inspected the work before it was paid for. Still another was a man of wealth and leisure, who was glad to devote himself thus to the welfare of his fellows. All the other gentlemen that had anything to do with the work were likewise men of standing in the community. All served without pay.

The result of the selection of such men was the construction of the largest possible number of miles of path with the smallest possible expenditure. They exercised care in the purchase and use of material. They knew that they had but a limited sum of money to spend, and they aimed to make it go as far as they could and to build as good paths as they could. They avoided expensive experiments. They made sure, before going ahead, that the plan they had adopted was the best. How well they succeeded is shown by the fact that no fault has been found with their work. As the various paths were completed, the bicyclists of the city were invited to join in what was called an "opening." From five hundred to two thousand would meet at the entrance of the path and ride over it. In every instance they expressed satisfaction with what had been done. It had been estimated, while the tax bill was under discussion, that the paths would cost ten cents a running foot. By the plan thought to be so chimerical the cost was reduced to from two to four cents a running foot.

III.

What was done in this instance, where it was believed indispensable to summon the aid of the state, can be done in all instances. No practical problem of social reform has been or can be suggested that can not be solved by voluntary effort. To appeal to the state to solve it is to appeal to force, to resort to feudal methods. It is, moreover, to assume that I know better than my neighbors what will make them happy—that I have the right to compel them to make that use of their money that will add to my pleasure rather than to theirs. By the pursuit of this absurd policy, modern reformers, forgetting that they are following in the footsteps of the old French despots, imagine that they are hastening the millennium. What they are hastening is only a revolt against their suppression of freedom. They are building up a despotism of democracy certain to become just as hateful and intolerable as the despotism of autocracy.

BOTANIC GARDENS.

By D. T. MACDOUGAL,
ASSISTANT PROFESSOR OF BOTANY IN THE STATE UNIVERSITY OF MINNESOTA.

II.—TÜBINGEN AND ITS BOTANISTS.

THE botanic garden connected with the old Würtemberg University at Tübingen is worthy of special notice, because of its history and its importance as a center of research in the biology of plants at the present time.

The university with which it is connected was endowed more than four hundred years ago by the reigning house of Würtemberg, and during the entire period of its existence it has enjoyed the exclusive patronage of the grand ducal and later the royal family, as it is the only higher institution of learning within the kingdom. Set as it is among a hardy and virile people, it has been the scene of many notable mental victories over tradition and superstition. It has always held a position in the forefront of human advancement, and its splendid achievements mark epochs in human thought. Here have originated great schools or methods of thought in the different branches of human knowledge. Bauer in philosophy and von Mohl in botany have each forwarded research in his respective line in a manner that can not be measured or easily estimated.

The subject of botany in this institution received its first attention from the side of medical science. With the introduction of the laboratory method of instruction, actual demonstrations of plants were used to supplement the lectures. To meet the need of material of living plants the garden was founded in due time, and it has at successive periods represented quite accurately the development and extension of botanical science,—a development to which the botanists of Tübingen have largely contributed. The subject of botany here has always been in the hands of workers of the first rank, who each in turn have materially advanced the frontiers of knowledge of the biology of plant life, for a period extending over three and a half centuries.

The first lectures on plants, dealing with their medical properties, were given at the university by Leonard Fuchs, from 1535 until his death in 1566, although it was not until a century later (1662) that the garden was founded. Fuchs occupied a prominent position in the history of ancient botany, since he made the first attempt to establish a system of terminology, and furthermore he was the first to base descriptions of species upon facts obtained from an actual examination of the plants themselves. In his *Historia Stirpium* about five hundred species are figured and described, and the woodcuts in this quaint old herbal are of value even at this time. It is to be borne in mind, however, that Fuchs had formed no idea of the natural relationships of plants. The species given in the herbal are arranged in alphabetical order. It seems almost inconceivable at the present day, yet the descriptions of plants made by botanists in the period preceding Braunfels (1530) and Fuchs were not taken from nature, but were borrowed from still earlier writers, and supplemented by additions drawn purely from fancy and colored by the superstition of the time.

The establishment of the garden in 1662 was purely for the purpose of conserving medicinal plants, and only such species were cultivated as could be grown in the open air. The art of growing plants in artificially heated glass houses was not understood at that time. The garden occupied a plot of ground lying on the banks of the Neckar in what is now the heart of the city of Tübingen, where it remained until 1805, when it was removed to its present position.

Simon Schwendener, Professor of Botany and Director of the Botanic Garden, 1878. After a photograph by T. Barzuck, Berlin.

The lectures in botany in the university took on a new dignity when a separate chair was devoted to the subject by the appointment of Rudolph Jacob Camerarius as extraordinary professor and director of the botanic garden in 1688. He was afterward promoted and remained at the university until his death, in 1728. Camerarius made a most notable addition to botanical science by the actual experimental demonstration of the principal facts in the pollination of plants (1691 to 1694). Sachs says in his history of botany: "Camerarius had observed that a female mulberry tree once bore fruit, though no male tree (*amentaceis floribus*) was in the neighborhood, but that the berries contained only abortive and empty seeds, which he compared to the addled eggs of a bird. His attention was aroused, and he made his first experiment on another diœcious plant (*Mercurialis annua*). He took, in the end of May, two female specimens of the wild plant (they were usually called male, but he knew them to be female) and set them in pots apart from others. The plants throve, and the fruit was abundant and filled out, but when half ripe they began to dry up, and not one produced perfect seeds. His communication on this subject is dated December 28, 1691." The importance of his discovery was not recognized at the time, and his conclusions were accepted in a figurative sense only. Not until the end of the following century was his experimental evidence used as a basis for further researches by Kölreuter. Linnæus, to whom great credit is given by many writers for his share in the development of the theory of the sexuality of plants, ignored the facts disclosed by Camerarius, and arrived at identical conclusions in a purely deductive manner, arguing from the necessities of the case.

Wilhelm Pfeffer, Professor of Botany and Director of the Botanic Institute, 1878–1887. After a photograph by W. Hornung, Tübingen.

After the demise of Camerarius he was succeeded by his son Alexander. Later the lectures on the subjects of botany and chemistry were given by one professor. After a short interregnum the subject was once more in the hands of a master spirit in the person of Joseph Gaertner, who was called to the chair of botany in 1760. Gaertner remained at Tübingen eight years, going to St. Petersburg to accept the chair of botany in 1768. He returned to Calwe in 1770, and published shortly afterward his *De Fructibus et Seminibus Plantarum,* which may be truly termed an epoch-making work. The study of fruits and seeds had languished for more than a century, and Gaertner came to it with a mind singularly free from prejudice. He was aware of the real value of fruits for the arrangement of plants in a natural system, but he did not attempt to found a system on such material alone. Having at hand a most extensive collection of plants from around the world, which he studied with a persistence that brought him nearly to blindness, his book is an inexhaustible mine of facts and a guide to the morphology of fruits and seeds. His collection of material and microscope are still preserved in the botanical museum.

The lectures in botany at the university were placed in the hands of Friedrich von Kielmeyer as professor of natural philosophy in 1805. At this time the garden was removed to its present location, on the banks of the Ammer, in the northwestern part of the city, and shortly cold and warm houses for plants and a residence for the university gardener were erected. Kielmeyer was succeeded by Schubler in 1817, and he in turn by Hugo von Mohl in 1835.

It would be difficult to overestimate the value of the work accomplished by von Mohl during the thirty-seven years (1835 to 1872) in which he was professor of botany at Tübingen. This period does not include the entire time of his activity in this place, however. In 1826 the faculty of medicine offered a prize for an essay on the nature of tendrils and climbing plants, and a thesis by von Mohl, who was then a student, won the prize. This academic essay, written at the age of twenty-two, remained the clearest presentation of the subject until it was taken up by the elder Darwin in 1865. During the half century in which he was

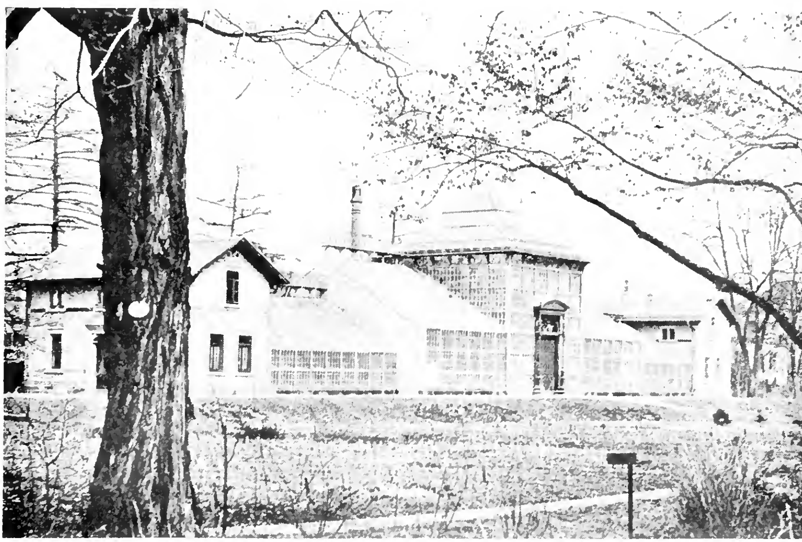
HERMANN VÖCHTING (sitting, facing front) and Group of Workers in Botanic Institute in Summer of 1896; Professor of Botany and Director of the Botanic Garden since 1887. After a photograph.

a leading figure in the botanical world, he used a purely inductive method of research, and by a long series of many-times repeated observations established manifold phenomena and facts which he welded into a coherent mass by a logic so relentless that he was incapable of being led astray into fanciful theories and dazzling speculations. Such a method enabled him to take a prominent part in the destruction of the chimerical teaching of the nature philosophy, especially in regard to the doctrine of the metamorphosis of plants. Furthermore, he succeeded in establishing the principles of anatomy so clearly that a rational system of morphology became possible for the first time. So important and basal were his demonstrations concerning the real nature of the primordial utricle that by many botanists he is said to have discovered protoplasm (1846). Von Mohl, with Schlechtendal, established the *Botanische Zeitung* in 1842. The list of his works includes ninety titles, embracing subjects in every department of the science. During his administration at Tübingen the garden was enlarged by three additions, to its present dimensions, occupying an irregular tract of land on both banks of the Ammer; important additions were made to the glass houses in the garden, and the institute building was erected in 1846. Perhaps no greater tribute can be paid to von Mohl's broad conception of the scope and needs of botany than the fact that this institute building erected fifty years ago, remains practically unaltered to the present day, and is still found fairly available for the purposes of modern investigation.

Upon the death of von Mohl, in 1872, he was succeeded by Hofmeister, who died after having held the post but five years. Hofmeister had perhaps accomplished his more important results before his stay at Tübingen. Like von Mohl, he used an inductive method of investigation, and he as well made enormous contributions to the material facts upon which many of our present generalizations in morphology rest. The results of the investigations published in his *Vergleichende Untersuchungen* in 1849 remain to-day superior to anything achieved in descriptive botany. To Hofmeister must be ascribed, among other important embryological results, the discovery of the alternation of generations in plants, and by the use of his phylogenetic mode of study the ideas concerning natural affinities of the groups of cryptogams and phanerogams underwent an almost total alteration. His establishment of the genetic relationship of these great subdivisions resulted in the overthrow of the prevailing belief in the constancy of species.

Prof. Simon Schwendener succeeded Hofmeister as director of the institute and garden in 1877. He, as well as his two successors, are still in the midst of active work, and it is by no means easy to forecast the final value of the results of their investigations upon the development of the subject. Schwendener has made very important contributions to the biology of lichens, phyllotaxis, besides a long series of contributions of the first rank in the domain of morphology and physiology. Among these his *Mechanische Princip in der Bau der Monocotylen* is of the greatest importance. Schwendener remained but a year at Tübingen, going thence to the University of Berlin, where he vigorously continues his researches. In consequence of his short stay but little of his work was accomplished at Tübingen.

The direction of the institute and garden was assumed by Prof. Wilhelm Pfeffer in 1878, who remained in the place nine years. The splendid results accomplished by himself and students during that time are published in a set of two volumes entitled *Untersuchungen aus den botanische Institut zu Tübingen.* The work dealt with the principal problems of physiology in growth, turgescence, secretion, movements, respiration, and nutrition. In 1887 Pfeffer removed to Leipsic. Both before and after his stay



VIEW OF PALM HOUSES, WORK ROOMS, AND HERBARIUM, IN AUTUMN. After a photolithograph in "Die unter der Regierung seiner Majestät des Königs Karl an der Universität Tübingen errichteten und erweiterten Institut der naturwissenschaftlichen und der medizinischen Fakultät," 1889. By permission.

at Tübingen he made most important contributions to the science, especially with regard to the physical and chemical properties of plant tissues, notably in osmosis and turgidity, and also in the transformations of energy within the organism. His laboratories and lecture room are thronged with students from all over the world, many of whom are Americans.

The present director of the institute and garden, Prof. Hermann Vöchting, succeeded Pfeffer in 1887. Prof. Vöchting may be said to be to some extent a representative of the modern idealistic school with which Braun, his old teacher, was identified. His work, however, resembles that of the idealists only so far as to exhibit the immense value of comprehensive discussions of the results of careful inductive inquiry, not only in the establishment of individual facts, but in the employment of these facts in their relations to the most general notions and their capabilities for the foundation of new and more comprehensive theories—a method of investigation productive of the highest results in all departments of biological science. One of the conclusions reached in this manner, which asserts the "polarity" of the plant cell, is at present beyond the general level of the subject. Polarity will doubtless be recognized as one of the most important physiological properties of protoplasm when the advance of the subject makes its appreciation possible. The researches of Vöchting have dealt prin-

THE BOTANIC INSTITUTE, VIEW FROM WILHELMSTRASSE.
After a photolithograph, by permission.

cipally with the physiology of movement and what might briefly be termed physiological morphology.

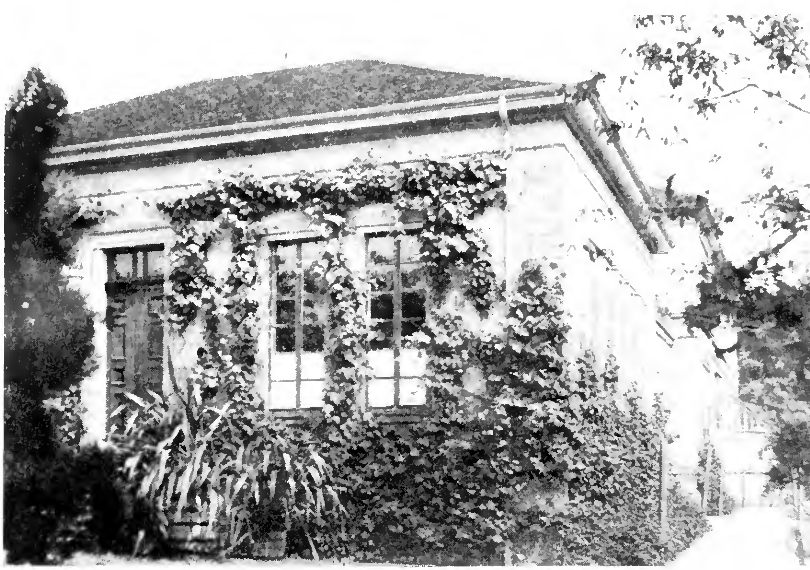
The garden is located in the northeastern part of Tübingen in western Würtemberg. It lies at an elevation of about one thousand feet, on the plateau encircled by the Schwarzwald, in latitude 48° 30′ north. Near it are hills covered with forests of pine, which rise two hundred and fifty to three hundred feet above it, while to the southward, twenty miles away, the Swabian Alps reach to a height of twenty-five hundred feet, in consequence of which the night temperature falls far below that of the day. A low winter temperature of −30° C., and a summer limit of 25° to 28° C., help to make a climate which resembles that of southern Michigan in many respects. The area inclosed amounts to about two and six tenths hectares of nearly level land on both sides of the banks of the Ammer, a small tributary to the Neckar. The grounds are planted in the system of Eichler, modified, however, to meet the ecological and æsthetic requirements. A small portion is devoted to aquatic plants, a second to an arboretum, another to an experimental plot inclosed and accessible only to workers. In the entire garden the instinctive ability of the naturalist is shown in the selection of natural conditions for the specimens of the various flora represented, and the alpinum may be regarded as a triumph in the art of artificial culture.

The alpinum is laid out in the northwestern part of the garden on a rectangular plot of ground one hundred and ninety feet in length and nine feet in width, near a stone wall seven feet high and parallel to its length. On this plot are piled the rocks and soil necessary for the culture of plants, in an uneven ridge, which in one place is six feet in height. The materials used were principally the native stalactite limestone and gravelly soil and granite from the Black Forest, forty miles distant. The limestone is peculiarly suitable for the lower Alpine plants and lithophytes, furnishing, as it does, innumerable cavities for the reception of soil and secure foothold for plants which cling directly to the rock. It has been found that the species from the higher European Alps refused to grow on such rock, and hence the granite was procured for the section devoted to this group. The entire structure is in many respects an admirable imitation of an east-to-west mountain ridge. The northern side affords many shaded crevices, and more or less shade to the whole is given by a number of small trees near by.

The most difficult problems which have confronted the gardener in the construction and management of the alpinum have been those connected with the water supply. The water content of such rocky soils is of course extremely small and needs almost constant replenishment. In Nature this is done by water from the melting snows above. Here it has been accomplished by a system of branching pipes with many openings below and above the surface, and a flow is allowed during the greater part of the day. The drainage is carried away by cement conduits, and in one place forms an Alpine lake eight feet in length and five feet in width, which furnishes in its waters and on the overhanging cliffs admirable conditions for a very rich flora. Near the lake are growing several specimens of Edelweiss, which here becomes somewhat longer stemmed than on its native cliffs, or in the Alpine gardens where it is cultivated to satisfy the thirst of the tourist for mementoes of "hazardous" ascents.

Many of the Alpine plants are quite intolerant of lime salts and grow best on the granite rocks, but the water supply used here is taken directly from the city system and is very richly charged with these substances, and as a consequence the culture of some of the plants of the higher slopes is impossible. This difficulty might only be overcome at some cost by a system of tanks for the storage of rain water, which would furnish exactly the natural conditions for a large number of species.

It is somewhat surprising to learn that in this area of about two thousand square feet more than twelve hundred species are successfully cultivated, almost all of which are perennials. In some places three or even four kinds are grown on a square foot of actual surface—a striking example of a form of intensive cultivation. It must not be supposed, however, that none but Alpine species are grown. A glance at the labels will show



Corner of Lecture Hall; View from Garden. After a photograph.

that many are at home far southward in the temperate zone. It is interesting to note that all of the North American species of *Cypripedium* are grown here successfully. As a matter of fact the alpinum offers a wider range of conditions than any other method of cultivation, and in some form similar to that described might offer suitable conditions of growth for species fairly representative of the flora of a region extending across twenty degrees of latitude.

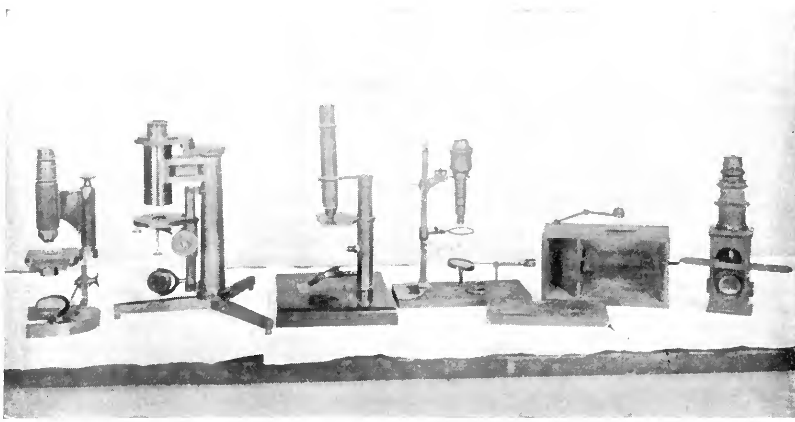
The glass houses are of the usual form, and include a palm house two hundred feet in length, to which are attached work-rooms and the herbarium building. The immediate supervision of the cultural department of the garden is in the hands of the head gardener, who is provided with a commodious dwelling and office building near the arboretum. He has under his direction a force of men varying from eight to fifteen with the requirements of the season.

The institute is an oblong brick structure, one hundred and seventy feet in length by sixty-five in width, standing in the southeastern corner of the grounds. This building is two-storied in part, the second story being devoted to the use of the director and his family. The first floor accommodates the director's offices, private laboratory, and experimental rooms, dark rooms, laboratories for physiology and morphology, the lecture room, and a museum containing the Gaertner collection.

The laboratories are supplied with a set of physiological apparatus embracing the standard forms, a large number of which were originally designed to facilitate researches undertaken here in the last twenty years. The museum contains the von Mohl collection of microscopes, which represents the development of this instrument from the time of Joseph Gaertner to that of Hofmeister, more than one hundred years. The Gaertner museum contains the carpological collections of Joseph Gaertner, on which his work *De Fructibus*, etc., was based, in the labeled bottles as prepared by him. For greater safety these bottles were inclosed in larger bottles and labeled by von Mohl, and the thoughtful observer looks forward to the time when a third casing of glass will be added to protect the prized handwriting of von Mohl. In this museum are also to be found the dried specimens of hybrids and seeds, drawings, manuscripts, and published works of Karl Friedrich Gaertner, and a large number of preparations for the microscope made by von Mohl and Hofmeister. The commodious lecture room is provided with all necessary appliances for successful demonstrations—charts, prepared specimens, wood and paper models, etc.

The investigator who comes here to undertake the solution of some problem in botany meets a body of congenial workers whose earnest enthusiasm is quickly contagious. He is furnished with ample space in well-lighted rooms and any necessary apparatus. If it is necessary to construct temporary apparatus to carry forward his experiments, a stock of material is at hand and he may have the intelligent assistance of the "Hausmeister," who has had a score of years of experience in such work in this institute. If the problem requires the application of delicate or complex machinery, he may call to his assistance Herr Eugen Albrecht—"Universitäts-mechaniker"—whose skill in designing effective apparatus for use in the physiology of plants and animals is known round the world. The library of the institute and that of the director contain a large number of works of the more prominent botanical authors, and a blank form properly filled will bring to his desk almost anything bearing upon his work from the library of the university, containing two hundred thousand volumes, in an hour or two. Outside the laboratories lies a garden stocked with an immense variety of well-grown plants representing great diversities of form and habitat, and presenting suitable material for the solution of a number of the more important open questions in the subject. Stretching away on every hand is the rich flora of the limestone hills, crested by coniferous forests. The subalpine vegetation of the Swabian Alps may also be reached by an excursion of a few kilometres.

The forests, lying within half an hour's walk of the garden, embrace examples of the royal, communal, and private systems



Group of Microscopes from the von Mohl Collection. The upright wooden stand on the right was used by Gaertner. The modern form on the left belonged to Hofmeister. The remaining stands were designed or used by von Mohl. After a photograph.

of management, and afford splendid opportunities for study in dendrology.

The most valuable part of the worker's experience, with such ample facilities at hand, however, is that which comes from the advice, encouragement, and suggestions of the director. Constantly engaged in the most laborious research for more than a quarter of a century, he has a vivid and sympathetic appreciation of the difficulties which beset the investigator, and his keen insight into the physiology of plant life leads him quickly to the solution of the problem in hand. His time and patience are unstintingly given to any who may have the slightest claim upon them, and the many times repeated assertion that the German professor gives a minor portion of his time only to his students is certainly ungrounded here. The writer is not acquainted with any American laboratory for botany in which the professor in charge devotes a greater proportion of his time to the student. In earlier times the Tübingen professors carried this devotion to the interests of the student to such a degree that it amounted to a fault, and published their own researches under the names of their students. This generous, unselfish, and high-minded attitude is an inheritance in the Botanic Institute at Tübingen, and is characteristic of the people among whom it is situated.

OUR PRESENT KNOWLEDGE OF THE ANTARCTIC REGIONS.

By Prof. ANGELO HEILPRIN.

IT can safely be said that we to-day know less about the antarctic regions than of any other portion of the earth's surface. We speak vaguely of an antarctic continent stretching across the southern pole, and some have even gone so far as to locate its boundaries, and to give an estimate of its superficial area. This has been placed almost anywhere between four and six millions of square miles—therefore larger than, or nearly twice the size of, the semi-continent of Europe. But no one is in possession of the facts which would prove the existence of such a continent, although it is by no means unlikely that it exists; and if it does, we know practically nothing of the possibilities of its flora or fauna. Up to the beginning of the past year perhaps the most striking definition that could be given of so-called Antarctica was that it was a region whose land area was entirely destitute of a flora and of a strictly terrestrial fauna. Not a vestige of moss, not a shred of lichen had up to that time been discovered; not an animal, excepting aquatic birds, had been found to give life to the few patches of open country that had been seen, or to the ice that almost everywhere covered it. The observations of the Norwegians Kristensen and Borchgrevink, made in the early part of 1895, to an extent modify this dreary conception, for at least one form of cryptogamous vegetation has been found within the Antarctic Circle—on Possession Island and on the opposite Victoria Land, near Cape Adare.

If we bar out the work of the past three years (1893–'95) it can be said that nearly all the knowledge that we possess of this Antarctica dates from a period a half century back and more—to the period of the researches of Bellany, Biscoe, Dumont d'Urville, Wilkes, and Sir James Clark Ross, and to no explorer are we indebted for more information than to the last-named. These investigators have determined the existence of certain patches of land, in most cases defined by prominent mountain swellings, which appear here and there behind a great barrier or wall of ice, to which the name of "Antarctic Barrier" has generally been given.

Such land areas—perhaps not in all cases positively demonstrated to be distinct from sea ice—are Victoria Land (due south of New Zealand), Wilkes Land (not improbably a series of island elevations opposite Australia, and known under the various names of Adélie Land, Clarie Land, Sabrina Land, etc.), and Graham Land (somewhat east of south of the extremity of South America). The most extended piece of coast or land line is that which has been traced southward in Victoria Land by Ross from about the seventieth to the seventy-ninth parallel of latitude, or over about six hundred geographical miles. It is only here, and in Graham Land (with the adjoining parts of Palmer Land, Louis Philippe Land, Joinville Island, Alexander Land), that our knowledge becomes at all definite.

Ross found the whole eastern coast front of Victoria to be paralleled by one or more mountain ridges of very considerable elevation, and bearing upon themselves a large number of clearly defined volcanic cones. Mount Melbourne, seemingly the highest point (with an elevation of nearly fifteen thousand feet), is described as having a prodigious summit crater. Mount Erebus (12,400 feet), the most southerly of all active volcanoes, was in violent eruption at the time of Ross's visit (January, 1841); a little to the east of it (in approximately latitude 78° 30′ south) is the extinct cone of "Terror," 10,900 feet. Beyond Mount Terror the Parry Mountains, also of very considerable elevation, and which continue to be the most southerly piece of land area that has ever been sighted, follow the generally southern trend to at least the seventy-ninth parallel of latitude, and not impossibly for a long piece beyond.

Geographers who define the contours of the presumed antarctic continent usually deflect its course eastward beyond Mount Terror so as to make it conform to the east-and-west ice barrier which barred Ross's passage farther southward; but it is significant that Ross says, "If there be land to the southward [of the barrier], it must be very remote, or of much less elevation than any other part of the coast we have seen, or it would have appeared above the barrier." This statement becomes of special importance, because elsewhere the land was clearly defined by its mountains at distances of ninety, one hundred and thirty, and even one hundred and fifty miles.

The region explored by Ross has only once been visited since —by Kristensen and Borchgrevink and their associates of the Antarctic. The Antarctic succeeded in following the route of Ross to about the seventy-fourth parallel of latitude, when, with open water still to the south, a return was made, owing to an absence of whale supply. Few facts of any consequence were added by this journey, the most important being, perhaps, the discovery of shreds of lichen on Possession Island and on the mainland of Cape Adare opposite, this being the first landing on what may properly be designated mainland. Borchgrevink confirms in almost every particular the observations of Ross, and from the two accounts we learn that Victoria Land is a region of lofty mountains, largely and perhaps almost entirely of a volcanic nature, and almost entirely buried within a mantle of snow and ice. The covering of snow and ice is not sufficiently massive to obliterate the relief of the land—differing in this respect from the interior of Greenland—and the contours of valley and mountain are well and clearly retained. Giant glaciers descend toward and into the sea, terminating in vertical cliffs of ice of one hundred, one hundred and fifty, and two hundred feet in height. A vast ice barrier of vertical cliffs, whether of glacial formation or otherwise, and retaining a nearly uniform elevation of one hundred and fifty to two hundred and fifty feet—with a reduction at one point to nearly eighty feet (or less)—defines a considerable part of the north and south coast line; beyond the seventy-eighth parallel of latitude this ice barrier trends eastward for at least three hundred miles, but it is not known that any approximate coast line lies back of it with a similar trend.

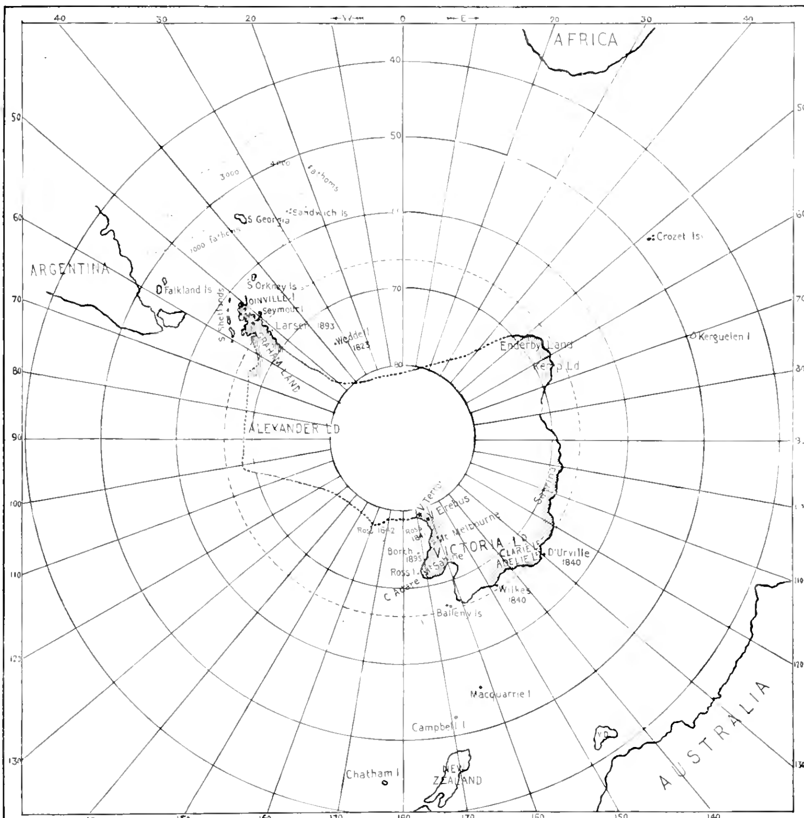
Westward of the one hundred and seventieth parallel of east longitude, and situated close upon the Antarctic Circle—now to the south of it, then to the north—and forming, as it were, a continuation of Victoria Land through some seventy degrees of longitude, are a number of designated land patches (such as Clarie Land, Adélie Land, Sabrina Land), which, with the uniting ice-cliff barriers, constitute the coast line of the antarctic continent of Wilkes—sometimes also known as Wilkes Land. How much of this continuous frontage of some two thousand miles is really land no one knows. The mountain undulations mark some parts as being indisputably such; yet a reasonable doubt may be entertained regarding some of the presumed land masses of Wilkes, and it is known that one of his mountain chains was sailed over by Ross in the region of the Bellany Islands.[1] A reference likewise to the admirable illustration of Clarie Land in D'Urville's monumental work on The South Polar Regions makes one suspicious as to the true nature of this *côte*, and forces one to inquire if it is not merely a portion of the great Antarctic Barrier.

Still farther west lie Kemp Land (probably island) and Enderby Land or Island, and finally, almost due south of the South American continent, the complex of Graham and Palmer Lands, with Terre Louis Philippe, Isle Joinville, and the more recently discovered or named King Oscar II Land, which was traced in 1893 by Larsen to nearly the sixty-ninth parallel of latitude, he himself attaining 68° 10′. This series of lands, which are closely contiguous with the South Shetland Islands, is also loftily mountainous, ranging to perhaps nine thousand feet, and with volcanic cones as a dominant feature. Lying east of King Oscar II Land, which is seemingly only a portion of Graham Land, are a number of small islands, some of which, as Christensen and Lindenberg, were volcanoes in active eruption at the time of Larsen's visit. This tract of archipelago lying south of the American continent is much less snow-bound than the region about Victoria Land, large areas of bare rock being exposed both on the islands and on the mainland, especially the volcanic slopes. Not improbably the heat of the volcanic cones has much to do with keeping an exposed surface, although it can hardly be supposed that this exposure is entirely due to this cause.

The geographical and geological study of the region under consideration resolves itself into four or more lines of inquiry: 1. Have we a continent in Antarctica? 2. What is the nature of the ice covering? 3. Of what construction are the rock masses? 4. Has Antarctica ever been united with any of the major divisions of the earth's surface which we recognize as continents?

The first inquiry hardly recognizes a positive answer as yet. Wilkes was certain that in the land masses seen by him, or thought to have been seen, we had the positive marks of a vast united continent; Ross, although he had seen more continuous coast line than any other investigator, was exceedingly doubtful on this point, and considered the evidence insufficient for positive determination; Murray, the distinguished geographer of the Challenger Expedition, has gone even beyond Wilkes, and constructed the contours of what appears to him to be true Antarctica, the outlines of which are in the map on the next page. These may be approximately correct or not—a matter about as difficult to disprove as to prove—but it is certain that the materials upon which this construction is based are hardly sufficient to warrant the mapping. Yet it is almost positive that a vast land area—perhaps two, three, or more of them—underlies the capping of snow or ice; but whether it is entitled to the designation of continent remains to be demonstrated by future exploration. Ross strongly emphasizes the doubt as to whether all the eminences or appearances reported to be land are really such, and he himself admits—cautious observer though he was—to having been deceived on more than one occasion. Murray, again, warns us that much of the ice barrier described by Wilkes is not the true barrier (which is presumed to be the boundary to a not distantly lying *terra firma*), but merely the cemented pack. It is a significant fact that none of the explorers refer to a distant elevated ice cap, such as everywhere bounds the horizon of the observer looking into Greenland, or to a mountain chain which is far removed from what is assumed to be the continental border.

The ablest discussion of the physical and geographical relations of Antarctica is furnished by the late Dr. Petermann in the *Mittheilungen* of 1863. He there argues strongly in favor of at least a partially open South Polar Sea, whose position is located central to the great ice masses which radiate out from it, and in



SKETCH MAP OF THE ANTARCTIC TRACT, GIVING THE MORE IMPORTANT POINTS THAT HAVE BEEN NAMED BY NAVIGATORS.

seasons of disruption—the months of November to April, the southern summer—press northward as the great Antarctic Barrier, the circle of pack ice which at varying latitudes has been the bar to passage of the different exploring expeditions. The special reasons advanced for this construction of the antarctic region are essentially two: (1) The comparatively low summer temperature of the south as compared with that of the arctic regions, an indication of oceanic rather than of continental conditions; and (2) the irregularity or instability of the pack ice, the front varying in position (in a north-and-south displacement) by hundreds of miles. Thus, in approximately the meridian in which, in 1823, Weddell reached the surprisingly high latitude of 74° 15′ south, the famous navigator Cook, nearly half a century earlier, was stopped in latitude 60°; and in 1855 Captain Grant found himself confronted by the impenetrable flat-topped barrier, three hundred to five hundred (?) feet in height, in latitude 56° 50′—40° west longitude. Both of the arguments here stated have their force, but in how far they prove their case future exploration or penetration alone can show. Ice movements similar to those of the south take place in the arctic regions, and they are largely determined by the winds and currents which sweep over or govern a virtually open sea; but it should be noted that the ice pack of the north is very different from what is commonly designated the "barrier" of the south, with its stupendous wall precipices of one hundred and fifty to three hundred (or five hundred ?) feet elevation; such fronts in the arctic regions belong exclusively to isolated icebergs or to the terminal faces of ice sheets (glaciers) which debouch into the sea and terminate at no great distance from the mainland. The bounding ice walls of the northern face of Melville Bay are examples of this kind. The main pack, or that which blocks navigation in the north, is a surface, regular or irregular, which rises but little above the level of the sea, except where it is tossed up into shingles and hummocks, or into those irregular eminences which have been by some identified with the so-called "palæocrystic" ice. On the other hand, a counterpart of the southern barriers is to be found in the land terminations of some of the giant glaciers of the interior, whose "Chinese walls" have been so graphically described in the explorations of Grinnell and Grant Lands (Greely).

It is unfortunate that the term "Antarctic Barrier" should ever have come into use, as it has been made to cover a variety of structures, and has led to confusion in the interpretation of the special features which it designates. There is no question, as Murray has pointed out, that much of the so-called "barrier" of Wilkes is merely ordinary pack ice—some of it, indeed, in the brash or broken condition; therefore, considerable allowance must be made in the acceptance of that assumed girdle which is supposed to define a continent. A point that probably favors the (Petermannian) view of partially oceanic conditions within the ice is the presence of strong northwardly trending currents, which have been observed by both earlier and later explorers. Thus, at his farthest southing, in 1894–'95, in latitude 74° 10′, Captain Kristensen, of the Antarctic, met with such currents trending almost due northward opposite Victoria Land, and the question naturally suggests itself, Is this a direct current, or one that is deflected northward after taking a westerly course along the edge of the southern barrier of Ross?

Of the arguments that have been advanced in favor of considering Antarctica as a vast continent buried deep beneath its covering of snow and ice, the most plausible are those which relate to the construction and form of the oceanic bottom within the region of the southern ice and the character of the ice itself. More explicitly stated, they are: (1) The shallowing of the sea toward the so-called antarctic tract—an approach to the borders of a continent—and the occurrence of what are stated to be sub-continental or terrigenous deposits, conditions that are well emphasized by Murray; and (2) the heavy massing of ice, which could seemingly not be other than of glacial origin. Ross found the depth of water opposite the barrier which stopped his farthest passage southward reduced to two hundred and fifty and one hundred and fifty fathoms, so that manifestly there was here a true shallow; somewhat similar results were obtained at a few other points along the barrier front. But it can be pertinently asked, In what special way would the approaches to an archipelago differ from those of a continent? With this special evidence of shallowing before him, Ross still believed in the probability of non-continental conditions, and he was in a measure justified in his belief by the fact that at many other points not far from the front of the barrier the lead indicated depths of from four thousand to six thousand feet, and even more.

The massiveness of the ice is in a condition which, so far as it is known to us, belongs exclusively to glacial formation; i. e., none but land ice is known to assume this form. The evidence which it offers, therefore, favors the notion of the existence of large terrestrial areas or gathering basins. Yet it is by no means impossible, or even improbable, that with the low summer temperatures which prevail in the antarctic tracts and the continuousness of fogs and clouds, the surface of the sea might of itself, through ages of precipitation and of comparatively little melting, build itself up in mountains of ice, hundreds or even thousands of feet in thickness. This view has, indeed, been held by some physicists, and no facts that are accessible to us are really incompatible with it. The uniformity of the table surface of the ice, which appears to be uninterrupted in places for hundreds of miles, combined with the fact that it only occasionally shows an undulating or rising surface back of it to mark out a land relief, is in itself a suspicious circumstance. This is very different from what we find in Greenland, the largest area of positive glaciation with which we are acquainted, and which certainly carries with it the constructional type of a continent. Whether seen from the east, south, west, or northwest, the relief line is plain and continuous, and over the greater part of it, in clear weather, the great dome of receding ice-cap is well visible. And yet from this ice accumulation hundreds of glaciers are given off whose terminal or sea walls are of much the same height as the greater part of the Antarctic Barrier. Naturally, it can be assumed that Antarctica is much less mountainous than Greenland—may, in fact, be a gently rising or almost flat plain—and that the great length of its glaciers, which marks off a termination possibly a hundred miles or more distant from the actual border of the land, is that which prevents the land contours themselves from being seen. But are there just grounds for a contention of this kind?

The distinctiveness of the antarctic climate as compared with the arctic is found in the relations of both the summer and the winter temperatures. The high summer heat of the north, which in the few months of its existence has the energy to develop that lovely carpeting of grass and flowers which gives to the low-lying lands even to the eighty-second parallel of latitude a charm equal to that of the upland meadows of Switzerland, is in a measure wanting in the south; in its place frequent cold and dreary fogs navigate the atmosphere, and render dreary and desolate a region that extends far into what may be properly designated the habitable zone. The fields of poppies, anemones, saxifrages, and mountain pinks, of dwarf birches and willows, are replaced by interminable snow and ice, with only here and there bare patches of rock to give assurance that something underlies the snow covering. Man's habitations in the northern hemisphere extend to the seventy-eighth parallel of latitude, and formerly extended to the eighty-second; in the southern hemisphere they find their limit in Fuegia, in the fifty-fifth parallel, fully three hundred and fifty miles nearer to the equator than where, as in the Shetland Islands, ladies in lawn dresses disport in the game of tennis. And still seven hundred miles farther from the equator, in Siberia, Nordenskjöld found forests of pine rising with trunks seventy to one hundred feet in height. Yet it must not be supposed that there are not, as is perhaps commonly assumed, gleams of warm sunshine in this inhospitable south; indeed, we have yet to learn to what extent the far south is warm or cold. Thus, Captain Kristensen, the gallant commander of the Antarctic, who made the first landing on what is assumed to be the mainland of Antarctica, asserts that on January 5, 1895, when nearly on the sixty-eighth parallel of latitude, "the sun at noon gave so much heat that I took my coat off, and the crew were lying basking in the sunshine on the forecastle" (Transactions of the Royal Geographical Society of Australasia, Victorian Branch, March, 1896, page 87); and Biscoe, writing on the 16th of January, 1831 (on approximately the sixtieth to the sixty-third parallel of latitude), states that "the temperature of the water was 34°, of the air in the shade 45°, in the sun 77°, with a corresponding general warmth to the feelings of the crew." The highest reading of the thermometer for the month of January was noted by Kristensen to be 40° F., and the lowest, 27°; fifty-three years earlier (1842) Ross found for the same month 39° and 27·5°, with a mean of 32°, thus indicating an equality almost without fluctuation.

The fact that the high south has not yet been penetrated in the winter months leaves us in uncertainty as to the winter temperatures that may prevail there; but some indications of this temperature are to be found in the records which have been obtained in the circumantarctic tract. Ross registered the absolute minimum, for the year 1842, in the Falkland Islands to be only 19·2° (−5·7° R.); but still more significant is the reading of the minimum thermometer which was left by Foster in 1829 on Deception Island, and recovered by Captain W. H. Smiley (as reported by Wilkes) in 1842, or after an interval of thirteen years. The registry was found to be −5° F. (−16·45° R.). It is true that Deception Island lies well without the Antarctic Circle, and that its insular condition must measurably reduce the rigors of a winter climate; but even these conditions permit us to form some just estimate of what " lies beyond," and of making some interesting comparisons with corresponding localities (so far as latitude is concerned) in the north. Thus, at Fort Reliance, in North America, the mercury descends to −70° F., and at Jakutsk, in Siberia, nearly one degree nearer to the equator, to −75°; and, if we are to fully believe the registry at Verkhojansk, for the winter of 1893, the unprecedentedly low temperature of −90° was reached. But one need not make comparisons with these especially cold localities, as it is well known that at the sites of the principal commercial cities of the world the mercury at times descends to from −5° to −15° (New York and Philadelphia, 1866, 1895). On January 23, 1823, the mercury in Berlin descended to −31° F., and in Paris, on January 25, 1795, to −21°. It is perhaps just to conclude from these and other facts that the extreme winter climate of the Austral Ocean, on or about latitude 63° south, is no more severe than that of southern France, and hardly more so than that of northern Italy. And while it is doubtless true that a considerably lower marking of the thermometer would be found in the much more extreme regions of the south, or nearer to the pole, it is practically certain that nothing comparable to the cold of the opposite face of the globe exists.

In summing up the various facts that have been noted, it may be admitted that they argue rather against than in favor of continental conditions, but they are by no means sufficient to make a demonstration; indeed, the fact that such a large mass of apparently continuous ice exists circumpolarly speaks against the conclusion, and it is probably the one most significant circumstance which has led to favor the view of continentality. It must be observed, however, that the continuousness of the so-called antarctic continent rests upon somewhat insecure and far from confirmatory evidence. The open sea (with only three ice islands visible from the mast) that confronted Weddell at the seventy-fourth degree of latitude speaks volumes in its own behalf, and is evidence of a kind which is rather strengthened than otherwise—as proving the insularity of the ice—by the subsequent findings of Biscoe, D'Urville, Ross, and Grant, who found it impossible to penetrate to within eight hundred or a thousand miles of the position reached by Weddell.

In the same year with Weddell, Captain Benjamin Morrell, Jr., sailing from New York, reached in Weddell's track (March 14th), latitude 70° 14′ south, and he also describes the sea as being "entirely free of field ice," and stated that "there were not more than a dozen ice islands in sight. At the same time the temperature both of the air and the water was at least thirteen degrees higher (more mild) than we had ever found it between the parallels of sixty and sixty-two south. We were now in latitude 70° 14′ south, and the temperature of the air was 47°, and that of the water 44°." * Morrell significantly adds, "I have several times passed within the Antarctic Circle, on different meridians, and have uniformly found the temperature both of the air and the water to become more and more mild the farther I advanced beyond the sixty-fifth degree of south latitude"; and further: "I regret extremely that circumstances would not permit me to proceed farther south, when I was in latitude 70° 14′ south, on Friday, the 14th day of March, 1823, as I should then have been able, without the least doubt, to penetrate as far as the eighty-fifth degree of south latitude" (*op. cit.*, page 67).

Not much weight can be attached to the latter part of this statement, as it is well the experience of polar navigators how suddenly the presumably "open seas" close up; yet it would be nothing short of an assumption to place a barrier where it has in fact not been seen to exist. The circumstance that navigators who have followed Morrell found impenetrable barriers north of Weddell's and Morrell's positions is no evidence of what lies southward of them, and so far as anything that we now know of to the contrary, King George IV Sea may extend quite to or even across the pole. Both Weddell and Morrell experienced winds from the south in this water; the former, writing on the 18th of

* Morrell. A Narrative of Four Voyages to the South Sea, 1832, p. 66.

February, remarks: "Not a particle of ice of any description was to be seen, the evening was mild and serene, and our situation might have been envied had it not been for the reflection that probably we should have obstacles to contend with in our passage through the ice northward." As regards the various eminences which have at different times been designated "land" (such as Kemp Land, Enderby Land, etc.), and which have so often been united together to form a continuous land mass, there is every reason to believe that many of them are merely islands, and even islands of inconsiderable extent. Thus, it is certain that if the positions assumed by Morrell and Biscoe for their respective vessels are true, then Biscoe must have sailed over a portion of what was subsequently designated Enderby Land (Enderby Island). The deceptive forms of ice have by nearly all polar navigators been at one time or another taken for rising land surface, a condition which makes doubtful the references to many of the "land" masses that have been made known to us. It is by no means unreasonable to assume, with Petermann, that Antarctica may yet prove to be a disjointed association of land and ice masses, purely archipelagic in form; in this sense, Victoria Land, which is to-day the most extensive tract known, may be merely a correspondent of the insular form of New Zealand.

The only important addition to our knowledge of true Antarctica that has been made since Ross's voyage belongs to the close of the year 1893, when Larsen penetrated, in the region of the Graham Land complex, to latitude 68° 10′ south, and brought back with him a "departure" in the geological concept of the region under consideration. The finding of Tertiary fossils (*Cytherea*, *Natica*, etc.) on Seymour Island (Cape Seymour) is the opening vista in an investigation which has heretofore been considered closed, and at once affords, to use a business term, a basis for consideration. Not less significant is the finding at the same locality of an abundance of tree remains (conifers, *Araucaria* ?). These fragments at least show that some part of Antarctica was of the same kind of construction as the continents generally, and their special *facies* immediately suggests a South American relationship. Previous to 1893 the only rocks known from the ice-bound region of the far south were granites, gneisses, (and related schists), the strictly eruptive and trappean rocks, and certain red sandstones (Piner's Island—Triassic ?) from a very limited area. Most (and perhaps nearly all) of the higher mountains are distinctly of a volcanic nature, and many of them bear huge craters on their summits. Ross found Erebus in eruption at the time of his visit (1841), and Larsen found the mountains of Christensen and Lindenberg Islands similarly active in 1893–'94. Kristensen and Borchgrevink, who sailed over a portion of Ross's course in 1894–'95, attaining off Victoria Land, with clear water ahead of them, latitude 74° south, confirm in almost every detail the observations of their predecessor, adding some additional facts regarding the large glaciers which descend from the heights of the Sabine Mountains. They were the first to set foot on the mainland (or main island) of Antarctica, and to them science also owes the first discovery within this realm of a rock-covering vegetation (lichens ?—on Possession Island and Cape Adare).

In its relation to other continents there is reason to believe that Antarctica, whether as a continent or in fragmented parts, had a definite connection with one or more of the land masses lying to the north, and the suspicion can hardly be avoided that such connection was, if with nothing else, with at least New Zealand (and through it with Australia) and Patagonia. In the fragmented parts of Graham Land archipelago and the outlying South Orkney and South Georgian Islands, we seem to have the bond of connection with the South American main; or, more specifically, a line of curvature of the great Andean chain, which, in its broken parts, can still be traced far beyond its present continental termination. If this concept is a true one, it places before us a parallel to the Andean curvature in the northern part of the South American continent, where the mountain system is deflected off into the broken mass of the Lesser Antilles; to the Aleutian flexure of the Cordilleran system of North America; and to the "Apennine-Atlas" and "Carpathian-Balkan" flexures of the Alpine mountains, the nature of which has been so clearly stated by Suess. In fact, it is hardly possible that any very extensive meridional or latitudinal mountain chain could have been forced up through contractional force without some such deflection being represented in one or more parts of its course; and where these deflections are found they are almost certain to be areas of breakage. The disruption of the Andean system is still (or has until recently been) taking place, as is evidenced in a portion of the Chilian archipelago.

When we look for the evidence of connection such as has been indicated, we find it in the fossils of Cape Seymour, already referred to, in a part of the living fauna of the continents of the southern hemisphere, and in the vestiges of a past life which these continents reveal. Thus, among land animals whose history favors this view, are the South American ostriches, whose close and only immediate allies are the ostriches and other large ratite birds of the African and Australian regions. The union of these birds in the southern continents, whatever may have been the exact place of their origination, gives evidence of migration, and this migration in the case of non-flying birds could only have taken place along united land areas. It may be assumed, and has been assumed, that these large and seemingly closely related birds may have been independently developed in the regions which they now occupy; but in view of certain facts presented by other groups of animals, especially the quadrupeds, it is probably safer to assume that their origin was a common one, and that they were distributed over a land surface which had union with South America, Africa, and Australia, or New Zealand. Such a uniting land mass was not improbably ancient Antarctica.

Much more positive evidence bearing upon the question under consideration is afforded by the composition of the South American Tertiary mammalian fauna. Up to and inclusive of the Miocene period this fauna was a distinctively South American one, or at least not North American. The hoofed animals representing various orders (*Toxodontia*, etc.) were of a type at that time almost unknown in the north; there were no true artiodactyls or perissodactyls, and no insectivores, cheiropters, creodonts, or carnivores. The essentials of the fauna were recruited from the orders of edentates, marsupials, and rodents; the first named have specifically South American types, as the sloths and armadillos, while the last named, also specifically South American, lacked the more common northern forms, such as the hares, rats, squirrels, marmots, and beavers. The middle Tertiary fauna thus gives evidence of the isolation of this portion of the continental tract, and leans to the probability that the fauna then and there existing was derived from a southern source. It is only in the later or Pliocene period that we have an introduction of the northern types of quadrupeds, such as the true carnivores, deer, horses, mastodons, etc. Whether or not the region where this southern South American fauna originated was the region of South America itself, or another land mass that was at one time united with it, is not made clear by the evidence of the faunal elements that have been noted; but significant in this connection, as has been pointed out by Prof. W. B. Scott, is the relationship of the Miocene marsupials, which incorporate within themselves a number of distinctively Australian types, a condition that has been properly emphasized by the investigator last mentioned as giving strong evidence of a former union between the two main southern continents.

In explanation of the anomaly, assuming a connection between South America and Australia, that none of the South American mammalian types reached Australia, Prof. Scott suggests an early connection between the latter region and Antarctica (and through it with South America, thus permitting of a broad dispersion of the marsupialian types), and then a final severance before the appearance of the placental form of quadrupeds. Whether this explanation will ultimately prove to be the correct one or not, the geological construction of the region makes it very probable that a disruption of the Austral tract took place before that of the South American.

Prof. Scott, in a review of the relationship of the southern land masses (Science, February 28, 1896), thus states his position: "In conclusion, it may be observed that the facts of paleontology may best be explained on the assumption that the antarctic land mass has at one time or another been connected with Africa, Australia, and South America, which formerly radiated from the south pole as North America and Eurasia now do from the north pole. While this seems a highly probable assumption, much remains to be done before the history of the southern continents is as well known as that of the northern ones, and in particular many questions must remain open until the Tertiary mammals of Africa and Australia shall have been recovered."

This evidence from paleontology may thus be taken to strongly supplement that which comes from the side of pure geology—evidence indicating a much further extension southward of the South American continent, and of a former union between it and a past and still partially existing Antarctica.

CONSUMPTION AND CONSUMPTIVES.

By WILLIAM L. RUSSELL, M. D.

TEN or twelve years ago even the most advanced physicians were not agreed that consumption belonged to the communicable diseases, and practically none took any steps to prevent its spread from the sick to the well. In fact, there were not a few who denied that it was ever contracted in this way. Heredity, physical conformation, atmospheric and soil conditions were regarded as the important factors, and all efforts were directed to the study and control of these. To-day there is an entire change of position. Communicability stands first in importance, and there are few who deny that it is the essential factor in the perpetuation of the disease. The most strenuous efforts now being made against its ravages are based on the belief that the greatest menace to the well is the presence of the sick.

Tuberculosis—of which, as will be explained more fully below, consumption is a variety—now appears at the head of the list of contagious diseases published weekly by the New York Board of Health, and means have been taken to have all cases in the city reported and instructed. Circulars containing directions for preventing contagion by disinfection of sputa have been placed in the hands of physicians for distribution, and many, if not all, reported cases are visited and instructed by the health officers. When an apartment has been vacated by a consumptive the following notice is posted:

NOTICE.

Consumption is a communicable disease. This apartment has been occupied by a consumptive, and may have thus become infected. It must not be occupied by persons other than those residing here until an order from the Board of Health, directing that it be cleaned and renovated, has been complied with.

Name of occupant....................................

Floor............ No........ St.......................

This notice must not be removed until the order of the Board of Health has been complied with.

The directions for cleaning and renovating require that calcimined or whitewashed walls and ceilings be washed with a solution of washing soda (one half pound to three gallons of water), and then calcimined or whitewashed afresh; that papered walls and ceilings be washed with the same solution and repapered; and that the woodwork be similarly washed and then repainted. Cleansing and renovating are aimed at rather than disinfection. These measures can be taken as an example of the method of dealing with tubercular lung disease in every large city, and, in fact, throughout nearly the whole country.

The reason for this new departure is to be found in the rounding out of the evidence of the contagious nature of consumption, by the discovery of the living agent whose presence and growth constitute the very essence of the disease, and the transfer of which from the sick to the well causes its spread. This is the microscopic, rod-shaped, vegetable organism named the tubercle bacillus. It was discovered by Dr. Koch, of Berlin, in 1882, and much of the mystery which had previously shrouded the disease was thereupon cleared up; for, although consumption is a disease which has been recognized during the whole period covered by history, no adequate explanation of its nature was offered until recent times. Previous to this century, it was thought that the destruction of the lungs was due to simple inflammation and ulceration. Then Laennec, a French physician, who invented the stethoscope, set forth the view that the small, pearl-like bodies with which the lungs were found studded constituted the sole cause. He called these bodies tubercles, and thus the disease came to be spoken of as tuberculosis.

Laennec's view was not accepted without opposition, and, until Koch's discovery set the matter at rest, many claimed that there were two or more kinds of consumption. In 1867, Villemin, also a Frenchman, demonstrated the possibility of producing the disease in certain animals by inoculating them with tuberculous material. It was found by others, however, that the same animals became tubercular if inoculated with apparently innocent material, or simply if an open sore were kept on them. The matter was thus still unsettled. The pathologists now came to the support of the contagionists by the discovery that the development and extension of the disease in contiguous cells and tissues and along the small vessels could only be explained by the presence of a contagious element. When, therefore, Koch demonstrated that the tubercles themselves were but the work of living organisms which had been introduced from without, a flood of light was thrown on the subject which cleared up all disputed points. He showed that not only was the diseased tissue crowded with these organisms, but that they were being constantly discharged in the sputum; that they could be cultivated in colonies free from all other germs outside the body; and that the pure cultures introduced into healthy animals caused them to become diseased, the bacilli being again found in their dead bodies. It may then be accepted as a settled fact that consumption is invariably produced by the introduction into the lungs from without the body of vegetable organisms, which, finding lodgment, multiply and eventually cause the destructive changes by which the death of the individual is accomplished. When it is remembered that consumptives have been expectorating countless millions of these organisms for ages, and that the cattle whose milk and flesh are used for food are not exempt from tuberculosis, no mystery need surround the source of any particular case. The mystery is rather that any of us escape. Nor could we, were it not that certain conditions, happily not always fulfilled, are necessary before the germs gain a foothold in the body.

It may strike some as extraordinary that while the contagiousness of the fevers, of cholera, and syphilis was established beyond question before disease germs were discovered, sufficiently convincing evidence was not also at hand in the case of such a prevalent disease as consumption. The popular conception of contagion and contagious disease has been derived from the behavior of such a disease as smallpox. It prevails often as an epidemic. Its onset is sudden and accompanied by pronounced symptoms. It runs a short and sharp course, and results in speedy death or recovery. A large proportion of those exposed are attacked, and the exposure may have been very brief. The case is entirely different with tuberculosis. Epidemics are almost unknown. The beginning of the disease is usually obscure and insidious; the course may extend over months and even many years, the individual being perhaps not seemingly very ill during much of the time. The majority of those exposed seem to have escaped, and of those attacked comparatively few are known to have been in especially close relations with the sick. It will thus be seen that in the one case the evidence is nearly always clear, cumulative, and convincing, in the other it is usually confusing and sometimes contradictory. In former times, when controversies on the subject were frequent in the medical profession, equally good observers often came to diametrically opposite conclusions. It must not be supposed, however, that knowledge of the bacillus as a causative agent is the only ground for belief in the contagiousness of consumption. If this were the case, the matter could hardly be regarded as settled, for malarial fevers are known to be produced by a micro-organism, but are not contagious. There has seldom or never been a time when a conviction that consumption was contagious did not prevail to some extent, and few physicians of much experience have failed to see one or more cases which could only be satisfactorily accounted for on this ground. It has even occasionally happened that in certain localities this theory of its nature has gained such widespread credence as to lead to definite action. This was the case in Italy during the period from 1787 to 1848, when vigorous measures were taken to stamp out the disease, and a special hospital for consumptives was established at Olivuzza. At Naples the bedding of consumptives was burned, and their vacated apartments were completely renovated before being used again. In fact, the unfortunate sufferers were often shunned, and whole families were driven to want. It is said, however, that this method of dealing with the disease made no impression on the death-rate, and it was therefore abandoned.

Some of the recorded instances of the communicability of tuberculosis are, especially with our added knowledge of the bacillus, quite striking. Among these may be mentioned the inoculation experiments of Villemin, already referred to. Before this, however, Laennec, who became eventually a victim to the disease, believed that he had inoculated his own finger by means of a saw while he was making a post-mor em examination of the dead body of a consumptive. A tuberculous nodule developed at the seat of the wound. Morgagni, too, at a still earlier period, showed by his writings that he realized the danger of inoculation in this way. Calves which have sucked cows suffering from pearl disease or tuberculosis are frequently found to be affected with the same disease. Dr. Jacobi has recorded an instance of a dog contracting tuberculosis by licking the sputa of his diseased master as he followed him about the garden. Acute or hasty consumption has prevailed in almost epidemic form among young recruits in crowded barracks in England, and the inmates of certain convents have been almost exterminated by the same disease. In a convent in Louisville nine of the nuns developed consumption within four months of the introduction of the first case, and four of them died. No new cases occurred after the remaining sick had been removed. In 1787 an inmate of a convent in Bilbao, Spain, died of consumption, and, as was customary then, the bedding and furniture were destroyed and the room thoroughly cleaned before it was again occupied. Two months later the new occupant of the room was attacked by the disease and afterward died. The same cleaning and destruction of furniture followed, but the next occupant succumbed within a year. It was then discovered that certain cords which might have been the means of conveying the disease had been allowed to remain in the room. These were now removed, the same precautions taken as before, and no other case had appeared at the end of five years. A few years ago the British Medical Association made an attempt to investigate the subject, and a circular letter of inquiry concerning cases of contraction by contagion was sent to each member. Reports of three hundred and twenty-one instances were received, two hundred and twenty-three of which related to husbands or wives who were thought to have contracted the disease the one from the other. It is worthy of note that many observers of long experience had seen but one or two instances, and some had not seen any.

The following observations relate to instances in which there have been more than one husband or wife, and embrace all such that have been recorded:

1. Thirteen instances in which a consumptive man had married more than one healthy wife. There were in all thirty-one wives, of whom twenty-seven contracted the disease, four remaining perfectly well.

2. Three instances of a wife becoming infected from her husband, and a second husband from her.

3. Two instances of women dying of consumption, after each had lost two husbands by the same disease.

4. Ten instances of husbands contracting the disease from their first wives, and their second wives in turn from them.

5. One instance in which a man had become infected from a diseased wife, his second wife from him, and a second husband from her.

The marriage relation furnishes conditions exceptionally favorable to contagion, and it is not surprising that so many of the recorded instances relate to contraction of the disease from husband or wife. And yet it can hardly be claimed that most of those who lose husband or wife by consumption contract the disease. Of 6,167 patients who had been treated at the Brompton Hospital in 1863, but 239 were widowed. Of these, however, 106 had lost husband or wife by consumption. Dr. Cotton, of England, found that only eleven of one thousand cases which he investigated had lost husband or wife by the disease, and our own Dr. Flint states that there were but five such instances in 670 cases observed by him.

Previous to the discovery of the bacillus, such observations as those last mentioned led many to doubt that consumption was communicable at all. It may be well, then, to consider a few other facts pointing to the same conclusion, as they are important in arriving at correct views on the whole matter. Chief among them may be mentioned the experience of the Brompton and Victoria Park Hospitals of London, where consumptives have been treated for many years. It is well to recall at the same time that special precautions against contagion have not been taken until recently. It was stated in 1882 that of sixty or seventy physicians employed at these hospitals during twenty years, but five had been attacked by consumption, of whom two died. The record of the large number of nurses employed during the same period, and whose relations with the sick were more intimate than those of the doctors, was still better; there were but two cases, and one of these was doubtful. One of the physicians to these hospitals, Dr. Williams, says that though he has been watching for twenty years he has not yet met with a case in which alleged contagion could be sustained, after close investigation. He adds that while the disease may be contracted in this way, the circumstances must be extremely favorable. At the Vienna General Hospital, where 2,736 deaths from consumption occurred in three years, not a physician or nurse was known to have contracted the disease. Nearly every one has known of relatives or friends who have lived in the most intimate relations with consumptives for long periods and have suffered no injury whatever.

Now, it does not follow from these observations that we are mistaken in assuming that consumption is communicable. We shall see in a moment that there is a good reason for exceptional instances. It is quite possible, though, that in our enthusiastic zeal to deal with it and stamp it out on this basis other important considerations are being neglected. Destruction of clothing and renovation of rooms seem to have been pretty thoroughly practiced in Naples and other places a hundred years ago without making any impression on the death-rate. Improvements in general sanitary conditions at Naples, however, have in these later times had a marked effect. It is, to be sure, highly important to destroy or disinfect sputa, and to discourage in general the pernicious practice of expectorating. The sputum is the very fountain-head from which the army of bacilli is re-enforced. This does not necessarily imply, however, that the concentration of our efforts on the destruction of the bacilli is the only, or even the best, way of exterminating the disease. Few diseases prevail so generally throughout the world as tuberculosis. No zone is exempt from its ravages, and it has prevailed from the earliest times. Its victims constitute seventeen per cent of all deaths, and nearly five thousand succumbed to it in New York city in 1894. It affects also the lower animals, especially the cow, which is so important a source of food supply. Many persons are fatally affected by it long before they are obliged to leave their occupations, or even to consult a physician. The methods which have proved so successful with the acute infectious diseases can hardly be applied effectually with such a disease as this, and the attempt to deal with it solely on this line may even prove mischievous sometimes by fostering a belief that exemption can be secured simply by shunning the sick. Should such a view prevail generally, unnecessarily severe and even cruel measures would sometimes be adopted by the timid and ignorant. Not long ago a writer proposed that all cases be segregated and quarantined in a valley in New Mexico, where climatic conditions were favorable to recovery, Government aid being given the impecunious, and a leading New York daily commented favorably on the proposition.

The importance, then, of correct views on this subject can scarcely be overestimated. We have seen that, though the disease is undoubtedly communicable, it does not prove so under all circumstances. It is a question if any one of sound heredity and good health has ever developed it simply from living with a consumptive in ordinarily good hygienic surroundings. It is generally admitted that predisposing conditions can always be found. The germs of this disease can not obtain a foothold until the resistive powers of the tissues have been reduced. There must be not only the seed but the soil. This impaired power of resistance may be the result of heredity, and this influence in the causation of disease is seldom shown to better advantage than in the history of consumption. There have been instances in which a single case introduced into a long and sound ancestry has vitiated the stock forever. How unfortunate that such matters are so little considered in marrying and giving in marriage! It is not that the disease is inherited, but the vulnerable tissues, the feeble resistive powers, render the offspring an easy prey to the ubiquitous bacillus. This weakness often shows itself by a tendency to become ill from slight causes, a sickliness, not by any means to be confounded with merely a lack of robustness or strength. One organ or part of the body, frequently the mucous membrane, is usually more prone to become affected, and the beginning of the disease can often be traced to an attack of some slight ailment. Not only the children of consumptive parents may show these characteristics, but also those of parents generally enfeebled, or whose ages are widely separated, or who are closely related by blood, or of a mother who has previously borne a number in quick succession. Even when heredity is sound, the same condition is sometimes induced by coddling, by improper feeding, by attacks of acute disease, or by want and distress. In growing children, a bad carriage of body may act injuriously by contracting and deforming the chest. The stooped position which boys sometimes assume in bicycle-riding should be discouraged for this reason.

Before the period of bacteriological research conditions thought to bear a causative relation to consumption were eagerly studied. Some of these thought to be important, it can now be seen, were principally operative by affording favorable circumstances for contagion, or were themselves symptoms of disease already present. They still teach useful lessons, however, and deserve more attention than is at present given them. We all know now the reason why bad air was for so long regarded as a cause of the disease, but it still remains the fact, nevertheless. Imperfect food supply was also assigned a place among the causes, but second to an imperfect supply of pure air. Well-fed factory operatives who work in close rooms are much more prone to the disease than poorly fed laborers who work outdoors. A French laborer moved to Paris with his wife and three sons from the country, where they had worked outdoors. The father and two of the sons soon died of tuberculosis; the mother and remaining son returned to the country and survived. This illustrates the well-known fact that the mortality increases with the density of population, being greatest in large cities and in barracks, prisons, and factories. Sixty-seven per cent of the deaths among the Guards in the English army are due to it. The death-rate in prisons increases steadily with the years of confinement, and diminishes as ventilation is improved. Inadequate nutrition because of insufficient food supply or of indigestion, which in turn may be the result of improper or poorly prepared food, undoubtedly predisposes to the disease. The same may be said of exhausting discharges or hæmorrhages, of childbearing, of enervating habits or practices, and of depressing emotions, all of which tend to reduce the resistive power of the body. Considerable importance has been attached to damp soil, and it would seem justly so. Dr. Buchanan, of England, found that the drainage of such soil always reduced the death-rate among the inhabitants of the region. Dr. Bowditch, of Boston, says that three fourths of 201 cases investigated by him lived in houses built on damp soil. He observed also that the death-rate was lowered by draining. He mentions several specific instances, among them the following: A and B married sisters.

No tuberculosis had ever been known in any of the families, except perhaps in the case of one grandmother, who had marks of former abscesses in her neck. A and his wife lived on dry soil. They had nine children, all of whom remained healthy. The house of B, on the other hand, was on damp soil. His wife and six of his eleven children died of consumption, and one of the survivors was ill with the disease when the observations were made.

The importance of these predisposing conditions can only be realized by knowing that the large majority of consumptives have never lived with others similarly affected. The disease is in these cases a result of a combination of circumstances into which direct known exposure has not entered. Nor can immunity be secured by shunning the sick. In fact, nothing further is required to protect those of sound health and heredity, who are obliged to associate with consumptives, than scrupulous cleanliness and an abundant supply of fresh air and sunshine. If, in addition, the sputum and everything soiled by it are destroyed and disinfected, the sick become harmless to all. The human body has within it the capacity of preventing the lodgment and growth of the tubercle bacillus. This capacity is only overcome as a result of hereditary or acquired influences. It is against these that the efforts of every one can and ought to be directed.

DISINFECTION AT QUARANTINE.

A FLOATING DISINFECTING PLANT.

By M. E. WARD.

THE necessity of thorough precautionary quarantine methods is generally accepted. The adoption and adaptation of methods and apparatus to keep pace with the knowledge that scientific research has placed at command is a matter that directly concerns the public and the departments of public health. That ceaseless watchfulness should be maintained, that trained diligence combined with high scientific skill should be a means to attain efficiency, that appliances in use should combine simplicity with efficiency, that in their operation delay of all kinds should be avoided, and that the individual should receive consideration and every comfort and convenience enlightened civilization can provide, are axiomatic facts.

Our great seaports and ports of entry are the centers most exposed to contagion and infection. Disease germs from the civilized and uncivilized parts of the world tend to drift there, carried by an ever-moving stream of emigration and traffic. The larger the center, the greater the number that pass through it to gain access to other parts of the country, carrying with them whatever of good or ill they may bring. Their baggage and clothing, if from infected ports, can carry the seeds of disease and afford favorable conditions for the reproduction of germ life.

The port of New York, with its magnificent harbor and immense marine commerce, is one of the centers that requires intense, concentrated vigilance to protect the city itself and the country at large. One of its great dangers is that of disease brought by incoming vessels.

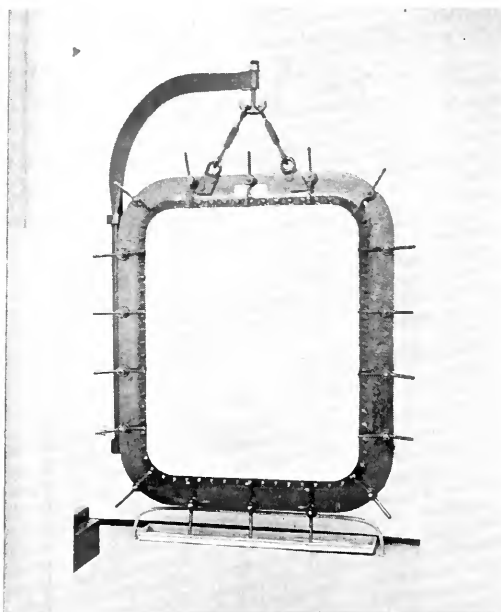
The health officer of the port of New York has charge of the health of all of those on incoming vessels. The headquarters of the boarding station is situated at the Narrows, on the Staten Island shore. Side by side are the grim fort and the health officer's headquarters—the one an arm of the nation, the other a department of the State; both there to guard and protect the safety of the country. Detention at quarantine has been a precautionary measure, the disinfecting process slow and laborious.


Hot and Cold Water Supply Cocks.

Disinfection is the destruction of germ life. The penetrative quality of the means is a most important factor. Access to the seeds of disease, destruction of germ life, and the removal of conditions favorable to the reproduction of germ life are necessary to effect thorough disinfection. The destruction of the germ to be effected without the destruction of property or unnecessary inconvenience or delay is the problem.

The means in use consists of a steam disinfecting chamber (two hundred and thirty degrees of heat is destructive to germ life); bichloride of mercury used in solution of 1 to 1,000 or 1 to 1,200; sulphur fumes, which last have but little penetrative quality; and sea-water and salt-water soap for bathing purposes, to be used when necessary. It has been found expedient to combine these means and construct apparatus to enable the process of disinfection to be carried out rapidly and thoroughly.

The floating disinfecting plant system now contains all that is needed to effect a thorough and complete disinfection. The people detained are submitted to a rapid and efficacious process of cleansing and disinfection, their clothing being treated simultaneously, and their privacy considered even when under strict supervision. The officers in charge can direct and control all operations from the central part of the vessel, and, being provided with separate toilet and disinfecting facilities, can return to their quarters or gain access to any part of the vessel without danger of conveying infection and without delay. Fitted with the combined apparatus, a boat containing the plant can be run alongside the suspected vessel, which can then be thoroughly cleansed, disinfected, and fumigated, the passengers and crew bathed, their clothing subjected to steam sterilization, and returned to them uninjured, and all baggage and bedding treated to a complete disinfection. The crew and attendants have their comfort and health cared for separately.



Door of Disinfecting Chamber closed.

Under the direction of A. H. Doty, M. D., health officer of the port of New York, the old side-wheeler Ripple has been remodeled. She looks new from end to end, and under the name of James W. Wadsworth presents a very trim, businesslike appearance. Inside she is arranged to economize every available inch of space, and is finished in such a manner that no germs of disease can be left to lurk undestroyed.

The Wadsworth has a twofold duty to perform: the bathing and disinfection of passengers, crew, and baggage; and the cleansing, disinfection, and fumigation of their vessel.

The passengers and crew and their effects are transferred to the disinfecting boat for treatment, and their vessel is thoroughly disinfected before they are permitted to return to it.

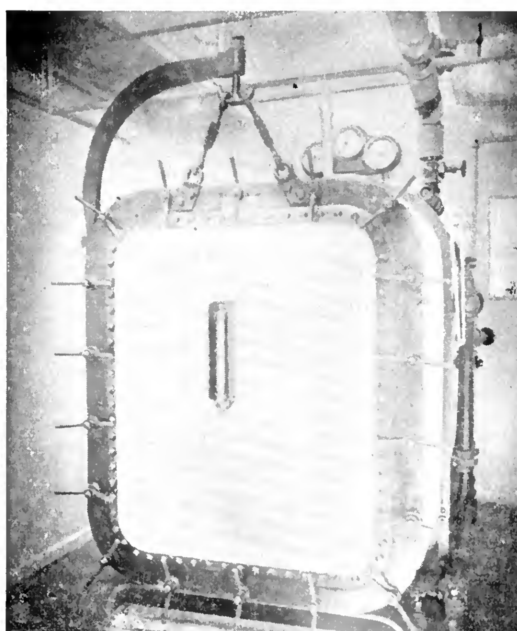
To effect this work with rapidity, there are several separate processes, each with its own set of apparatus, conveniently located. Each or all can be operated from the central part of the vessel, where the officer in charge of the disinfecting processes is stationed.

The plant contains a disinfecting chamber; bichloride tanks, with separate pumps and hose system; soda tank and hose system; salt-water pump and connections for the baths; sulphur furnace with air pumps and reservoir; and a central office, containing indicators and the controlling apparatus of the entire disinfecting system.

The boat is fitted with two immense fresh-water tanks; and the officer in charge can supply the baths with hot or cold, fresh or salt water at his discretion.

Outside, huge pipes, extra tanks to contain solutions, and conveniently situated cocks are visible. The railings have all been rearranged, to facilitate the handling of passengers.

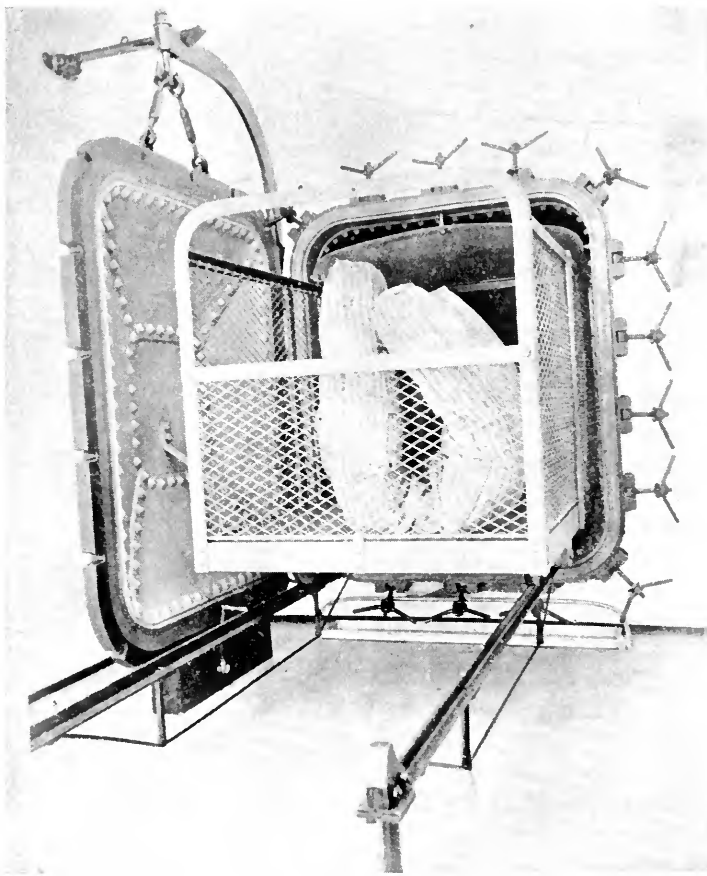
The boat is practically divided into three sections: the after part of the vessel, which is devoted to the care, disinfection, and handling of passengers; forward, the crew's quarters; and the central part of the vessel, containing the boiler, engines, pumps, and furnaces, and the room where the operations are controlled, and a separate set of disinfecting and toilet apparatus for the use of the officers in charge.



Discharging End of Disinfecting Chamber.

The disinfecting chamber is situated in the center of the after part of the vessel. Surrounding it are the reception rooms, disrobing rooms, bath rooms, and dressing rooms.

In a process of this kind it is necessary to take every precaution against the spreading of disease. This is provided for in the finish of the boat, which offers no resting place for disease germs to accumulate. All parts of the boat where the disinfecting processes take place are lined with sheet iron, finished with white enamel. The floors are of sheet lead, each furnished with a separate outlet pipe. Each room has a separate floor, which does not directly communicate with adjoining rooms; and the lead floors are protected with rubber mats, which can be treated without injury to a washing down with bichloride solution. The benches and other fixed furniture are set away from the walls to facilitate cleansing, and,



Car receiving Packages before being run into Disinfecting Chamber.

together with their fittings, are finished in white enamel, affording free surfaces, readily cleansed and disinfected.

The two bath rooms—an illustration of one of which is shown—are provided with showers and extra flexible hose connection for hosing down. The baths and the temperature of the water used are regulated in the central office; and the hot and cold levers are so arranged that the cold water always precedes the hot, thus preventing a sudden or too great rise of temperature in the flow of water when distributed by the showers.

The passengers are assembled for disinfection aft, on the upper deck. From there they descend to the reception room, which is situated over the stern. Opening from the reception room, on either hand, are the entrances to the disrobing rooms. Entering one of these, the passenger to be disinfected removes all clothing, which is then made into a bundle, checked, and tossed through a convenient opening into the receiving car of the disinfecting chamber. The passenger proceeds through a door opposite to the one by which he entered to the bath room; from there again, through another exit, to the dressing room, where the bundle of clothing awaits him, disinfected.

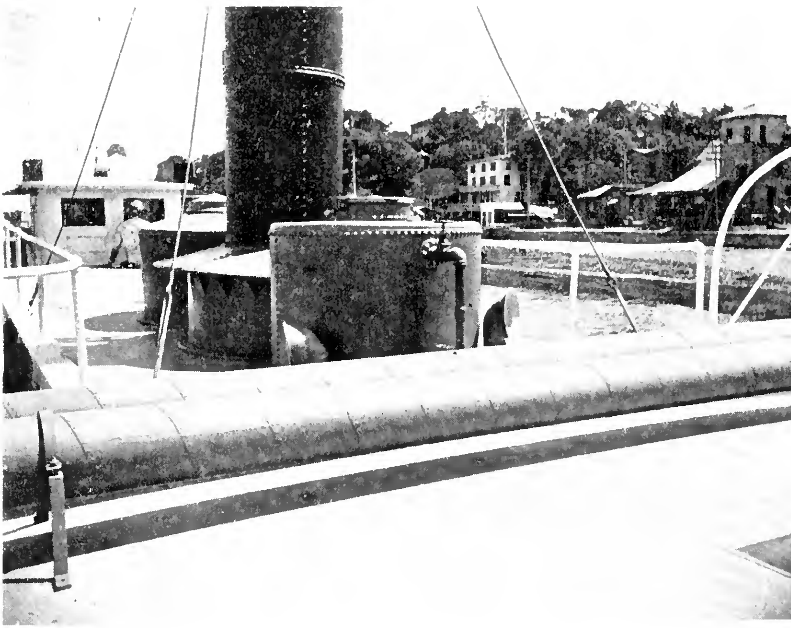
Thoroughly cleansed and disinfected, the passenger emerges clothed to proceed to the upper deck, to which there is a convenient staircase situated outside the dressing-room door. In a separate railed portion of the upper deck the passengers collect, and from there are returned to their vessel.

The entrance to the room into which the receiving end of the

One of the Bath Rooms.

disinfecting chamber opens is between the entrances to the two disrobing rooms.

The room into which the receiving end of the disinfecting chamber opens is finished in iron, enamel, and lead, as are all the other rooms. Overhead is a hatch in the upper deck, through which such large bundles as bedding, etc., can be lowered into the receiving car. The car of the disinfecting chamber is run out or into this room on rails. These rails are movable, and can be taken up and replaced at will. In operating the disinfecting chamber these rails are placed in position, the door of the disinfecting chamber opened, and the car or crate run out. Into this car the bundles of clothing are tossed from the disrobing rooms, which



Bichloride Tank.

are situated on either side. From the deck above the bedding and other large objects to be disinfected are lowered into the car through the hatch. The car is then run into the disinfecting chamber, the door closed, and the process of disinfection commences. The door of the disinfecting chamber requires special mention. It is made of steel, protected by asbestos-magnesia covering, and is swung into place from a crane and secured by turnbuckles against a rubber gasket, effecting a perfect seal. The door is so hung that one man can handle and swing it even in a seaway, which is obviously a great advantage.

The disinfection of bedding, clothing, etc., is accomplished by means of steam sterilization. The penetrative quality of the means must be rendered effective.

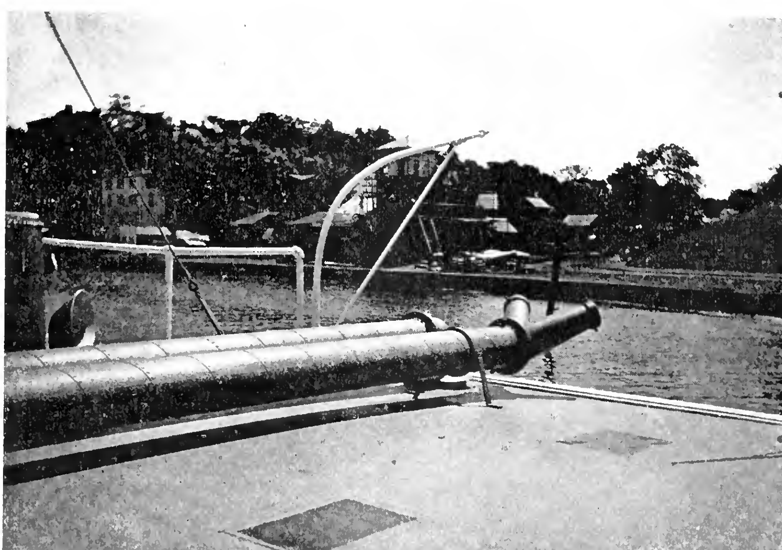
The disinfecting chamber is a huge steel room or chest, and in it the clothing, etc., are treated. A vacuum is created in the chamber and live steam introduced and exhausted until every part of the contents of the car has attained the desired degree of heat.

The bundles into which the clothing, etc., are rolled are securely fastened before being tossed into the receiving car, and remain there undisturbed, each numbered, to effect rapid identification.

The rapidity and thoroughness of this disinfection depend on the vacuum-system process.

The air is drawn from the disinfecting chamber, and as the vacuum increases the air is withdrawn from the interstices of the fabrics to be disinfected.

Advantage is now taken of the fact that a rise in the temperature takes place rapidly in a vacuum. To effect the rise in temperature, to attain the necessary degree of heat, live, dry, superheated steam is admitted to the interior of the disinfecting chamber. This steam contains in reality little more water than the air that was withdrawn, being in a finely divided state at the high temperature at which it is introduced into the vacuum. The



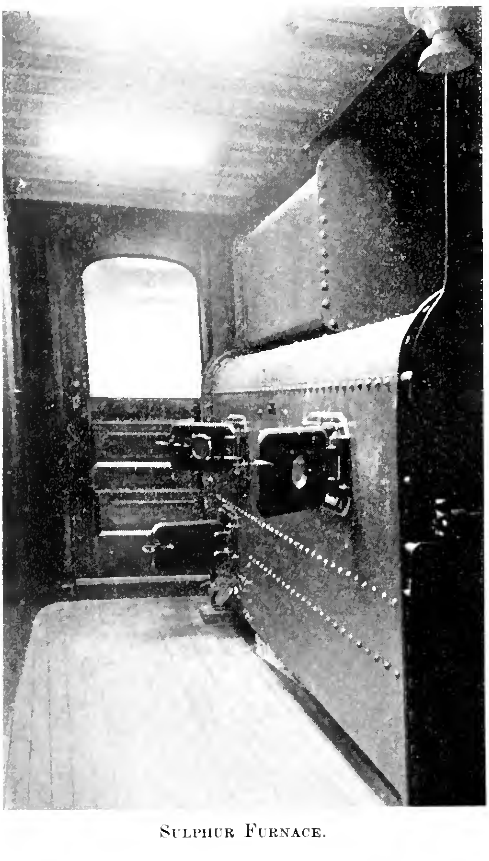
Sulphur Supply Pipes.

temperature is easily maintained, there being no air to convey away the heat; and the steam penetrates to every interstice of clothing or fabric.

After a proper temperature has been maintained for a sufficient length of time, cool air is admitted to the chamber and exhausted alternately, until the temperature is sufficiently lowered, when the clothing, etc., is removed and distributed.

The car is discharged at the opposite end of the chamber from which it entered. The huge steel chest of the disinfecting chamber is double jacketed, and protected by asbestos-magnesia covering. The operations of the chamber are controlled by means of a Foster valve.

The interior of the disinfecting chamber has fixed rails for the car to run upon, and is also fitted with a shield to protect the contents of the car from damage by condensed moisture. All water formed on the roof of the chamber drops from the shield into a receiving pan, and can be drawn off from there by a separate connection. The clothing treated is not injured in any way.



Sulphur Furnace.

The discharging end of the car opens into the room where the health officer controls the disinfecting system. This end is fitted with a door similar to the one already described. In operating the chamber, one door is closed first, and steam admitted to the jacket, and as much air expelled by expansion as possible before the second door is closed. Then the air is exhausted and the vacuum process effects a thorough disinfection.

The vacuum is produced by the siphon process: steam under high pressure is driven across the end of a tube leading into the interior of the disinfecting chamber. This tube is fitted with valves and cocks. The jacket of the disinfecting chamber is fitted with separate valves and cocks, and the temperature can be raised, if desired, without admitting steam to the interior of the disinfecting chamber.

The Wadsworth has but one boiler, but that is large for the size of the boat. It supplies steam power to work the entire disinfecting system, as well as the power to run the boat's engines. The top of the dome of the boiler is fitted with a pipe leading to an extra dome; this is the reservoir that supplies the superheated steam for the disinfecting chamber. The engines supply power to all the different pumping systems in the vessel; and fitted as the Wadsworth is with such powerful and complete pumps and hose system, she can be used as a fire boat should occasion require.

There are pumps for hot water, for cold water, for sea water, for bichloride solution, and for soda solution. The salt-water pump is made of composite metal. Ball-nozzle hose are used.

The sulphur furnace has four pans, each large enough to contain a couple of pails of sulphur. The sulphur fumes are collected and retained in a tank above the furnace, and drawn off as needed by a rotary fan, to be distributed through a huge system of supply pipes. About four pounds of sulphur to one thousand feet of cubic space is used. After the sulphur dioxide is forced through the pipe system, the sulphur can be cut off and fresh air forced through the same pipe system.

In disinfecting a vessel the soda solution is used to remove grease and render accessible surfaces in constant use, which are then washed down with the bichloride solution, which is followed by a thorough rinsing of sea water.

The crew's quarters of the Wadsworth have a separate fresh-water tank and separate bathing and toilet facilities. Cedar is the wood used throughout the forecastle, which is finished so that whitewash can be readily applied. All parts of the vessel that carry the disinfectant plant are finished so that they can be thoroughly hosed down without danger of the waste being carried to the bilge. The ventilation is as nearly perfect as possible; all the rooms and quarters have plenty of light and air.

The clothing can be treated in a very few minutes, and the rest of the process is both rapid and efficacious. The boat is in commission, and the tests have all proved satisfactory.

Now that such progress has been made in the right direction, we shall expect to see our local health departments equipped with something similar, that is at once compact and capable of cleansing and disinfecting either a room or a district at short notice.

ONE of the oldest French almanacs, described by M. Gaston Tissandier in *La Nature*, is *Le Kalendrier des Bergiers*, or Shepherds' Calendar, printed at Lyons in 1504. It contains many curious things, among them a calendar of feast days, which are calculated by counting on the fingers and joints. This is followed by some astronomical information, and then by articles—most of them curiously illustrated—on the tree and branches of the vices, the pains of hell, the book of the salvation of the soul, the "nathomie" of the human body, the art of "fleubothomie" of the veins, the astrology of shepherds, the sayings of birds, the judgments of "phigonomie," how to know the planet under which a child is born, etc.

A STUDY IN RACE PSYCHOLOGY.

By ANNA TOLMAN SMITH.

THE average American negro presents a puzzling contradiction in his educational progress. As rule he masters the elements of reading with ease; but as a rule also the developed language, the expressive medium of subtle relations and of complex experiences, defies his efforts. It is true that even the untutored roll off abstruse terms and involved phrases with peculiar unction, but this is a case of "words, words," that rather proves than disproves my meaning. I have in mind not sound as such, but sound as "an echo of sense."

The phenomenon which I have mentioned had so often been brought to my notice that I put myself at last to find out the explanation. This could only be done by examining a particular case. Circumstances determined the selection, with the result, of course, that there are conditions to be weighed in the balance. On the whole, however, the case, I believe, is typical. The subject of my experiment is very nearly a full negro, if family tradition and family features may be trusted. No trace of white blood is discernible in either parent, and their ancestors known to them for two generations back were negroes like themselves. On the father's side, tradition says, there was an Indian grandfather three removes from the present generation, but the Indian element has been lost in the transmittal, unless possibly it survives in a slight modification of the African hue. The man is of a dark coffee color, stout built, strong, sluggish, and extremely faithful, as is shown by the fact that he has retained the same place eighteen years. The mother is slightly darker in color than her husband, and of tall, supple figure; her mind is active, her movements are quick; she rules and guides her household by virtue of a superiority that all instinctively recognize. As a girl she was trained to domestic service by a painstaking mistress, while the father passed his youth as an ordinary field hand. Three prenatal conditions are typified in the name which these parents with due ceremony bestowed upon their son—Isaiah Asbury Bell. The family name is theirs only by virtue of a previous condition of servitude to planter Bell; Methodism accounts for the second name, and pious reverence for a book which neither of them can read, and perhaps a certain pleasure in euphonious sounds, for the first. The latter inference is confirmed by the names given their three daughters—Triphenie, Romana, and Albertina. This sensitiveness to sound I note as a family trait, because it may prove to have some bearing upon the boy's personal equation. Isaiah is a young edition of his father, equally sluggish, awkward, and obstinate. At the time of my experiments he was sixteen years old, and had been regularly at school since his tenth year—that is, for five years—and irregularly from his seventh to his tenth inclusive. He could read the Third Reader in a monotonous, stumbling way, perform simple operations in arithmetic quite rapidly, and write an excellent hand. As he was in my service, I thought it my duty to keep up his education, and, undismayed by many futile efforts with his predecessors in the place, I began daily reading exercises with him. Of necessity, the Third Reader does not interest a boy of sixteen, and, interest being the essential spur to acquisition, I tried the newspaper. Every day I selected some local occurrence which excited his mind, and by talking it over with him and explaining the new words endeavored to give him the mastery of the printed account. By this means the limitations of his vocabulary were soon apparent. It stopped with the names of familiar objects or of actions possible to himself. Outside of that range he never caught at new words as white children do, nor did they excite his curiosity even when the context was interesting. To illustrate: Here is a short list of words, no one of which conveyed any meaning to his mind—testify, drought, witness, apparent, fulfill. These all occurred in an account of the Knox fire, a local event which excited him greatly. We read the matter several times in slightly different forms, and I dwelt upon each of the strange words, giving familiar illustrations of their uses, but the very interest that he felt in the event about which we were reading seemed to interfere with his grasping these particulars. I think his mind never got beyond the general impression that the fire and the ruin as he saw it were described in the paper. His mental state, as it was revealed to me through his reading, might be described as unanalyzed content. Eager to get the true measure of his verbal power, I applied the familiar test of instantaneous associations with a given list of words. I submit the best results that I obtained after repeated experiments with varied lists:

CONCRETE TERMS.

	Associated Ideas.	*Words.*	*Associated Ideas.*
Pole	North.	Vase	Blue.
Book	Black.	Hat	White.
Pencil	Lead.	Horse	Brown.
Paper	Reading.	Bear	Grizzly.
Fire	Place.	Procession	Street.

I had great difficulty in finding abstract terms which excited any response, but finally secured the following:

Words.	*Associated Ideas.*	*Words.*	*Associated Ideas.*
Strength	Man's.	Anger	John (the name of a comrade).
Memory	His.	Fear	Not.
Sorrow	His.	Disobedience.	
Time	Piece.	Love	He.
Courage	Dog.	Kindness.	

These experiments continued for some time. Meanwhile, vacation days having ended, Isaiah returned to school. Unfortunately, the boy had been kept grinding at the elements when flexibility and susceptibility had long passed their zenith. He had at last, however, arrived at the dignity of geography, which lent momentary zest to his flagging spirits. To encourage the new zeal, I talked over the subject with him at night. A lesson on the races of men seemed to impress him more than usual. When I asked him to repeat the five races whose names and traits he had learned in the morning; he recalled all but the Malay. I finally told him the forgotten name, when he instantly responded, "Oh, yes, the malaria race!" I repeated the name several times without comment, but he failed to notice the distinction. The very next evening a little white girl of ten years, who had also just entered the fifth grade, was telling me the same lesson, and she, like Isaiah, had forgotten the name of one race, the Mongolian. After the omission had been supplied, I turned to her mother and told the story of Isaiah's slip. Quick as a flash and with evident amusement the child exclaimed, "Oh, he mistook a disease for a people!" The inference is plain: the one had groups of apperceptions in her mind that were entirely wanting to the other.

That I may not fail to give the positive side of Isaiah's linguistic attainment, I present here a specimen of his original composition. It is an account of a feature in a well-known game which, so far as I can ascertain, was introduced by colored boys:

"The first boy who I new to play prisoners-base was Charles H. Dorsey And the way you play it is to have equal number on each side of the street and one has to show a lead if he get cought he has to hold out his hans, And if he falls he will say broken bones."

The statement, it will be seen, comprises fifty-five words besides a proper name. Of these, all but four are monosyllables. A peculiar phrasing not unlike that common among deaf-mutes has resulted from the boy's inability to master the subtleties of connecting particles.

The facts here presented are not, in themselves alone, either novel or significant. The question which they raise is, however, fundamental. Are they the sign of inherent deficiency or are they the outcome simply of external conditions? In dealing with Isaiah I recognized that he had come rather late to the elements; this happens also with many white boys, and is by no means an insuperable obstacle to future progress. The circumstance really facilitated my study, as it gave me mental states more positive and well defined than those of younger children. Evidently the problem before me resolved itself into two conditions: the mind of the boy—his environment. The estimates of mind, reading, writing, etc., which formal education employs were evidently not applicable to this individual upon whom the school had left so slight an impress. While I was revolving the matter a new mode of testing his mental powers was suggested. I chanced one evening to be arranging some sets of small color cards in Isaiah's presence. It was evening, the light was dim, and I had difficulty in distinguishing the slightly different tints of the French blues and greens. Whenever I hesitated the boy, who was watching the work with undisguised interest, would instantly pick out the right card. As it was in a range of æsthetic tints which I was certain had had no part in his customary surroundings, I inferred that he had been through color exercises in school. Inquiry proved that I was mistaken; color perception and color distinction were natural powers improved simply by the observation of familiar things. Here too I discovered that a network of associations had arisen, the very condition whose absence had made advance in reading so difficult. His color associations were with natural objects, chiefly fruits and birds—for example, red with an apple, the inside of a melon, a robin's breast; blue with the sky and the jay, yellow with a lemon, and so on. Flowers he seldom mentioned. The reason is obvious. He had a gourmand's taste, and was already quite an experienced hunter. Associations ended with the primitive colors, his ready recognition of shades and hues being a mere matter of immediate perception.

A possible mode of applying the hint thus obtained was suggested by the memory tests described by Prof. Munsterberg in the Psychological Review for January, 1894. The material employed (i. e., colored squares, three and a half centimetres) was easily secured and was of precisely the kind to excite distinct perceptions in Isaiah's mind. Beyond the arrangement of the cards there was, however, no likeness between my experiments and those of Prof. Munsterberg alluded to. The series employed by me were shorter than his, consisting each of ten cards instead of twenty, arranged either for simultaneous or for successive presentation. My subject went through no preliminary training, and no time limit was set for his observation. He was at liberty to look at a series till he thought he knew it, when he proceeded to arrange a duplicate set of the cards in the same order from memory. He had no idea of my purpose but regarded the exercise as a game, a notion which I encouraged by now and then pitting myself against him. Simple as the exercise appears, it afforded a clearer view of Isaiah's mind than speech could possibly have done. Here, at the stage of simple sensation and within the psychic circle that it evolves, he was all alert and responsive. It is difficult for me to convey a clear idea of his awakened activities; I can only sum up what he did in dry statistics, which are meaningless aside from comparison. I should add, with reference to the experiments, that in the absence of apparatus for signaling our expedient was as follows:

At the word *now* from Isaiah the series presented was covered and the duplicate set of cards placed before him. An assistant, watch in hand, marked the time passed both in examining and placing the cards. I did not caution Isaiah against the use of mnemonic devices, for I judged that he knew none, his range of associations being extremely limited. The experiments were made from twice to three times a week for about five weeks. In three instances, the same series was repeated twice in succession, in every other case a series was presented but once. The summary of results is as follows: Simultaneous presentation, eighteen series, ten colors each; average time for learning each color, five and three fourths seconds (or fifty-seven and a half seconds per series); average time for placing each color, nine and two thirds seconds, or one minute and thirty-six seconds per series; percentage of errors, 36·6. Successive presentations of ten series, ten colors each; average time for observing each color, five and three fifths seconds; average time for placing each color, nine and three fourths seconds; percentage of errors, twenty-nine.

I made occasional essays with aural series—i. e., reading the names of the colors arranged until Isaiah was ready to replace them. Of these I preserved only the following record: Four aural series, ten colors each; average time for learning each color, five and five sevenths seconds; average time for placing each color, six seconds; percentage of errors, fifty.

The experiments having proceeded thus far, I entered upon an educative series. By this means the time for learning a series was reduced to half a minute, and for placing the same, to forty-five seconds, while the percentage of errors fell to sixteen.

In arranging the series the boy's action was slow, and he seemed able to begin indiscrimately at either end or in the middle. Apparently he recalled the colors partly by name; this, however, helped him little, as he did not know the names of shades and neutral tints. I tried having him count, as a means of inhibiting the names when he was examining the cards, but I thought this helped rather than hindered, as the name attached itself to the number that fell to it; in other words, here his mind instantly formed new associations. It would be absurd to compare the results of these experiments with those of Prof. Munsterberg already alluded to. The latter were performed upon adult subjects who were in training for the work, thoroughly possessed of its purposes, and supplied with instruments of precision for signaling, record, etc. Nevertheless, one can hardly fail to note that while the average time required by Isaiah for learning a series was from two to three times that allowed the trained students, his percentage of errors was on the whole less than their average. To realize exactly what the results indicate, one should try to see how many colors of a series he can replace after viewing them less than a minute.

I have given here a record of memory tests that were pursued systematically for a short time. Circumstances soon changed, and I was only able to make an occasional experiment with more complicated material; but one point was established to my satisfaction—namely, that Isaiah was endowed with the germs of mental life, perception, association, and memory. The question remained why these were not active in that most important of all school exercises—reading. The answer is to be found partly in the negroes' quick response to sense impressions. All persons familiar with their habits have noticed this susceptibility, but I believe Mr. R. Meade Bache is the first to bring it to proof in the laboratory.

The results of his experiments, presented in the Psychological Review of September, point very clearly to the conclusion that the negro race is superior to the white in automatic power. Here, I believe, we have the key to Isaiah's success in reproducing an impression received through the senses, and also, in general, to the ease with which children of his race go through the elementary process of learning to read. Speech is a power that comes to most of us unconsciously, and the first stages of reading require little more than the visual recognition of signs that stand for familiar things. But, this stage passed, every word is a generalization, back of which lie traditions, customs, experiences, sentiments, and ideas, which are the heritage of a race. They are the stuff of the mind transmitted from generation to generation through the myriad channels of family, of social, of school, of church, and of business life. It is obvious that to a race wanting in our own experiences a large part of our vocabulary must be meaningless. Analogous experiences, of course, give insight into a foreign tongue, but here the colored child is at a peculiar disadvantage. The traditions of African savagery, even if they had reached him, offer no likeness to the history of the Anglo-Saxon. Slavery was a state with laws and customs and ceremonies bearing certain resemblances to our own, but the negro who has passed through this state to the freedom of American citizenship is, as it were, a man without ancestral history. Instead of cherishing his past and trying to impress its memories and ideals upon his children, he seeks rather to destroy them. He reacts against his past and inhibits it. On the other hand, he has not yet become sufficiently possessed of our civilization to impart its mother-lore to his children. The absence of social restraints, either in the form of crude superstitions or of complex sentiments and ideals, explains perhaps the frequent outbursts of ferocious passions on the part of negroes; the same condition insures also a primitive state of Nature in their children. Scientific research affords proof of the fundamental unity of mind, but it gives no less decisive proof of differences due to ancestry and training. The negro child is psychologically different from the white child. In automatic power he is superior, but in the power of abstraction, of judgment, and analysis he is decidedly inferior. This fact must be recognized in the school training. In purpose and in liberal provision the education of the negro should be the same as that of white children. In detail and method it should be adjusted to the racial plane on which he stands.

But to return to Isaiah. Vacation having ended, he was sent back to school to resume the rehearsal of lessons that conveyed no meaning to his mind. Fortunately, he made a venture for himself and secured the drummer's place in a band; this occupied all his spare time and afforded an outlet for his automatism, with a pecuniary advantage besides. At the end of the year my persuasions added to his strong personal desire prevailed, and he was allowed to quit vain repetitions and go to work. His place in the industrial world is a humble one, for, in spite of the fact that his parents have been willing to give him much more than the average time at school, he has not been raised above the rank of unskilled laborers. This it seems to me is unpardonable. A youth in whom perception, memory, and simple judgment are active might, I am confident, in ten years have been raised a little higher in the scale of independent being. If he had been at Hampton or Tuskegee, the result would have been different, for in these he would have been educated through experiences, social and industrial. In the public schools within his reach he must drill over the elements, to the arrest of development, or go forward to abstract thought of which his mind was incapable. I have dwelt upon a particular case because it is a psychological type. It confirms what the laboratory indicates—namely, if races are to be developed by formal education, its processes must be conformed to their conditions, not *vice versa*.

THE POPULAR ÆSTHETICS OF COLOR.

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THE human race, like most large groups in Nature, presents a considerable variety amid a still more fundamental similarity. It is evident that, if only we measure finely enough, no two specimens, however simple, are precisely alike; and in proceeding from the simple to the complex the opportunity for variation and diversity rapidly increases; and yet amid all this diversity of individuals there is much that is common, typical, and similar. In mental processes, with which we are here primarily concerned, it seems fair to expect that, given the same premises and a fairly simple problem, similar conclusions will be reached by different individuals, owing to the similarity of the logical processes involved. But we know very well that when these processes are complex, and particularly when the emotions and interests of men are involved under substantially similar circumstances, very diverse conclusions may be reached, until, in extremely complex questions and in those in which personal interests are dominant, we find *tot homines tot sententiæ*.

Of all varieties of human judgment, the ones generally considered as least subject to rule and most open to caprice are those commonly referred to as questions of taste. These questions of taste refer partly to our individual and peculiar likes and dislikes, and partly to our more strictly æsthetic preferences and aversions. Æsthetic judgments, however, are subject to the influences of heredity and environment, of education, of general mental development, and the like. We speak of certain preferences as childish, as savage, as Philistine, as uneducated, as national, as local, as a fashion or a fad. In some directions it is possible to gather an æsthetic census and determine in a statistical way the distribution of particular likes and dislikes, and to attempt to gain from such material some suggestions of the underlying laws in obedience to which certain sense-perceptions are judged to be more or less pleasure-giving than others. The æsthetic relations and proportions of simple geometrical figures and lines have been studied by this method, and it is very readily applied, as is to be attempted in the present paper, to the study of the nature and distribution of color preferences.

The material for the present study was collected in connection with the Psychological Laboratory of the World's Columbian Exposition, held in Chicago in 1893. The public was invited to record its color preferences by means of a placard, which was displayed in a well-lighted corner of the laboratory, bearing the inscription shown on page 363.

This method of voting was made possible by having on hand a constant supply of small cards, each bearing a number from 1 to 25, and arranged in numerical order in small boxes or trays. Of such boxes there were two sets, one containing square and the other oblong cards. By means of these devices the *shape* of each card dropped into the ballot box indicated the sex of the voter; the *printed number* on its face indicated the voter's favorite color; the *letter written* on its back, his preferred combination of colors; the *number written* on its back, his age; and the fact that all this information was recorded on one card established the relation between the preferred single color and the preferred combination of colors.

The colors thus displayed were those bearing these names in the series of colored papers prepared by the Prang Educational Company, and to Mr. Prang my obligations are due for very material assistance in this investigation. I am also indebted to Dr. Herbert Nichols and Mrs. M. D. Hicks for the selection and arrangement of the colors and the permission to use the color scheme prepared by them for the study of color preferences. In such a study only a small and somewhat arbitrarily selected range of colors can be conveniently presented, and it is likely that the results may be to some extent influenced by the particular colors among which a choice was requested. Regarding the nature of the colors here presented, it may be noted that the twenty-four single colors fall into two groups of twelve each, the second group forming respectively the lighter shades (in the same order) of the colors in the first group. Each group of twelve colors is composed of the six "primary" or "normal" shades of the colors red, orange, yellow, green, blue, violet, and of six intermediate or transitional colors—red orange, orange yellow, etc. In the color combinations no transitional colors are used, and, so far as is possible in twenty-four combinations, a wide range of grouping and combination is presented.

The material thus gathered, about four thousand five hundred records in all, may be considered from a variety of points of view, and may be made to furnish interesting information regarding the range and distribution of average color preferences. We shall consider first the preferences for the single colors and for color combinations as they occur in the general average, and then ascertain how far these preferences are modified by differences in sex and in age.*

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* During the two months or more during which the public was invited to vote its color preferences 4,556 cards were dropped into the box, 2,746 (about three fifths) by men and

1	RED
2	RED-ORANGE
3	ORANGE
4	YELLOW ORANGE
5	YELLOW
6	YELLOW-GREEN
7	GREEN
8	BLUE-GREEN
9	BLUE
10	BLUE-VIOLET
11	VIOLET
12	RED-VIOLET
13	LIGHTER RED
14	LIGHTER RED-ORANGE
15	LIGHTER ORANGE
16	LIGHTER YELLOW ORANGE
17	LIGHTER YELLOW
18	LIGHTER YELLOW-GREEN
19	LIGHTER GREEN
20	LIGHTER BLUE-GREEN
21	LIGHTER BLUE
22	LIGHTER BLUE-VIOLET
23	LIGHTER VIOLET
24	LIGHTER RED-VIOLET
25	NO CHOICE

STATISTICS OF COLOR PREFERENCES.

First, decide which of the colors in the upper row is most pleasing to you; then take a card with the *number* of your preferred color upon it, and,

Second, decide which of the combinations of pairs of colors is most pleasing to you; then write the *letter* corresponding to your preferred combination of colors upon it; add your *age*, and drop it in the box.

Number 25 and *Letter Y* are provided for those who have no preference.

MEN will please use the *square*, and WOMEN the *oblong* cards.

A	GREEN	RED
B	BLUE	ORANGE
C	VIOLET	YELLOW
D	LIGHTER GREEN	LIGHTER RED
E	LIGHTER BLUE	LIGHTER ORANGE
F	LIGHTER VIOLET	LIGHTER YELLOW
G	LIGHTER GREEN	RED
H	LIGHTER BLUE	ORANGE
I	LIGHTER VIOLET	YELLOW
J	BLUE	RED
K	VIOLET	ORANGE
L	GREEN	YELLOW
M	LIGHTER BLUE	LIGHTER RED
N	LIGHTER VIOLET	LIGHTER ORANGE
O	LIGHTER GREEN	LIGHTER YELLOW
P	ORANGE	RED
Q	YELLOW	ORANGE
R	VIOLET	BLUE
S	RED	VIOLET
T	YELLOW	RED
U	GREEN	ORANGE
V	BLUE	YELLOW
W	VIOLET	GREEN
X	GREEN	BLUE
Y	NO CHOICE	

Our first interest lies in determining what colors are the general favorites. The first place is held by *blue*, which is selected as the most pleasing color by slightly more than one quarter of all the voters; and the second place, though not a good second, by *red*, which is chosen by somewhat less than half as many as choose blue. In the next group of most pleasing colors are found *lighter blue, blue violet, red violet, lighter red* (or pink) *violet*, and "*no choice*," while the five least favorite colors are *orange* and its shadings toward red and yellow. In order to illustrate the significance of this result it may be noted that the *four* colors, *blue, red, lighter blue*, and *blue violet*, constitute just about *half* the entire preferences; or, again, if we divide the number of records into four approximately equal parts, *blue* would constitute the first quarter; *red, lighter blue*, and *blue violet* the second quarter; *red violet, lighter red, violet*, "*no choice*," *green*, and *yellow* the third quarter; and the remaining *fifteen colors* would constitute the last quarter of the color preferences.

It will be remembered that the colors presented for selection were divisible into two groups, the one group composed of the lighter shades of the colors of the other group. On comparing the preferences between the two groups it appears unmistakably that the *darker colors are decidedly preferred*. Of every seven persons five choose among the darker colors and only two among the lighter. An equally unmistakable tendency is the preference for the primary colors—i. e., red, orange, yellow, etc.—as opposed to the transitional ones—i. e., red orange, orange yellow, etc.; this preference is nearly as marked as that of the dark above the lighter shades. This seems to indicate that colors more distinctly corresponding to familiar shades and names are apt to be chosen as opposed to those that are less typical and familiar. All these results appear so clearly and strikingly that they may be regarded as possessing considerable general validity.

We may now consider the color preferences of the two sexes. The differences between the male and female preferences are con-

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1,810 (about two fifths) by women. Of these, only 3,043 (1,864 men and 1,179 women) indicated both the preferences for the combination of colors as well as for the single color, and only 2,594 (1,548 men and 1,046 women) recorded their ages. These numbers are suggestive, as indicating that, of all those sufficiently interested to stop and select a color, only *fifty-seven per cent* were careful to follow the entire directions, while just about two thirds did as requested, except that they did not record the age. In all these respects the women are no more nor no less accurate than the men.

The ages of the voters cover a wide range, from six to seventy years. The age best represented occurs at about twenty-two years. One half of all the voters are between nineteen years and six months and thirty-five years of age, and two thirds of them would be between seventeen and thirty-nine years old. The age distribution of the men and women presents no significant differences.

siderable. While *blue* is pre-eminently and overwhelmingly the masculine favorite, it is by no means so general a feminine favorite. The favorite woman's color, standing at the head of the female list, is *red*. Roughly speaking, of every *thirty* masculine votes, *ten* would be for *blue* and *three* for *red*; while of every *thirty* feminine votes, *four* would be for *blue* and *five* for *red*. Red and blue are thus much more nearly equally popular among women than among men. Other relatively marked masculine preferences are for the colors related to blue (blue violet and violet), and other feminine preferences are for lighter red (or pink), and, to a less extent, for green and yellow. Further, men confine their selections to relatively fewer colors than do women; and finally, while all men and women alike are much more apt to choose a normal than a transitional color and a darker than a lighter shade, yet the tendency to do so (about the same in the former direction) is markedly different in the latter respect; of a *dozen* men, *ten* would choose among the darker colors and only *two* among the lighter for the most pleasing color; while of a *dozen* women, *seven* would choose among the darker and *five* among the lighter shades. This feminine fondness for the lighter and daintier shades appears also in other respects, to be noted presently.

Passing next to the discussion of the preferences among the combinations of colors enumerated above, the first noteworthy result is that no combination of colors occupies the position of a decided favorite as did blue among the single colors; but that preferences for the several combinations vary gradually from the most to the least favorite. The two most frequently (and about equally) preferred combinations are *red with violet* and *red with blue*, which are somewhat similar in effect (the violet being very dark in appearance); more than *one fifth* of all the persons contributing to the results choose one or the other of these combinations. The third in the list is *blue with violet*. The three most favorite combinations are those composed of the three colors, *red*, *violet*, and *blue*. The next position on the list is taken by those who are unable to decide upon any one combination as their favorite, and it should be noted that this group is nearly twice as large in the selection of the combination as it is in the selection of a single color. Then follow *lighter red with lighter green*, *red with green*, *lighter red with lighter blue*, and *red with lighter green*. Some one of the above *eight* color combinations was chosen by *three* out of every *five* persons who recorded a preference, the remaining *two fifths* of the preferences being distributed very widely and rather uniformly among the remaining *seventeen* colors. The combinations most generally avoided are *orange with green*, *orange with violet*, *lighter orange with lighter blue*.

Before leaving this division of the subject one further conclusion may be indicated. This relates to the relative frequency of the several colors in the color combinations. Such a comparison is possible only for the normal or primary colors and their lighter shades, and is further hampered by the fact that the several colors are not equally offered for selection in the color combinations. A method of comparison making allowance for these points yields the conclusion that, on the whole, the same colors are preferred and avoided in both the single colors and the color combinations. While the order of preference is measurably the same, we find no such decided favorites as is blue among the single colors, but that the several colors are much more uniformly represented. Red and blue and violet and lighter red are near the head of both lists, and orange and lighter orange at the foot of both. The most striking exception is lighter green, which is very rarely chosen as a single favorite color, but appears frequently in the color combinations. It may also be observed that on the whole the lighter shades of the colors appear relatively more frequently in the color combinations than in the single color preferences, and that this is particularly the case for the women.

The results of the comparison of color preferences for those of various ages are somewhat meager. This is probably due to the wide distribution of age here represented. It is probable that the characteristics peculiar to certain ages could be best determined by recording the preferences of large groups of persons of nearly the same age—a form of investigation that is particularly desirable among children, in whom changes of taste are going on more rapidly than in older persons. For the purposes of comparison the ages were divided into five groups, the number of records in each group being approximately the same. The groups thus formed are for the youngest, eighteen years and below; the next, nineteen to twenty-four years; the third, twenty-five to thirty years; the fourth, thirty-one to forty years; and the oldest, forty-one years and above. The most noteworthy characteristic of the color preferences of these groups is their general similarity; but there are four indications which are sufficiently marked to be probably free from chance. These are, that *blue* is least selected by the youngest group, about equally by the three middle groups, and decidedly preferred by the oldest; that *violet* is gradually avoided as age increases; that those who make most use of the "no choice" column are between twenty-five and thirty years of age; and that *lighter red* is particularly preferred by those below eighteen years of age. It is equally difficult to detect any marked differences between the sexes respecting their color preferences at different ages, but it is perhaps not accidental that in these results the liking for *pink* (*lighter red*) is confined to young girls, and does not appear among boys, and that lighter violet is more distinctly preferred by the older women than by the older men.

The method of collecting these preferences, it will be recalled, enables one to know the combinational color preferences of the individuals who choose a given color as their favorite. It is thus possible to study the correlation that may exist between the choice of a single color and the choice of a color combination. It will not be worth while to do this except for those colors that are chosen by a relatively large number of individuals. Taking, for example, those who choose blue as their favorite color, we find what combination of colors these "blue-choosers" were most prone to select, and so on for those who chose red, lighter blue, blue violet, red violet, lighter red, violet, and green. The first marked result of such a comparison is to show that the *favorite color is extremely apt to reappear in the combination of colors.* The evidence for this may be given in some detail. If we represent by 1 the proportionate choice of a combination having the color blue in it in the general records, we find that the number expressing how many of the "blue-choosers" would also choose a combination in which blue occurred would be 2·17, or more than twice as many as the general average. So for *red* it would be 1·87, for *lighter blue* 3·98, for *lighter red* 3·82, for *violet* 2·85, and for *green* 4·44; or on an average 3·18, which means that a person who has chosen any one of the above colors as his favorite color is more than three times as likely to choose a combination in which that same color appears as is the average chooser. It also appears that the men obey this tendency slightly more than the women.*

Having found characteristic differences between the single color preferences of the sexes, we are prepared to find them as well in the preferences for color combinations. On the whole, the order of preference of the combinations of colors for the men and for the women is very much alike; and when they differ it is frequently doubtful, especially when the combination of colors is rarely selected, whether such differences are accidental or not. Of the masculine preferences those which seem most decided

* Several other "correlation" conclusions may be drawn, of which the following are the most interesting: It appears that the men who are rather exceptional and choose a color which is a common feminine favorite, and the women who select a typical masculine color, are more apt than the more conforming choosers to retain this color in their color-combination preferences; it also appears that the tendency to retain this favorite color is limited to the same shade of color and does not apply to a different shade of the same color, and it further appears that those who select a favorite color which is selected by a relatively large number of persons are more alike in their combination preferences—i. e., they confine their selections to a more limited range of color combinations than those whose preferred color is not a popular favorite.

are for the *red with blue* combination and the *blue with violet,* there being *five* men to *one* woman choosing the former, and *three* men to *one* woman choosing the latter; while the most marked feminine preferences are for the *lighter red with lighter green, red with green,* and *red with lighter green,* there being nearly *four* times as many women as men choosing the former, *twice* as many the second, and *two and a half times* as many the last of these three. We observe in these differences the reappearance of the masculine preference for *blue* and its related colors, and the feminine preference for *red,* and also the feminine preference for the lighter colors. The liking for combinations of red with green in their various shades seems also a particularly feminine fondness.*

In reviewing these results of this popular census of color preferences, it is apparent that while in some directions the conclusions seem clear, suggestive, and interesting, in others their interpretation and value are at present doubtful or defective. It must, however, be borne in mind that these returns have been gathered among the general public and by only one of several methods; their full significance can hardly appear before special studies shall have been made of the influences upon color preferences of age and nationality, of education and special artistic endowment, of conventionality and association, and of the many other factors that contribute to the complexity of even the simplest æsthetic judgments. For the present, the results are presented as merely an initial contribution to the statistical study of the popular æsthetics of color.

An interesting case of mimicry is described by Mr. Charles A. Witchell as shown in his brother's Dandie Dinmont terrier, which was in the company of a fine mastiff for a short time when young. "The little dog was somewhat awed by the great beast, which could easily have made a meal of him; but he was evidently very proud to be allowed to accompany her for a ramble in the country." In a short time he began to try to reproduce her baying, which was much lower in pitch than his bark, and made very great efforts to accomplish it, which he finally did very successfully. "He raised his head and uttered a great bark, about an octave in pitch below his usual tone. All his breath was exhausted by the effort, and he immediately coughed, as though his larynx had been strained." Mr. Mitchell also observes that when one of the fish in his aquarium gaped, any other one near would be tolerably certain to gape soon afterward.

* It is possible to calculate for the men and women separately the tendency to select given colors in the color combinations (irrespective of the colors with which the given color may be combined). Such a comparison yields the conclusion that the colors relatively better represented in the combinations of color than in the single colors are, for the men, *blue* and *violet;* and for the women, *lighter red, lighter yellow,* and *green.*

EVOLUTION OF THE CARRIER PIGEON.

By M. G. RENAUD.

THE exhibition at the Trocadero and the dispatches of pigeons recently made at sea have attracted public attention to what may be called *columbophilism*. They have, moreover, revealed the existence of many flourishing societies that display their activity in the training of hundreds of thousands of pigeons. It is worth while to inquire into the motives which have provoked this enthusiasm concerning these birds.

Messenger pigeons are certainly of great service in time of war as means of communication between different parts of the army and the country when the telegraph lines have been broken. But this does not account for the great extension which has taken place in the last few years in pigeon-training. Belgium, for example, has as many pigeons as all the other European countries put together. But in selecting and training the best varieties of pigeons the Belgians have not been actuated solely by considerations of national defense. Their interest in their favorite sport is largely determined by the excitement of gaming, and their Sunday pigeon matches are occasions of much betting. Very few persons think now of utilizing the pigeons for purposes of daily life. They have the telephone, telegraph, and mail; why should they go back to so primitive a method of correspondence? Hence an excuse is devised for relegating the pigeon to the category of luxuries. We hope to show that it is something more important. We believe that relations of every kind would gain much in convenience if the pigeon was employed concurrently with the most improved means of correspondence. This useful messenger might in many cases supplement or even take the place of the post and telegraph. The most elaborate system of telegraph lines can only serve places of a certain degree of importance, and they are not built to effect connections the use of which is not constant or profitable enough to justify the expense of constructing and maintaining them.

Most valuable use has been made of carrier pigeons in the past. The ancient civilized empires of Asia included many perhaps relatively well settled regions infested by robbers and extensive deserts through which well-armed caravans passed but inconveniently and where the most secure means of communication was by means of these birds. The Greeks borrowed the use of pigeons from these nations, and an Eginetan athlete sent home the news of his victory at Olympia by means of one of them. The Romans had a system of optical telegraphy and supplemented it by pigeons. The use of this aërial post became more and more general toward the end of the empire. In the middle ages the news of the capture of Damietta by St. Louis was announced to the Sultan by this means. At a later date pigeons rendered important services in sieges like those of Haarlem and Leyden. The pigeons of St. Mark have been taken care of since the thirteenth century in recognition of the services which they rendered to the republic during the siege of Candia by Dandolo. During the continental blockade the financiers of the continent kept up communications with their London correspondents by pigeons. After normal national life was restored to Europe and as the improvement of communications went on, the service of the pigeon post was neglected till the siege of Paris in 1870 called it to life again. But the fishermen of Boulogne, Dieppe, and Saint-Malo still send pigeons forward in advance of their boats as they are returning home, with reports of what their catch has been.

The birds that stock our pigeon houses are of the Belgian breed, which has been developed by centuries of selection from the rock pigeon. This breed differs much from its wild ancestors in habits and instincts. The carrier pigeon is not quite so large as the ring pigeon, but has a more expressive head, more elegant form, and a more brilliant and more varied plumage. The training of the young pigeons begins when they are three or four months old. They are let loose at gradually increasing distance, all in one direction, from the pigeon houses. At six months of age one should be able to return from a distance of two hundred miles at a speed of fifty miles an hour. At the end of the second year it should come back from distances of more than three hundred miles, and of the third year from six hundred miles. Pigeons return more rapidly from places lying in the direction in which they have been trained. Training in one direction has some advantages and several disadvantages in practice; but as the trainer of to-day is not seeking useful results, but simply to beat in the races, he adopts the method best adapted to his purpose. As the races at the same city always take place over the same course, why take the trouble to give the birds a various training? Under the stimulus of the races and through the training for them, a great improvement has been effected in the quality and powers of pigeons.

Two interesting questions present themselves concerning the length of time during which the pigeon can recollect the place of his home and the distance from which he is able to find his way back to it. Some birds have found their way home after five years' absence; and it is generally considered that good birds can be depended upon for six months. Pigeons have returned from Vienna and from Rome to Brussels, and others, sold to be carried away to America, have made their way back to their original owner in Belgium.

When pigeons were to be sent back and forth, it has been usual to keep two sets, with their respective homes at either end of the course; and when they have reached their home, to carry them back to the places from which they are to be dispatched. An ingenious process has been devised to overcome this difficulty and cause the birds to fly with equal certainty in both directions. Pigeons, for example, whose home is in Paris are confined for several days at St. Denis, and fed there at a stated hour every day with some favorite food which is not given them at their real home. They become in the course of time familiar with their new home and its choice dishes. When set at liberty, they start off at once for Paris, without forgetting the good things they enjoyed at St. Denis. When they are to be sent back, they are made to fast a little while, and are then let loose at about feeding time at St. Denis. They go thither, and, when they have their own way, time their going so as to be there at the exact moment of feeding. Birds have thus been taught to fly back and forth regularly between places thirty miles apart.

When a carrier pigeon is set at liberty at a distance from its home, it rises in the air, describing a spiral, higher and still higher, then takes a start. In about a quarter of an hour it will be seen again directly above the point at which it was freed. It starts thence anew, and takes the right direction without hesitation. Compare this quickness of decision with the embarrassment experienced in a strange region by an intelligent man who has read up about the country and is fortified with all the knowledge concerning it that science can give him!

The sense that guides the pigeon in its direct return to its home is as much a mystery as it ever was. It is not sight, for the bird at its highest flight can not command the vision of a single familiar object or place. Theories of electric currents have been imagined and other methods of analyzing and explaining the instinct have been devised, but they are all alike conjectural and insufficient. But while we do not know the cause or the method of the faculty, we have it in our power to modify and direct it in a certain degree. To the wild pigeon, which goes far in search of food, the power to find its way back to its nest is a necessary condition to its existence. The domestic pigeon does not have to go long journeys for food, but its return home is nevertheless determined by this question. The best fliers are those which are least competent to pick up anything to eat on the road. The sense of orientation—the homing sense—has been cultivated and bred in them at the expense of other faculties which have become less useful to them. While very poorly armed to contend with the conditions of a wild state, the carrier pigeon is perfectly equipped for its present conditions of existence and for the services that are demanded of it. Its faculties have been developed and specialized in the direction sought by the breeder. Man does not create in selecting; he exerts no immediate influence on the production of variability. He contents himself with exposing organized beings, for a special purpose, to new conditions of existence. Nature then acts on the organization and causes it to vary. Man chooses the variations which Nature furnishes and accumulates them. This is the principle, the application of which has given us races of pigeons with very different aptitudes. For example, French and Belgian breeders select with a view to success in the races, and often specialize the instinct of their pigeons. Birds from the same stock will, for instance, be trained for generation after generation to the east-to-west direction; and if we take a pigeon without being acquainted with the special aptitude of its ascendants, and try to train it to the north-to-south direction, we shall probably meet with mishaps. In England, where much fog prevails, the breeders keep only the birds that can fly through a misty atmosphere. The English breeds have consequently a capacity for finding their way in weather which would often baffle the pigeons of other countries. For like reasons pigeons raised in Sweden and Norway are able to return to their homes in the face of snow, which often puts the instinct of French pigeons to fault. The training of pigeons at sea requires special aptitudes, which a rational breeding will develop by selection.

We read in books on pigeon culture that the carrier pigeon is hardly ever white. The reason for this is very simple: pigeons on their journey are selected by birds of prey, which most readily pick out those of conspicuous colors; consequently these birds disappear without having opportunity to found a stock. This observation does not apply so much to the common pigeon, which, never straying far from habitations, is less frequently struck by the hawk. So pigeons flying near the ground are certain to fall sooner or later under the shot of the hunter, and usually leave very few descendants. This circumstance, independent of our will, often intervenes to play an important part in the transformation of a domestic species.

Selection permits us to adapt our races to any sort of service. We might, for example, create a stock of birds that would retain the recollection of their home for a very long period; we might develop the aptitude for traveling back and forth. We have sometimes asked ourselves what limit could be fixed to the utilization of the carrier pigeon. To fix a limit would be to deny the principle of transformability of species, which is a law of evolution. Our races are continuously undergoing modification, and are consequently capable of indefinite improvement. Instead of looking for limits to the employment of the pigeon, we should point out some practical object to the trainers, and tell them simply we want birds that will come back in all weathers, in every season, and from all points in the horizon. Our demand would be promptly fulfilled. The bird is very prolific, and the task of the trainer is further facilitated by the fact that pigeon-matings are for life, unless the couples are forcibly separated; and it is therefore possible, without difficulty, to keep many varieties distinct in the same pigeon house.—*Translated and abridged for the Popular Science Monthly from the Revue des Deux Mondes.*

SPIDERS AND THEIR WAYS.

By MARGARET WENTWORTH LEIGHTON.

Spider,
At my window spinning,
Weaving circles wider, wider,
From the deft beginning;

Running
Rings and spokes, until you
Build your silken death-trap cunning—
Shall I catch you—kill you?

Sprawling,
Nimble, shrewd as Circe;
Death's your only aim and calling,
Why should you have mercy?

Strike thee?
Not for rapine willful:
Man himself is too much like thee,
Only not so skillful.

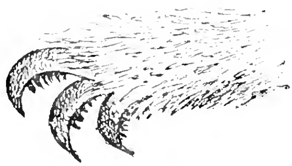
—George Horton's *Songs of the Lowly.*

NOT so skillful, and doubtless never will be, for to-day a spider's thread is used in the telescope because man has been unable to manufacture one so fine and delicate.

Whenever I look at the marvelous web of the great black-and-gold garden spider I remember that pretty story of the way in which the group of spiders received its name of *Arachnidæ.* In the olden times there was a lovely maiden named Arachne, who could weave and embroider with such deftness that the nymphs all gathered to watch her. They whispered to each other that she must have been taught by Minerva herself, who was the goddess of Wisdom. Arachne overheard them, and, denying their accusation, challenged Minerva to a trial of skill. Minerva accepted the challenge, and when the webs were woven Arachne's was wonderfully beautiful, but Minerva's far surpassed it.

Arachne was in despair and hung herself, whereupon Minerva's chagrin was so great that she transformed her into a spider, and her descendants preserve much of her skill.

We are apt to think of spiders as insects, but really they are only distantly related to insects, their first cousins being scorpions and king crabs. The spider's body consists of two parts. It has four pairs of legs, a pair of palpi, and a pair of mandibles. The legs are jointed, and on the last joint there are three claws. The palpi are used as feelers and to hold the food. The breathing apparatus of the spider is a combination of lungs and gills. It has glands containing poison which lie partly in the head and partly in the basal joint of the mandibles. There is a tiny opening in the claw on the mandible, out of which the poison flows when the spider captures its prey. It has eight eyes. The spiders are classified largely by the different arrangements and grouping of the eyes. Some have them in one or more clusters, some in rows, and others scattered about. They appear to be able to see as well by night as by day. Near the end of the body are the spinnerets—two, three, or four pairs—out of which the silk comes for weaving the webs, nests, and egg cocoons.


Spider's Claw, enlarged.

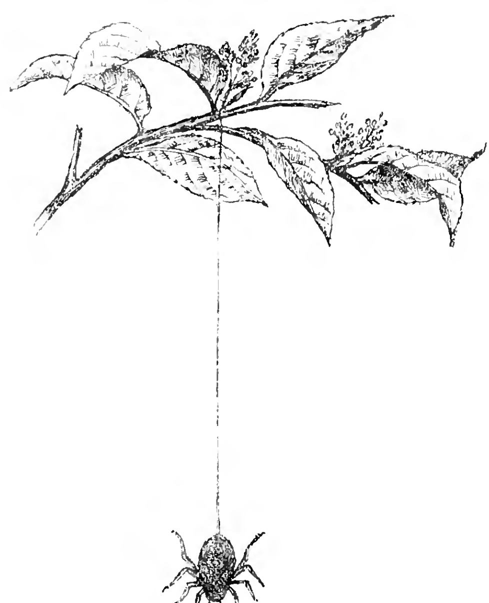
Usually the female spider is much larger and stronger than the male. One naturalist thus graphically describes their wedded life: "Their honeymoon is of short duration, and is terminated by the bride's banqueting on the bridegroom. Doubtless she evinces taste and discrimination in her appreciation of a 'nice young man.'"

Spiders, like lobsters and other crustaceans, have the power of reproducing certain parts if they happen to meet with an injury, as legs, palpi, and spinnerets.

We find as marked differences in habits, tastes, and characters among spiders as among human beings. Some kinds prefer always living in houses or cellars, not seeming to care for any fresh air or out-of-door exercise. Mr. Jesse tells of two spiders that lived for thirteen years in opposite corners of a drawer which was used for soap and candles. Others delight in making burrows in the earth, in dwelling under stones or behind the loose bark on trees, and others live under water. Many never leave their webs, but patiently wait, hoping some insect will become entangled in the snares they have set. Others dash about and seize upon every luckless insect that crosses their path. The most adventurous of all are those that sail out into the world on one of their own little threads. Darwin tells of encountering thousands of them many leagues from land when he was taking his famous voyage in the Beagle. He says: "The little aëronaut, as soon as it arrived on board, was very active, running about, sometimes letting itself fall, then reascending the same thread. It could run with facility on the surface of the water."

In the bright autumn weather, if we observe closely, we may sometimes see some of our own small spiders ascend to the tops of trees, fences, and other high objects, rise on their toes, turn the spinners upward, throw out a quantity of silk, and sail away. They can be seen plentifully any fine day in October or November, before the cold weather, on Boston Common. They grasp the silken thread with their feet and seem to be enjoying themselves as much as the birds and butterflies.

Many instances are recorded of music-loving spiders, perhaps the most interesting being that related by Beethoven's biographer, who says: "A spider weaving its skillful though delicate trap for its daily dinner worked industriously in the corner of the ceiling until Beethoven began to play. Beethoven, who at that time had not thousands hanging on his baton, was rather pleased and attached to this listener, which most practically proved the value it attached to the performance by risking its life in coming nearer the enchanted instrument. And ill was it rewarded. The mother one day, perceiving the ugly animal, seized and killed it. But the boy Beethoven was so put out and so miserable at losing his strange auditor that he burst into tears and, seizing his violin, smashed it against the floor, shivering it into a thousand pieces."



Epeira diadema SUSPENDED BY ITS THREAD.

Many kinds build their webs and cocoons in exposed places and take no pains to conceal them, while others cover theirs with tiny pebbles and bits of earth for protection. Some kinds of spiders abandon their egg cocoon as soon as it is finished, while others carry it about with them until the babies appear. One mother allowed herself to be torn to pieces rather than leave her cocoon.

We might compare the spiders' different modes of getting about to those of the birds. The hunting spiders leap and hop, the house spiders generally run forward, other kinds run backward and sideways with equal facility, and some, as we have seen, float about in the air. The most marvelous of the spiders' gifts is the silk-spinning. The spinnerets or spinners are little organs at the hind end of the body. Each has a number of very minute holes in it. Out of these the silk flows in a liquid form, but as

SNARE OF LONG-BODIED GARDEN SPIDER, *Tetragnatha extensa.*

soon as the air strikes it it hardens into a thread. The strands from the different holes all unite and form what we know as the spider's thread. There are great differences in the kinds of webs and nests which different spiders make. One of the most interesting is the web of the great black-and-gold garden spider. First she spins several lines all joined in the center like the spokes of a wheel, and attached to stems or leaves of plants at the outer edges. When the rays are finished she begins at the middle to make the spiral part. It is fascinating to watch her, as she crosses each spoke, stop and pat down the silk once or twice, then pull it to see if it is well secured before passing to the next one. When the web is finished, she makes a zigzag ladder of white silk, running from the bottom outer edge to the center. When she hangs in the middle of her web, as she does much of the time, the ladder helps to conceal her. The web is made of two kinds of silk—one smooth, the other covered with an adhesive liquid. When the insects are caught, their legs and wings are soon covered with the sticky juice, so that it is impossible for them to escape. The spider, knowing it would not be convenient to become entangled herself, spins one long, smooth thread from the center to the outside, which she uses in traveling to and fro.

The common house spider is wonderfully sagacious. Once in a while a large insect is caught in her web. She wants to take it up to her inner retreat to devour, and it is too heavy for her to carry. What is she to do? First she bites its leg, injecting some of her poison, which stupefies it. Next she throws some additional threads about it and ascends to the top, pulling the thread as hard as she can. When she has rested for a little time, she winds more threads about her victim and pulls again, each time attaching the threads at the top. In this way she finally succeeds in hoisting her feast into her house, though the process may last several days.

Who would think that our predecessors in the art of curling the hair were spiders? One species has been provided by Nature with a sort of little curling comb called the *calimistra*. It is on the hind legs and consists of two rows of parallel spines. The web, which she makes of bluish-white silk, is unusually pretty, as each thread is gracefully curled by drawing it between the spines.

Thoreau calls the little gossamer webs which we see spread over the grass on a dewy morning the napkins of the fairies. Even Chaucer, who wrote five hundred years ago, mentions them as a great curiosity to the people of his time. He says:

> As sore wondren som on cause of thonder,
> On ebb and flood, on gossamer and on mist,
> And on all thing, 'til that the cause is wist.

A hundred and fifty years ago a Frenchman, M. Le Bon, made some stockings, purses, and gloves from spiders' silk. The Bermuda ladies use the thread of *Nephila* for sewing, and Queen Victoria was presented by the Empress of Brazil with a dress made of spiders' silk.

Spiders molt several times, each time appearing in a different color. We should hardly expect to find very brilliant or showy colors among them, yet some of them are gorgeous in the extreme. A little crab spider that built a house in my garden was the brightest lemon-yellow all over, and shone like a jewel amid the dark green of the surrounding foliage.

One of the English spiders has a black head and thorax, with an orange-red body, on which are six black spots, each ringed with white; another has a green coat with brilliant red and yellow striped trousers, for all the world like a king's jester. One dainty lady is clad in violet and white, a flaunting miss in black and flame-color, and her sister in cherry and brown.

Some of the *Thomisidæ* are the exact colors of certain flowers, in the centers of which they sit all day, watching for the insects that come to get honey.

Two of the spiders' worst enemies are mud wasps and ichneumon flies. In searching recently for spiders beneath the clapboards on the south side of the house, I came across one of those curious structures which the mud wasp builds. I broke it open, and out tumbled a quantity of small spiders. The wasp's storehouse was in three compartments, and all together contained forty-nine spiders, all of the same kind and about the same size, in a torpid condition. The wasp had laid an egg in each of these spiders. She does not kill the spider, but merely stupefies it, so that when her egg hatches the larva may feed upon the luckless spider.

If one be a student of Nature he will perhaps have noticed a spider rush away and hide in her crack without any apparent reason. The moment before she had been enjoying the bright sunshine, and the student wonders why she ran away. The spider's perceptions are so keen that she knows long before he does that the sky will soon be overcast and torrents of rain descend or a cold wind begin to blow. If she stayed out she might soon be benumbed and unable to run into her house.

The water spiders are covered with hairs which shed the water, so that they never get wet. The little house under the water in which they live and raise their families is as snug and dry inside as yours and mine.

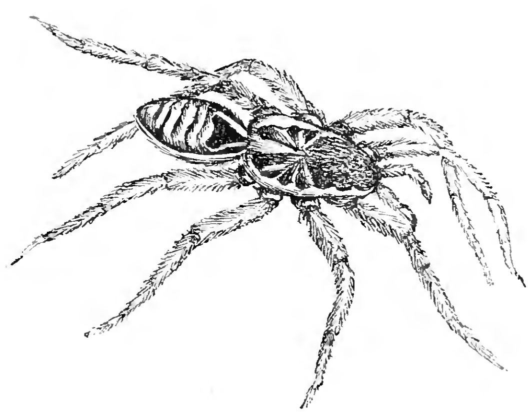
No spiders are more interesting than the trapdoor spiders and their first cousins the tarantulas. The former live in Europe and California. First, they make a burrow in the ground and then build the door. The California ones make their door of mud and sticks. It fits into the tube as a cork does into a bottle. The covers built by the European species are mere little lids, but they are always built so as to resemble the surrounding surface. One kind shows her sagacity by building a sort of double door, by which she can escape should an enemy storm her fort. At the surface is the usual door, and a few inches below this another.

When the spider hears an enemy investigating her burrow, she runs below the second door and pushes it up, so that the marauder will think he has happened upon an empty nest, the second door forming the bottom of it. The babies are born in the tubes, and remain with their mother until they are able to make nests for themselves.

These spiders spend the days in their burrows, but at night they all flock out to enjoy themselves. They fasten open their doors and make little webs over the grass. Many night-wandering beetles are caught, and then comes the banquet, which consists of the softer parts of the beetles. In the morning the closest observer could not find a trace of the preceding night's revelry, so carefully have the spiders cleared away all webs, beetle legs, and wing covers.

One group of spiders is called *Lycosa*, which means wolf spider. Perhaps they were named from the similarity of their habits to those of the wolf, being like him wandering and predaceous.

One of these is the tarantula, a great hairy fellow who inhabits warm countries. The species received its name from the Italian city of Tarentum, where they have been found in large numbers. There is a curious superstition connected with the tarantula's bite. If a person was bitten it was thought nothing could save his life but the playing of some lively dancing tunes. When he heard these he was supposed to be unable to resist the temptation to dance. Thus he grew very warm, and the perspiration came out in great beads all over him, each bead filled with poison. After he had danced as long as he possibly could, the poison had all escaped from his system. The tarantulas feed on small birds as well as insects. Indeed, one of the great southern species is called the bird-catching spider.



Lycosa tarantula.

In India, where all animals are treated with consideration and even reverence, the little children often keep these spiders for pets. They tie a cord round a spider and lead it about, feeding it with worms and insects. Mother *Lycosa* always carries her egg cocoons out with her on her hunting expeditions, attached to the spinnerets.

Last summer I kept a garden spider for three weeks under a tumbler, and had the pleasure of watching her building her house of snowy silk, with its three entrances, and raising a large family of children. She soon learned to take flies from my hand and drink water from a leaf which I gave her fresh every day. After a time she seemed to languish and droop, so I set her free in the garden once more.

> If you wish to live and thrive.
> Let a spider run alive,

says the old Kentish proverb.

PETROLEUM, ASPHALT, AND BITUMEN.*

By M. A. JACCARD.

PETROLEUM, asphalt, and bitumen may be regarded as so related to one another, so like in origin and properties, as to be capable of being considered in the same treatise; and we may, therefore, speak properly now of one, now of the other. The oldest known form of natural hydrocarbon was the bitumen which rose to the surface of the Dead Sea, called from that circumstance the Asphaltum Lake. Tradition says that it used to appear on the surface in considerable masses, and was collected by the Arabs and exported to Egypt, where it was used in embalming, and for a few purposes in the arts. The ancients were also acquainted with the liquid form of bitumen, petroleum. Herodotus speaks of the mineral oil of Zante; and other Greek authors mention the springs of Agrigentum, the product of which was burned in lamps, and was known as Sicilian oil. The fire worshipers of Persia erected temples over the burning springs.

Of the use of these substances in the middle ages, and later, we chiefly know that the petroleum springs of Pechelbronn, in the sixteenth century, spontaneously furnished mineral oil in such quantities that the peasants around used it to feed their lamps and grease their carriage wheels. The virtues of the mineral springs of the Jura Mountains were made known in 1712 by a Greek doctor, who pronounced them a treasure that had been unknown from the beginning of the world. Since then new sources have been discovered in all parts of the world, and the

* From Le Pétrole, le Bitume et l'Asphalte. Par A. Jaccard, Professeur de Géologie à l'Académie de Neufchâtel. Paris: Félix Alcan, 1895.

uses and applications of petroleum have been immensely and wonderfully extended. The discovery of the American beds of petroleum and the application of industrial processes of distillation to them have been the beginning of a new industry, and of largely extended researches in all countries. Leopold von Buch (1801), who seems to have been the first to discuss the origin of the natural hydrocarbons scientifically, supposed that they were of animal origin. Violet d'Aoust, in 1814, believed them to be of the same origin as the rocks with which they were associated, native eruptive products, the resultants of causes still unknown ; and repeated this opinion ten years later. Puvis thought, in 1836, that bitumen penetrated the rocks, according to their porosity, after their formation. Rozet, in 1836, thought that the bitumen of Pyrimont was sublimed from the depths of the globe through a crack that marked the direction of the formation, and was condensed in the porous rocks. Millet, in 1840, thought the same bitumen was derived from the decomposition of accumulations of vegetable matter, and ran down through the rocks. Itier, in 1839, supposed that the bitumens of the Jura were derived from the adjacent bituminous schists, which were full of vegetable fossils. Daubrée, in 1850, believed that the mode of their formation was similar to that of coal, but admitted the possibility of their having been derived from mineral synthesis. These views and the theory of volcanic origin have been reiterated in various modified shapes by other authors. M. Lartet published, in 1866, a valuable study of the geological relations of the bituminous deposits of the region of the Dead Sea.

When the mineral oils of the United States had become a prominent subject of attention, Mr. Leo Lesquereux made an elaborate discussion of them in the form of a letter to Liebig, in 1865, in which he gave his reasons for supposing that they were the products of the decomposition of marine plants. Dr. Sterry Hunt about the same time concluded, from an examination of the petroleum beds of Kentucky, that the oil, or the organic substances from which it was produced, were deposited in the strata where the oil is found contemporaneously with the formation of the rock. Mr. Orton, after a thorough study of the petroleum of the Trenton limestone of Ohio, published his conclusion in 1884, that it was of organic origin—derived from the decomposition of vegetable and animal matter. The supply could not be renewed, and was therefore not inexhaustible. It was probably produced at the ordinary temperature and not by distillation.

Some authors, assuming that these hydrocarbons are derived from the decomposition of organic matter, have tried to imagine the manner of the process, and to distinguish between it and ordinary or putrefactive decomposition.

It is apparent that nothing more than the value of a hypothesis can be attached to these speculations. Nothing indicating sublimation has been observed where the theory supposes it to have taken place; the operation of a natural chemical distillation is not proved by any evidence of such a process having anywhere taken place. The opinions of MM. Daubrée, Lartet, and Coquand, in favor of a chemical origin, being based upon studies of the formations themselves, are regarded as being of more substantial value. These authors, however, are judged to have erred in confounding the original formation of the substances with their appearance where they are found—which, in the view of the author, are two very different affairs.

A bituminous limestone of the Val de Travers, Switzerland, is formed almost wholly of shells, *echini*, and similar fossils, held together by a calcareous cement. Some of these fossils are only casts, the shell having been absorbed, while the interior, otherwise empty, is partly filled with a viscous bitumen, the quantity of which is proportioned to the size of the shell. In the smaller brachiopods there is only enough to color the inclosing rock a chocolate brown; in the larger ones it forms a lump which is softened by warming. The bituminous limestone of Auvernier is marked by infinitely numerous little cavities, such as are seen in tufas, which are made visible by the presence of a brown substance, the residue of a volatilized bitumen. It also contains casts or impressions of fossilized shells, and in these again are deposits of brown or blackish substance—the organic matter of the mollusk, transformed into bitumen. The cavernous or breccialike rock of Bevais, a few miles south of Auvernier, contains what we might perhaps call glutinous inclusions—cavities corresponding with the internal part of the fossils, colored brown with organic matter. There are also real pockets of viscous bitumen, which liquefy under a slight increase of temperature. A closer examination of the cavity shows that it is the result of the destruction of an astræan polyp. Of the association of petroleum and fossils in the United States, an observation has been recorded by M. Daubrée of petroleum occupying the cavities of fossils—orthoceratites, brachiopods, and corals, as well as porous parts of the rock—in some of the beds of the Ohio Valley; and a statements by MM. Fuchs and Launay, that "a remarkable characteristic of the Canadian oil is the profusion of remains of mollusks and crustaceans, with some traces of marine vegetation, which it contains. This is one of the most serious facts on which an organic origin is attributed to petroleum."

Of the occurrence of these hydrocarbons, including also natural gas, a review of all the theories and evidences leads us to the conclusion that stratified deposits of asphalt, bitumen, and petroleum are found in the different countries of the globe, often associated with salt, gypsum, sulphate of iron, and mineral springs. A considerable number of these deposits are asphaltic or petroleum-bearing basins, of greater or less richness, the working of which requires the boring of wells, or the excavation of galleries permitting a tolerably exact determination of the manner of occurrence of the substances. Nowhere do the works furnish any evidence of the existence of reservoirs or cavities comparable to the caverns of mountainous regions; but everywhere the hydrocarbons are in the state of impregnation or mixture with the rocks in which the workings are made. When they exist in a viscous or solid condition, there is reason for presuming that this state or manner of being is due to particular phenomena of concentration operating at the moment of deposition or after it. The existence of veins or of eruptive beds, ancient or recent, is nowhere established in a certain and indisputable way, but it may be that fissures existing in the rocks have been filled, either from above or laterally, by a posterior displacement.

In attempting to account for the origin of the hydrocarbons, a distinction may be made between two states in which they present themselves, whether on the surface or in the depths of the soil. The initial state, or that of formation, is represented in the stratified beds, where a series of superposed layers is presented. The substance exists, impregnating the rock, and, more rarely, in viscous or solid bituminous masses. The second state, that of alteration or transformation, is met in the beds which have been modified by dislocations, posterior to the solidification of the matters which were deposited in a movable or plastic state. To these dislocations may be attributed the natural petroleum wells which have been known from antiquity, as well as the flows of viscous bitumen which in some regions become solid on exposure to the air.

The slow distillation of marine bodies may be likened, to a certain extent, to the processes of conservation of fossil wood in the bottoms of marshes, peat bogs, etc., under the mud. But while the absence of air is sufficient to assure the preservation of these, the presence of an entirely impermeable envelope is necessary to prevent complete decomposition into volatile gases such as takes place with all animals simply buried under water.

The presence or existence of natural springs of petroleum in the vicinity of mountainous regions is explained, not by dislocations of the ground, but by the fact that the formation of the reliefs is anterior to that of the mineral oil. Instead of regarding these springs as available as guides in researches, they should be regarded as signs of the approaching exhaustion of the arenaceous strata impregnated with oil; these reservoirs not being susceptible, like those of our springs, of being refilled, as the springs are kept full of water by the penetration from the surface.

If, then, we put aside the eruptive process as not well founded, it follows that the search for petroleum should be made with account taken of the conditions of formation of the sedimentary beds, of the extension of the basins in which they are deposited, and of the formations over them.

While the natural hydrocarbons are indisputably found in the sedimentary beds, from the most ancient to those which are still in process of formation, it is nevertheless certain that so far they are most extensive and most generally distributed in the Tertiary formations—excepting always the Silurian and Devonian deposits of North America, which were formed under geophysical conditions which have not yet been recognized in other regions where formations of the same age exist.

In a general way, the signs of the existence of solid, liquid, or gaseous hydrocarbons, exhibited by mud volcanoes, disengagements of natural gas, etc., authorize the presumption of beds near the surface, so that it is useless in such cases to anticipate a favorable result from deep borings.

All the facts noted by students of the natural hydrocarbons may be explained without difficulty under the hypothesis of the organic origin of the natural hydrocarbons, which becomes a complete system, the value of which imposes itself upon every one seeking the solution of the question. All is easy of conception if we suppose a simultaneous precipitation of mineral matters and organic substances derived from the decomposition of animals and plants, when these are found in suitable conditions of the medium and of their own being at the moment they are buried. But all becomes obscure and inexplicable under the hypothesis that these substances are formed in the depths of the globe under the influence of a high temperature and considerable pressure.

Captain F. E. Younghusband is a scientific explorer of much experience in the mountain regions and high plateaus of Central Asia, who has observed the men as well as the topographical features and natural history of those regions. He declares in his latest book that while the traveler sees in his journeys every step of the ladder of human progress, from men who are little more than beasts of burden to the statesmen, men of science, and men of letters of the first rank in the most civilized countries of the world, he has "not been impressed with any great mental superiority of the most highly developed races of Europe over lower races with whom I have been brought in contact. In mere brain power and intellectual capacity there seems no great difference between the civilized European and the rough hill tribesmen of the Himalayas; and in regard to the Chinaman, I should even say that the advantage lay on his side."

A CURIOUS CANADIAN IRON MINE.

By J. T. DONALD, M. A.

THE province of Quebec in the Dominion of Canada is sometimes known as French Canada, because of the rights and privileges granted the inhabitants of French origin when Canada passed into the possession of the English crown, and because the majority of the inhabitants are of French ancestry and speak the French language. Time has flown, but in many parts of Quebec language and customs have remained stationary. To-day the student of language or of folklore or of ballads finds large portions of French Canada what old France was a century or more ago; and just as the student of the French language can hear spoken to-day the French tongue as it was spoken a century ago in old France, so the traveler who visits the historic district of Three Rivers may turn back the hand of time, as it were, and see to-day the mining of iron ore, and until recently the smelting also, carried on exactly as in the Old World decades ago.

At Three Rivers, not far from midway between the cities of Montreal and Quebec, the St. Maurice flows from the north into the St. Lawrence. The lower portion of the valley of the St. Maurice is historic ground in the annals of iron-smelting on this continent. The immense deposits of bog ore of this district were objects of attention during the French *régime*, and as far back as 1668 official examinations of these deposits were made by order of the Government of France. The erection of a furnace was begun by a private company under very favorable arrangements with Louis XV of France in 1737, but it seems that the French Government obtained control of the work, and in 1752 the St. Maurice furnace was blown in, and the old stone stack with walloon hearth bearing the date 1752 and the insignia of France, the *fleur-de-lis*, still stands to dispute with that of Principio, in Maryland, the right to be considered the oldest in America. This quaint old furnace was in use until as late as the summer of 1883. It is worthy of note, too, that in 1775, during the American invasion of Canada, one of the lessees of this old furnace aided the Americans and actually cast shot and shell to be used by them against the city of Quebec.

The manufacture of iron is still carried on in this district. A few miles from the old St. Maurice furnace one finds at Radnor the well-equipped modern water-jacket forty- to fifty-ton furnace, the property of the Canada Iron Furnace Company, producing a very superior grade of charcoal iron. This touch of the modern world seems almost out of place in a region in which old France lives again, but, as we proceed still farther up the St. Maurice Valley, the curtain is once more drawn, as it were, over the modern world.

At Lac à la Tortue, twenty-one miles from Three Rivers, we are again in the dim past. We can stand upon the shore of this lake and see a sight that might have been the original for an illustration of iron-ore gathering in Scandinavia one hundred years ago.

This Lac à la Tortue (Turtle Lake) is our curious Canadian iron mine. It is a body of water about four miles long by a mile and a quarter in average width, occupying the center of a large area of swampy land. The surrounding land is largely composed of sand formed by the wearing down of the Archæan rocks by glacial action.

It is well known that decaying vegetable matter yields acids that dissolve the oxide of iron. Evidences of this solvent action of vegetable acids on iron are frequently seen in pieces of slate. The slate is colored by iron, but frequently white or light-colored spots occur. These are points where a leaf or a fragment of bark has been deposited with the fine mud in which form the slate was deposited. The leaf or bark has decayed, the vegetable acids thus formed have dissolved the iron oxide to which the color of the slate was due, and of course a white or colorless patch is formed.

In the sandy area around Lac à la Tortue we find the most favorable conditions for the action of vegetable acids on iron oxide. The sandy land produces a rank vegetation, and its decay furnishes abundance of organic acids. These acids are in solution in the drainage waters, which on their way to the lake percolate through the sand. They thus come into contact with the iron oxide in the finely divided materials, dissolve it, and carry it along to the lake. Here a new chemical action comes into play. The solution of iron in vegetable acid (in which the iron is in what the chemist calls the form of a protosalt) is oxidized by the action of the air on the surface of the lake into a persalt, which is insoluble, and appears on the surface in patches that display the peculiar iridescence characteristic of petroleum floating on water. Indeed, not infrequently these films of peroxide of iron are incorrectly attributed to petroleum. These films become heavy by addition of new particles, they sink through the water, and in this manner, in time, a large amount of the iron ore is deposited on the lake bottom. It must not be supposed that the ore is deposited as a fine mud or sediment. On the contrary, in this lake ore, as it is called, we have an excellent illustration of what is known as concretionary action—that is, the tendency of matter when in a fine state of division to aggregate its particles into masses about some central nucleus, which may be a fragment of sunken wood, a grain of sand, or indeed a preformed small mass of itself. Precipitated in water, as our lake ore is, it of course has great freedom of movement, and we therefore find it in flat concretions, more or less porous and circular in outline; the general appearance amply justifying the term "cake ore," which is locally applied. These concretions vary much in size, some of them being no larger than mustard seeds, others eight or ten or more inches in diameter. Frequently the larger cakes are joined together and form masses looking not unlike batches of a certain kind of bun commonly exposed in the shop window of every confectioner, and made by coiling a strip of dough round and round a piece of itself.

The ore is not found over the whole lake bottom; it occurs along the whole margin, and also well out from shore where streams enter the lake, the distance of the ore deposit from shore depending, of course, upon the volume of water carried by the streams and the velocity with which it enters the lake. Certain strips of ore occur at a considerable distance from the shore and in as much as sixteen feet of water. These deep-water, mid-lake deposits denote probably the courses of former streams which are now nonexistent, owing to some change of level.

Not only is this lake an iron mine, it is more; it is something like the widow's cruse of oil of which we read in Holy Writ—the supply is being constantly renewed. Vast amounts of iron still exist in the surrounding sands. Vegetable acids are formed from the decay of each year's vegetation, and each year the drainage carries into the lake and deposits there a large amount of iron. This is no mere theory: one can actually see the deposition of the ore along the margin, and, moreover, it is found in actual working; if a certain spot be worked out, it will in a few years again yield ore in paying quantity.

Lake ores are abundant in northern Europe,* but, so far as the writer's knowledge extends, Lac à la Tortue and a neighboring lake are the only instances of the kind in North America. The ore is extracted from our lake mine by hand and by power. The shallow margin is divided into sections and allotted to suitable parties who may desire to work them and who are paid at a specified rate per ton of ore raised. Two men generally work in company. Their implements are a shovel, a strong circular sieve, and a rough hand barrow. When work is to be begun the workmen remove shoes and stockings and use their feet in searching for ore which lies imbedded in the soft sand, nothing coarser than sand, except ore cakes, being found in the lake. Guided by their feet, the workmen put down their shovels and bring to the surface a quantity of ore and sand which they throw into their circular sieve. This is then held below the surface of the water

* Very interesting details concerning the ores are found in Percy's Metallurgy.

and made to rotate to and fro until the soft sand is washed away from the ore, which is then thrown on a scow provided for the purpose or carried to shore. When a sufficient quantity has been collected it is carted to the railway near at hand and loaded on cars.

From the deeper parts of the lake the ore is raised by means of a steam dredge. The captain of the dredge moves over the lake, and, putting down a pole and working it about on the bottom, can easily learn where there is a body of ore suitable for dredging. The dredge is then moved to the desired spot and work is begun. The ore and sand are brought up in buckets on an endless chain and thrown into a long, revolving screen, adjusted and inclined so as to deliver it upon scows moored to the dredge. In its course down the screen the mixture of ore and mud is acted upon by water which is thrown upon it with considerable force.

By this means the mud and sand are washed out of the screen and the clean ore is deposited on the scows. These are towed by a steamer to the landing at the head of the lake, and the ore is transferred to cars to be conveyed to the furnace, ten miles distant.

The plant on the lake consists of the dredge, a number of scows, and a small tug, the latter being used in moving the dredge from place to place, in towing the scows, and in carrying supplies, for the crew live on the dredge from Sunday night until Saturday night, and work overtime, in order that a year's supply of ore may be raised during the summer.

The ore obtained from this lake is essentially a brown hematite—that is, hydrated peroxide of iron, with which is associated more or less organic matter. The writer has made numerous analyses of the ore, and the following is that of a sample representing a large quantity:

Ferric oxide	70·04
Manganic oxide	1·78
Alumina	2·20
Lime	·32
Magnesia	·27
Phosphoric anhydride	·76
Sulphuric anhydride	·23
Silica	7·84
Loss on ignition	16·84
	100·28

This lake ore, mixed with carefully selected bog ore from the adjacent district and with a certain percentage of magnetic ore, is smelted with charcoal in the Canada Iron Furnace Company's furnace at Radnor, and produces a charcoal iron (brand "C. I. F.") far superior to the iron from the Lake Superior charcoal furnaces.

It brings a high price, and is largely used in the manufacture of mill rolls and car wheels. Indeed, its superior qualities are so marked that it is used by various manufacturers in the United States in cases where great strength combined with wearing and, in the higher grades, chilling quality is of first importance.

As an evidence of the splendid quality of this iron the writer gives the following extract from a letter written a short time ago by a leading American manufacturer, viz.:

"Desiring to make a casting which should combine great strength with a tough wearing surface, we have lately been experimenting with the Canada Iron Furnace Company's metal, and by using it we have raised the transverse strength of our test bars from 2,300 and 2,500 to from 3,900 to 4,000, the test being with one-inch-square bars twelve inches long. We have never been able to accomplish any such results with any other iron we have used, and in addition to this greatly increased strength we find an added toughness which makes the casting work almost like a piece of steel."

THE PSYCHOLOGY OF GENIUS.

By Dr. WILLIAM HIRSCH.

OUR knowledge of the physiology of the human body has been so much enriched by pathological facts that we may truly say that some branches of it would, as far as we can see, have remained forever closed books if the effects of disease had not been observed. So it is with psychology in its turn. Since mental disease has been systematically studied, the science of the mind has undergone a veritable revolution. Having laid down its conceptions and having learned that psychical processes, like all other phenomena of Nature, are subject to definite law, psychology has made an effort to determine the law of the mental processes of genius and to frame a definition of genius that should take into account facts which are now scientifically established. Many attempts have been made to determine what genius is, from which various conclusions have resulted, but those inquirers who have sought to penetrate to its psychological laws and to explain its phenomena upon recognized psychological principles have been obliged at last to acknowledge that they had to do with the most diverse psychological conditions which have been promiscuously labeled as genius. The question whether the popular word genius can be used as a scientific term can be decided only by a psychological analysis of those poets, painters, virtuosos, scholars, statesmen, and generals who have been generally recognized as geniuses. Famous poets, observant of their own inward conditions, have often said that their works were composed as in a dream, unknown to themselves; that instead of being deliberately constructed, their ideas have, as it were, flown to them.

Involuntary thought is frequently described by the poets as unconscious. That can not be accurate, for "unconscious thought" is a contradictory phrase. Not even a dream can be said to be unconscious, whether it be purely ideal like most dreams, or produce action as in sleepwalking. In such a state self-consciousness alone is suspended, not consciousness itself. Fancy stands halfway between dreaming and active intellectual function. The latter depends directly on the will, while in the former the will is in total abeyance. All men are subject to fall under the influence of fancy. In ordinary men it makes day-dreams, which everybody recognizes to be opposed to purposive thought. All that fancy produces depends on former impressions of sense. It is powerless to create anything new; its products are mere combinations in memory of the residua of former impressions. They may be unlikely enough, and in that sense it may be true that its products are "original"; but this does not conflict with the facts alleged. It is this creative and somewhat independent power of fancy which lends to the work of art its character of originality, and hence it is that many inquirers have found in that the essence of genius.

The psychological analysis of famous poets will show that the intellectual function is no whit less important a factor of poetic genius than fancy itself, although the latter is the one immediately employed in the act of composition. We have seen that creative fancy works with the material which former impressions of sense have left behind as their remains or residua. The more comprehensive the knowledge of the poet, therefore, and the more he is in condition to assimilate and compact the impressions the world conveys to him, and the sounder and truer his judgments of persons and situations, and the more methodical his thought and the better his memory, by so much the more will his fancy display luxuriance, and so much more various will be his creations. Another psychical phenomenon, besides fancy and intellectual function, surprises us in famous poets—to wit, a refinement of the feelings, heart, and moods. We often find these qualities developed in great poets to a point we can scarcely imagine. Another trait remarkable in famous poets is an instinctive and invincible impulse to express the ideas and feelings within them. In consequence of this impulse, the work of genius is not a voluntary labor, but the involuntary product of a psychical need. It is not a hankering after applause and success, nor a regard for his other interests, which induces the man of genius to perform his task. It is solely a passion to give shape and form to the idea that exists in his fancy. The true poet does not versify because he would, but because he must. The comparison of traits applied to a considerable number of typical "men of genius" leads to the conclusion that the word does not express any one psychological concept, and that nobody has succeeded in giving a pregnant definition of the quality or is likely to do so. As insanity is equally indefinable, and it is impossible to draw a sharp line between mental sanity and mental derangement, it may seem useless to attempt to compare two such indefinite quantities; still, the comparison may possibly enrich our knowledge and lead us toward a recognition of the truth.

It is no newfangled notion that genius and insanity are connected. It has been reiterated from Plato down. The chief condition of mental sanity is a well-proportioned development of the different psychical factors. But as in the development of the different mental faculties, so also in their proportion to one another, a certain latitude of health is to be allowed. In one man fancy is preponderant; in another, consecutive thought; while a third may have particularly strong feelings as his characteristic. Yet we have no reason to say that these minds transgress the border of health. It is the difference in the relation of the different psychical elements that makes the diversity of men's characters. Now, we know that there are no two characters in the world that are precisely alike. It follows that there is no norm for these relations. The higher the grade of development of the genius and of the individual, the more prominent will differences of psychical factors become, and a correspondingly greater latitude of health must be allowed.

A comparison is instituted between the different symptoms of exaggerated proportions in development which have been discovered in great men, and an endeavor to ascertain the distinctions between these and symptoms of insanity. Among these symptoms are hallucinations, to which the soundest of men have been found more or less subject, over-exuberance of fancy, and self-abandonment in the restless strife for some ideal goal. In great artists and scholars, on the one hand, and in the insane on the other, there is a great, irresistible impulse which fills them to overflowing and makes them forget all personal considerations. But while in the former the restless compulsion to create, the hot aspiration is the kernel of the highest and noblest perfection of man, in the latter there is a morbid impulse which is usually directed to the silliest things. Formerly such a state was called a monomania, since this irresistible impulse seemed to be the only pathological symptom; but careful observation has shown that there is always a more general psychical malady, usually the consequence of arrested development. It is perfectly astonishing with what tenacity and untiring persistence such patients go to work. Those patients exhibit the same phenomena who may be termed inventors and Utopians. They not seldom sacrifice their means and bring themselves and their families to ruin by their unconquerable desire of making inventions and discoveries. They are fully convinced, in their folly, of the epoch-making importance of their improvements, and all pains are lost to cause them to desist from their ridiculous performances. In contrast with students, in whom the turning point of their mental action lies in the understanding, in artists moods and feelings are often the starting point of their productions. Hence we find that in them this part of the mental organ has not infrequently an enormous development. As with the other psychical characters, so likewise here we find that the high refinement of a single factor—always, however, in just proportion to the total action of the organ—produces outward phenomena having some similarity with those states which are due to disturbed inward equilibrium, and which we often have occasion to observe in the insane.

No doubt, poets and artists, as well as scholars, often exhibit an outward appearance of self-absorption and of indifference to their surroundings. This is common to them with many of the insane. But how disparate are the causes underlying these phenomena! With the weak-minded it is the want of power to concentrate the attention which renders them uninterested and indifferent to the outward world; but with poets and scholars it is, on the contrary, the high degree of that power which brings about similar phenomena. As we know, the centrifugal condition which we term attention not only extends its power to the organ of sense whose action is emphasized, but it must also be able to order off all the rest of the impressions of sense. The great thinker appears uninterested in surrounding things because his whole attention is directed to the well-ordered sequence of his logical thoughts, to which end, with fullest consciousness, the outward impressions are ordered off. The weak-minded man is present at a performance. The sounds of the words of the orator ring in his ears, but the slightest outward or inward impression suffices to make his attention wander. His thoughts ramble. They are everywhere and nowhere. The mentally gifted man, on the contrary, constantly has his mind on the matter in hand. If he wishes to concentrate his thoughts upon an outward object, nothing that takes place is able to escape him. Neither the psychologist nor the psychiatrist ought to be content to observe behavior superficially, but must trace out the motive of it in order to draw any inference from it. The most absurd conduct sometimes has reasons consistent with health, while conduct which would not surprise a layman at all may be regarded by a psychiatrist as a well-recognized symptom of insanity.

A further explanation of many peculiarities of men of genius is to be sought in their relations to the society in which they live. A man with a reputation for high talents, distinguished from his youth for his superiority and genius, always has his circle of admirers with its proportion of flatterers. If he had the misfortune to be a precocious child, he will have been accustomed from his earliest youth to the idea that his genius is far above ordinary men and above the rules that apply to those men. If such a man is, in later years, attacked by a competent critic upon this or that point, or if schools and parties are formed unfavorable to his method, whether in art or in science, he will, of course, react otherwise than a man would do who was accustomed to opposition of every description. He will, perhaps, regard his just critic as a personal enemy; he will complain that he is misunderstood by his contemporaries, and his passion may go so far that the public at large and superficial observers among psychiatrists may consider him to be the victim of a delusion of persecution.

Peculiar inclinations and other mental idiosyncrasies of men of genius can mostly be very readily explained. Everybody accustomed psychologically to study and dissect those whom he meets, so far as opportunity is afforded, is familiar with the remark that each individual of the human race has his peculiarities, more or less odd, his "weaknesses." The ordinary man, if he has the least breeding, has been accustomed from his youth up to hold in check one inclination or another which violates the usages of society, or even perhaps of good morals. He has learned to attend sufficiently to his own conduct not to allow habits to take root which might appear unusual or be disagreeable to others. But the man of genius is far too much governed by his inward processes, his fancy, and his work to pay attention to trifling details of manner. He therefore appears what he really is, while the average man would not do this. Consequently, chance peculiarities and special inclinations appear in the former more than in the latter.

Thus it is that the behavior of great men is not to be measured by the same standard as that of others, that we have to take account of the motives of their actions, and that the psychical conditions must be kept in view if we are to draw any trustworthy inferences from their behavior. Those mighty natures must be judged from their own organization, and not from the Philistine point of view of the so-called average man.

As a further proof of the affinity of genius to insanity, it has been alleged that a great number of eminent men have actually had attacks of insanity. But the question is not whether there have been great men who were insane, but whether the proportion of those who have at some period of their lives been attacked by insanity of different types has been markedly greater or less among famous personages than among the general run of mankind. In order to decide this, we should be in a condition to state with exactitude what the percentage of insane among the total population was at a given period of history, how many men of genius there were at that time, and how many of these were insane. Such researches must be repeated at different times of history; then, if they were irreproachably exact and sufficient, it would be possible that some sound conclusion might be reached.

There has also been an attempt to trace a connection between genius and insanity through facts of heredity. In spite of some valuable works in this department, it must be admitted that the observations hitherto adduced are still far from sufficient to have any scientific value. The fact that in several families of eminent men insanity has occurred in no wise justifies us in drawing any conclusion. In order to do that, we must, as in the former case, be in a condition to establish statistical comparisons which shall be *absolutely exact* between the proportionate occurrence of insanity in the families of men of genius and those of ordinary men. Every disinterested observer must be struck with contradictions and the inadequacy of the investigations that have been made in this field.

It is true that between famous men—the so-called geniuses—and the insane many resemblances may be traced. Nevertheless, they are, as we have seen, mere resemblances, not real affinities. Just as every symptom of mental disease has its analogue in health, so has it also an analogue in genius. But, owing to the entire mental action being higher than in average men, the states analogous to morbid symptoms here come out more markedly. Genius resembles insanity as gold resembles brass. The similarity is merely in the appearance. When we go deeper into the facts we find the two states so widely disparate that we are not justified in saying that they are allied; still less, with Moreau, that genius is a morbid condition.

Finally, let the fact be considered that most of the great men, both of art and of science, were misunderstood by their contemporaries, and were only appreciated after they were dead. In recognition of this truth, Goethe pronounces that a genius is in touch with his century only by virtue of his defects, only in so far as he shares the weaknesses of his times. The genius of the truly great man outstrips, with its great wing strokes, the rest of the flock. Those who can not keep up with him can not comprehend him. They are puzzled at first, and finally set him down as a fool. In short, they confound genius and insanity.

AFFECTIONS AND JEALOUSIES OF LIZARDS.

By M. J. DELBOEUF.

WHILE the possession of articulate language marks man as distinct from other animals, it seems certain to me that he and they are formed upon the same pattern so far as relates to sensations and feelings. This will hardly be contested as to sensations. Animals that have no eyes have of course no sensations of sight such as clear-seeing ones possess, and we have not the highly developed sense of direction of birds of passage and carrier pigeons; but these may be cultivated, and we are told that the American Indians have the sense of direction in an astonishing degree and can track their enemy as a dog does a hare. We have, it is true, some difficulty in conceiving the nature of the dog's power of scent, and it is possible that ants and bees have other senses than those we have; but these differences, marked as they may be, are at the bottom quantitative and not qualitative. Perhaps a slight modification of some part or another of the sensorial apparatus would give us sensations now strange to us.

Of the feelings, we find in all the higher animals those of love, friendship, hatred, anger, devotion, courage, suspicion, jealousy, cunning, fear, rancor, and pity. Some hens show a marked predilection for their chickens. The contrary also appears. There are stepmothers among hens, dogs, and cats. There are also feelings devious as to their object. The child adores its doll; a dog may be attached to a stick.

These various feelings are manifest also in the lower animals, as my continuous observations on my captive lizards, concerning which I have published several articles, have tended to prove.

My first two lizards had been captured, one in the Spanish Pyrenees and the other at Tarn, in France; wherefore I called them the Spanish and the French lizards, but afterward gave them the names of Pedro and Pierre. I was surprised on the very first day that I occupied myself with their education to observe the absolute contrariety of their characters and dispositions. Pierre, won over at once by the honeyed dainties I offered him, soon became accustomed to let himself be handled without trying to bite or run away, and to hide himself in my clothes, preferring the back, where it was warmer. Pedro, wild and untamable, if one tried to catch him, withdrew into a corner, and then stretching his paws in front of him, his eye glistening and his mouth wide open, hissing, springing at the hand that came near him, and, if he bit it, holding firmly and causing the blood to flow, revealed a resolution that even impressed the young men in my laboratory.

I made a cage for the lizards of iron wire, open above, and, having a large room in my country house into which the sun shone all day on three sides, I put them in it. Pierre soon learned to leave his cage, to climb up to the windows by some rags I had hung to them, and passed from one to another, following the sun. In the evening he returned to the cage. Pedro, more stupid, tried vainly to get out of his prison, and, when I put him on the ledge of a window in the sun, let himself be overtaken by the shade, persisted for hours in efforts to get through the glass, and finally went to sleep where he had been left. Pierre, always in motion and investigating, discovered an old mattress in the room that had a hole in the cover, and took a liking to the hole. The mattress was put where it could not be reached except over a bridge of cords connecting it with the cage. Pierre, always expert, learned very soon to pass over this bridge to his hiding place. Pedro never could understand what the cords were good for, and his love of comfort never carried him to the point of finding the luxurious mattress. More recently Pierre, when at Liége, found a hole in the lining of a thick *portière* curtain, of which he became acquainted with the most minute folds and turns, and when he is there there is no means of getting him away.

The physiognomies of the two correspond with their characters. Pierre's eye is black, mild, intelligent, and scrutinizing. In Pedro's, the pupil, surrounded with a golden yellow circle, reflects distrust, hostility, and ferocity. It took six months to tame Pedro, and it was quite two years before he ceased to show his fierce temper when I came upon him too abruptly.

Pierre and Pedro lived on the best of terms with one another. At Liége they slept side by side, often interlocked. Pedro was fond of following Pierre in his wanderings and escapades. One day Pierre was lost. He had got out of my desk, had gone down several steps of the stairway, and had slipped in under the carpet, where he was casually found about three weeks afterward. During the whole time of his disappearance Pedro refused all food, and had no relish for insects and earthworms, till Pierre was restored to him. Seeing him so melancholy, I made an appeal to all my friends in the south of France to get me a new companion for him. M. H. Dineur, an engineer of Prades, sent me a lizard, October 1, 1891, three months after Pierre had been found. From that day on a great change was noticed. I had not learned the sex of my animals, but I observed now that they were both males, while the new one was a female. Pedro conceived a great antipathy for Pierre, which became more evident every day. Between the pursuits and bitings he suffered from Pedro, Pierre led a martyr's life till I was obliged to make a separate cage for him, and when Pierre was let out for an airing Pedro had to be shut up.

Both, however, became very familiar with me, but Pedro more than Pierre. They would run to me, when I called them, from one end of the room to the other; but I had to hold out a meal worm for bait to bring Pierre, while Pedro would come when my hands were empty. This was not because he was stupid, for when he saw that I had no worm, and I drew back, he would follow me like a dog, and would climb upon me when I stretched out my leg.

M. Dineur sent me the next year several lizards at different times, all of which were received with an ill grace. Among them was a much larger one than Pedro, which he disliked along with the others. One day this lizard took Pedro up and gave him a good shaking, after which Pedro was very cautious in his annoyances, and would run away the instant the other turned toward him.

One lizard was respected by Pedro. It had been sent me from Algeria by M. Forel, of Zurich, of a species we had not been able to identify—a tree liver, small but even fiercer than Pedro, and quite untamable. After devouring one fine specimen and half eating another, it became a marked terror to all the other members of the collection. Only one of my lizards was fond of gentles; the others spit them out as soon as they had tasted them. As we may say of a company of men, "So many heads, so many minds," so we might say, with a little variation, of my pets, "So many lizards, so many dispositions."

Several of my lizards have died; Pedro, a few months ago, of a disease that first affected the eyes, after having been with me five years. Pierre is still living with me, but has long had a tumor on his leg, has lost his tail once by my fault and twice by his own, and no longer likes honey, but shakes his head with an air of disgust when it is put upon his nose—a fact that shows that the taste of lizards, too, may change with the years.

As to the longevity of lizards: I do not think I am much mistaken when I suppose that they may live twenty or thirty years, or even longer. As they advance in years the plates of the head, smooth when they are young, show wrinkles and cavities which become more marked and numerous. Those with me have not grown much, and though I weighed them often—usually about once a month—the results were too irregular to permit of any conclusions being drawn from them. The weight of the larger lizards varied to the extent of thirty grammes, according as they were well or sparingly fed. Pierre now weighs one hundred and six grammes, another one one hundred and twenty-eight grammes, and another thirty-eight grammes—weights which are evidently proportional to the cubes of their lengths; but, according to my figures, they have not gained any in five years. I conclude from this that many years must have passed before the larger ones attained the weight they have.

The bifid extremity of their tongues, soft and always moist, is most probably an organ delicate to touch and probably to taste. They never cease to project it forward on to all the things within their reach, and although accustomed to meal worms, they begin generally by feeling them—at least the first one—in this way before taking them. The whip-tails (*Uromastix*) do the same, and when set down in the grass test all the flowers with their tongue. I should observe further that these animals did not hibernate with me, and that they were as lively and active in winter as in summer. The same may be said of two jerboas which I kept in captivity for three years and a half. Hibernation, therefore, does not seem to be a physiological necessity, but to be rather a natural effect of the cold, like the depression of the thermometer. The lizards were very fond of keeping themselves in front of the registers.

I now come to a trait which on reflection appears to me to be characteristic in the highest degree. Jealousy is a feeling not less natural to animals than to us. The males compete in strength, beauty, or talent to conquer the females. Beasts of prey, from spiders to lions and eagles, enforce respect of their hunting grounds. All defend their bed, their burrow, or their nest; and probably, too, herbivorous animals living in herds do not permit other herds to trespass upon their pastures. The jealousy of the dog is well known; if he is left alone, he will eat the part of the cat, and even rob the pigs of their messes. I have kept two jerboas for three years, all very familiar. Every evening we give each of them an almond, which they come and take out of the hand, and even ask for. But hardly has one received hers than, without paying any more attention to us, the other pursues her, takes it away from her, and a struggle ensues—a struggle which is otherwise courteous. The same play is acted when dandelions are given to them; hardly has one detached a leaf when the other tries to snatch it from her.

My lizards did not vary from the general rule. The best worm was always the one that a comrade had. If it was long, we might witness such a steeplechase as is seen sometimes in poultry yards.

Pedro was jealous of my preference and caresses. When he was on my sleeve, I could keep him for hours motionless by passing my hand lightly along his body; but if I took Pierre or another lizard up, his rage broke out at once, and he would jump upon him with his mouth menacingly wide open. If, however, I chose the large lizard, he gradually drew back, as if regretfully, without leaving me. Now, what good do caresses do to a lizard? Dogs and cats, they tell us, are delighted with them. But these animals, when they were young, were caressed by their mothers, who licked, bit, and amused them, and it is not strange that they should find in our cajolery a kind of recollection of motherly tenderness. They play together, embrace one another, and press against one another. The man who plays with them is like a companion of a little more respectable species, and that is all. In menageries, monkeys, bears, lions, tigers, and hyenas indulge in caresses to the point that some animals seek them and provoke them. But lizards, with their scaly skin, unaccustomed to embracing, feeling, and licking, hatched in the sun! My Pedro therefore presented a deviation of the feeling of jealousy. We not rarely see parrots that like to be stroked on the neck or the head. I once accustomed a vulture in the zoölogical garden of Ghent to pass his head out between the bars of his cage in order to have it held and caressed. My friend Prof. Gilkinet tamed a wild rabbit till it became as familiar as a dog, and learned to like the hand that stroked it. All these creatures have known the pleasures of the nest and of maternal contact. But again, a lizard? I suppose that when cuddled between my handkerchief and my hand, it felt in that kind of moist and easy cavity a renewal of the pleasure of the days when it was free, and had a secure refuge in the shelter of the leaves against a burning sun. On the other hand, when another lizard comes, it displays envy or anger as if it were threatened with dislodgment. Is it that? It alone can tell what is passing in its darkened psychic sensibility, for man can not penetrate the animal mind. But could he penetrate the human soul if he had not language; can he penetrate the soul of one whose language he is not acquainted with? If we met a savage in the midst of a virgin forest, should we be better able to divine his intentions than we should those of an alligator?

Does it not result from these observations that, aside from the faculty of abstract, artificial, and conventional language, which seems up to this time to be the exclusive appanage of man, there is no clearly marked difference in general feelings between man and his lower brethren? Or rather, as I have ventured to say on another occasion, I ask if there may not appear in each animal species from time to time scamps, individuals inclined to rapine and murder, like my lizard Ben Youssouf, or simple, uneasy creatures like Pedro?

Furthermore, these minute observations, which may seem puerile in the eyes of many, help to establish the psychological transition from man to animals placed much lower in the zoölogical scale than lizards. In this aspect, they may be considered an humble contribution in support of transformism.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

SKETCH OF GEORGE BROWN GOODE.

THE United States has had no more assiduous working naturalist than Dr. G. Brown Goode; and few if any of them have contributed as much as he to the development and increase of the resources of our country. He was also one of the world's greatest museum administrators, and an anthropologist of most comprehensive views.

GEORGE BROWN GOODE was born in New Albany, Indiana, February 13, 1851, and died in Washington, D. C., September 6, 1896. While he was still a boy his parents removed to the State of New York. He cultivated the taste for natural history, which he manifested early, and it found food and encouragement in the Reports of the Smithsonian Institution, which formed part of the family library, and which he was accustomed to read. As a student in Wesleyan University, whence he was graduated in 1870, he was marked by his predilection for natural-history studies and the interest he took in museum methods. After graduation he entered Harvard University as a graduate student, and enjoyed the teaching of Agassiz. On the erection of Orange Judd Hall at Wesleyan University, he was invited by the faculty of that institution to arrange the collections in natural history. He performed the work with a skill and discrimination that marked him as specially adapted for it, and had, no doubt, great influence in deciding his future career. His first contribution to scientific literature was a note published in the American Naturalist in 1871, recording the occurrence of the billfish in fresh water in the Connecticut River; and his first paper exhibiting range of investigation and power to collate facts was one showing that snakes do actually receive their young within themselves by swallowing them, on the appearance of danger, to let them out again when the danger is past. For the purpose of this inquiry he sought evidence through an advertisement in the American Agriculturist, asking for the communication of observations on the subject. He had become interested in the work of the United States Fish Commission, and meeting Prof. Baird at the meeting of the American Association in Portland, Me., in 1873, was invited by him to become a member of its staff. In that capacity he was for several years a member of the commission's summer parties. He also became connected with the National Museum as assistant curator, and served it for a time without other compensation than duplicate specimens, and these he turned over at once to the museum in Orange Judd Hall. He was named in a short time assistant director of the museum, and in 1887 assistant secretary of the Smithsonian Institution in charge of the National Museum, the position which he still held at the time of his death. On the death of Prof. Baird, he became for a short time Commissioner of Fish and Fisheries. This appointment, Science observed at the time, "meets at once the requirements of an exacting office and the exceptional provision of the law creating it. Prof. Goode is intimately acquainted with the methods of Commissioner Baird, whose scientific zeal and knowledge he shared, and his experience and attainments in practical fish culture and in the science of ichthyology made him first among those whose qualifications the President has been called upon to consider." The law, however, gave no salary for this office, and during the few months Dr. Goode held it he performed the duties of two offices for the pay of one. In time the law was amended, the office of Fish Commissioner was made independent of the National Museum, and Dr. Goode was relieved by the appointment of Marshall McDonald to it.

Most of Prof. Goode's contributions to science were made during his connection with the National Museum, and for information concerning them we are largely indebted to the admirable summaries published by Dr. Marcus Benjamin and Mr. Theodore Gill in Science. In 1876 he published in the Bulletin of the United States Museum a Catalogue of the Fishes of the Bermudas, and the Classification of the Collection to illustrate the Animal Resources of the United States; which latter work was expanded three years afterward into the Catalogue of the Collection to illustrate the Animal Resources and the Fisheries of the United States, a volume nearly three times as large, prepared with reference to the Smithsonian exhibit in the Centennial. He published numerous monographs, many of them in collaboration with Dr. Tarleton Bean, chiefly descriptive of new species of fishes, and some dealing with special groups, of which perhaps the most important was that on the menhaden, first published in the Report of the Fish Commission, and afterward as a separate work. In connection with the tenth census, of 1880, Dr. Goode had charge of the work relating to fish and fisheries; and of the five sections of the seven large quarto volumes comprising the report on that subject he himself mainly prepared Section I, on the Natural History of Aquatic Animals. It covered more than nine hundred pages of text, and was illus rated by two hundred and seventy-seven plates. "This book was intended to reflect as exhaustive an investigation of the subject as possible. The scheme drawn up by Dr. Goode embraced the natural history of marine products; accounts of the fishing grounds, the fishermen and fishing towns, apparatus and modes of capture; preparation, care, and manufacture of fishing products; and economy of the fisheries. For the purposes of the studies necessary to its preparation, the coast, lakes, etc., of the country were mapped off into twenty-four districts, each of which was assigned to a field assistant. "This work," says Mr. Gill, "was by far the most complete survey of the economical fishes of the country that had ever appeared, and has since been the most prized. It led to another." This other was American Fishes; a Popular Treatise upon the Game and Food Fishes of North America, with Especial Reference to Habits and Modes of Capture. This volume was prepared, the author said in his prologue, for "the use of the angler, the lover of Nature, and the general reader." It was not intended for naturalists, and the technicalities of zoölogical description were therefore avoided. Prof. Goode's plan, in selecting from the seventeen hundred and fifty species of fish indigenous to our waters those to be described in the book, was to include every North American fish which was likely to be of interest to the general reader, either on account of its genuineness or its economical uses. The physical features of each fish were described, its range and season were marked, its habits in regard to feeding, migration, and breeding were delineated, and something was told about the method of capturing it and its value as food; but it contained "no discussions of rods, reels, lines, hooks, and flies, and no instructions concerning camping out, excursions, routes, guides, and hotels." Mingled with these facts were information about the different names of fishes in different places, exciting fishing adventures, and excursions into the literature of the subject.

In the meantime Dr. Goode had (1879–1881) prepared the text for a work on the game fishes of the United States, intended to accompany twenty large folio colored plates by S. A. Kilbourne. The collections made by the Fish Commission and the steamers Blake, Albatross, and Fish Hawk were carefully studied by Dr. Goode and Dr. Bean, and the fruits of their labor were put forth in a book in two volumes, with one hundred and twenty-three plates, on Oceanic Ichthyology, a Treatise on the Pelagic and Deep-sea Fishes of the World, which came from the press only about two weeks before Dr. Goode's death. In 1880 Dr. Goode published the story of The First Decade of the United States Fish Commission: its Plan of Work and Accomplished Results, Scientific and Economical. The same subject was presented in a paper read before the American Association at its Boston meeting, 1880, the aim of which was declared to be to show, in a general way, what the commission had done, was doing, and expected to do—"its purposes, methods, and results." In 1881 he published Epochs in the History of Fish Culture, and in 1882 an encyclopædic article on The Fisheries of the World. He was author of the article on Pisciculture in the Encyclopædia Britannica, an admirable presentation, in four pages, of the necessity of special measures for preserving fish and preventing their destruction, and of putting into practice the art of breeding them, with the history of the art and its present condition, in which the part taken by the United States in the fish-cultural enterprises is fully set forth. He had almost completed an elaborate memoir on the distribution of abyssalian fishes, in which he recognized for them a number of different faunal areas—a thing which no previous student of them had done. He had been engaged for some time previous to his death in the preparation of a Half-Century Book of the Smithsonian Institution which he had projected. He contemplated a complete Bibliography of Ichthyology, to include the names of all genera and species published as new, and had collected the materials for it. In this department he completed as part of a series of Bibliographies of American Naturalists, those of Spencer F. Baird (1883) and of Charles Gérard (1891), and one not yet published, but printed, of Philip Lutley Sclater, Secretary of the Zoölogical Society of London and a distinguished ornithologist. A sketch of the life and work of this naturalist, published in Science for September 4, 1896, is, so far as at present appears, his last published article. Other articles, only partly showing the broader range of Dr. Goode's interests, are his two addresses before the Biological Society of Washington, in 1886 and 1887, on The Beginnings of Natural History in America, in which his "diligence in the collection of data and skill in presenting them are well exemplified"; a paper on The Origin of the National Scientific and Educational Institutions of the United States, contributed to the American Historical Association in 1890, in which a connected view is given of the growth of such institutions from their beginning in the attempt of Mr. Boyle, Bishop Wilkins, and others, to establish in the colony of Connecticut a society for promoting knowledge; a paper on Museum History and Museums of History, read before the American Historical Association, in which is included a statement of the author's ideas of what a museum should contain, what purposes it should be intended to serve, and how it should be arranged and managed; and an address before the American Philosophical Society on the one hundredth anniversary of the death of Benjamin Franklin, on that great American's Literary Labors, in which he showed that Franklin never wrote for literary fame, but only for the good he might do by disseminating his thoughts and suggestions. Prof. Goode's contributions to ichthyology, in the Reports of the Fish Commission, Harper's Weekly said in 1887, "are not all of a purely scientific, but for a large part of a practical character. The most thorough and exhaustive researches ever made by any one about a special fish is that on the menhaden, due to Prof. Goode, and is a model of clearness, of industry displayed in collecting the facts, and of practical usefulness. Material furnished by him for the study of the swordfish is of equal value. In connection with Captain Collins, R. E. Earl, and A. Howard Clark, a life history of the mackerel was prepared, which remains to-day one of the completest of treatises on one of the most valuable of American fishes. Prof. Goode's notes on the life history of the eel have settled all questions in regard to the peculiar habits of this fish."

It was Dr. Goode's lot, by virtue of his skill in museum organization, to bear a prominent part in the arrangement and installation of the exhibits of the United States in the various international and general exhibitions which were held during his active career. He was thus associated with the Smithsonian exhibits at the Centennial Exhibition in Philadelphia in 1876; at the Fisheries Exhibitions in Berlin in 1880 and London in 1883; at New Orleans, Cincinnati, and Louisville; at the Chicago Columbian Exhibition in 1893; at the Columbian Historical Exhibition in Madrid, Spain, in 1892–'93; and at the Atlanta Cotton States Exhibition. In recognition of his services at the Madrid Exhibition he received the Order of Isabella the Catholic, with the grade of commander.

Next to being a zoölogist and particularly an ichthyologist, Dr. Goode was perhaps most eminently an anthropologist. Mr. Gill observes that his catalogues embraced the outlines of a system of anthropological science; and Prof. Otis T. Mason, in a sketch of him in the American Anthropologist, says that in his system of museum classification he insisted that all the sciences of every kind are essentially anthropological. The earth was to be regarded as man's abode, and was studied by him as such, both in its astronomical relations and its geological aspects. In the same way physiographic studies were regarded by him "as leading up to a knowledge of the earth's surface, as ministering to life, and especially to the health and happiness of man"; and meteorological apparatus and phenomena, geographical explorations and voyages, technographic resources, physics, mechanics, chemistry, botany, zoölogy, etc., were all regarded by him predominantly as they bore upon man's life and welfare. "Beyond the material resources of the earth and the forces by which they are regulated and shaped lay in Dr. Goode's scheme the special human industries devoted to the exploration of the earth, the elaboration of materials, the transportation and exchange of productions, and their utilization as well as their enjoyments. From the foregoing studies Dr. Goode's comprehensive plan led up to the social relations of mankind in their material manifestations, then to the intellectual co-operations of mankind as manifested in the arts, sciences, and philosophies, terminating with education, reform, and climaxes of human achievement. This great anthropological syllabus of all knowledge Dr. Goode used as the modulus of his own thoughts and a plan by which he arranged his books, his pictures, his clippings from newspapers, useful facts gathered here and there, and everything of a material nature which he desired to preserve."

He was interested in botany and versed in it, making the study of the flowers one of the attractions of his excursions; an earnest student of all matters pertaining to American history, a delver in genealogy from his boyhood, author of a work on his family history, and one of the editors of the Wesleyan University Alumni Record; one of the founders of the American Historical Association and a member of the Southern Historical Society; was interested in patriotic societies, and an officer of those of the Sons of the Revolution and Colonial Wars. He was a founder of several scientific societies in Washington and a member of others in this country; was a past president of the Philosophical Society and the Biological Society of Washington; was elected a member of the National Academy of Sciences in 1888; had been chosen in the American Association to be vice-president for the Section of Zoölogy at its meeting of 1897; and was a member of the Zoölogical Society of London.

Great as were Dr. Goode's scientific attainments and achievements, his friends and biographers are most emphatic in their testimonials to his personal attractiveness. Prof. S. P. Langley, whose associate he was in the Smithsonian Institution for many years, says, in the memorial he contributed to Science: "I have never known a more perfectly true, sincere, and loyal character than Dr. Goode's; or a man who with a better judgment of other men or greater ability in molding their purposes to his own, used these powers to such uniformly disinterested ends, so that he could maintain the discipline of a great establishment like the National Museum, while retaining the personal affection of every subordinate. . . . His historical powers in grouping incidents and events were akin to genius. His genealogical writings showed wide and accurate research, while his literary faculty displayed itself with singular charm in some of his minor writings. But how futile these words seem to be in describing a man of whom perhaps the best, after all, to be said is that he was not only trusted but beloved by all with an affection that men rarely win from one another!"

Mr. Gill says: "His disposition was a bright and sunny one, and he ingratiated himself in the affections of his friends in a marked degree. . . . But in spite of his gentleness, firmness and vigor in action became manifest when occasion called for them."

Prof. Mason says: "It would be difficult to find among those who are professional anthropologists a man who had a more exalted idea of what this science ought to be. . . . In addition to this comprehensive and appreciative view of anthropology, Dr. Goode was among the foremost scholars in the line of his own studies, and the bibliography of his works fills many pages of manuscript. He was, in addition to this, a good man, with a gentle, affectionate spirit, a lovely family life, a patriotic heart, and a singular devotion to the interest of the public. He never lost sight of the fact that Mr. Smithson's bequest was not only for the 'increase of knowledge' to glorify discovery, but for the 'diffusion of knowledge' to bless all mankind."

The memorial resolutions of the Biological Section of the New York Academy of Sciences, after referring fittingly to his scientific work, add that "those of us who had the good fortune to know Prof. Goode personally recall his genial interest in the work of others, his true scientific spirit. We have thus lost one of our ablest fellow-workers and one of the truest and best of men."

THE interest in schools of all grades in the South, from the common school to the university, is represented by President Julius D. Dreher, of Roanoke College, in a paper read before the American Social Science Association, as steadily growing. "The increase in the enrollment of eager pupils in public schools is a proof of that active interest. An additional proof is found in the fact that colleges and seminaries are attended by an increasing number of young men and women who practice self-denial or profit by the sacrifices of anxious parents, in order that their higher educational advantages may be enjoyed." Even the tendency to multiply higher institutions of learning is still further evidence of this general interest. Notwithstanding all that has been said, it must not be forgotten that under many adverse circumstances the Southern people have done a tremendous work since the war in providing schools for the masses and in building and strengthening institutions of higher education. They might have been wiser in their plans and more judicious in some respects in spending their money, but no people ever projected educational institutions in the midst of more inauspicious surroundings, and that, too, with the consciousness that a race, recently in slavery and hence able to contribute almost nothing in taxes, was to share equally with themselves in the schools supported at public expense. What has been done against so many odds may be regarded as the sure promise of greater advance in the future.

A STRANGE tale of a shepherd dog caring for a cat is told by a correspondent of *La Nature*. The cat was neglected, and the dog perceived that it was suffering from hunger. He was accustomed to go to a neighboring house where he was usually given delicacies from the table. One day the people of the house, answering a sound at the door, found the dog waiting there with the cat firmly settled on his back. Food was given the cat, and its escort rested while it ate. For three days the dog brought the cat thus; then the cat came afoot, but the dog was always with it.

Editor's Table.

ANXIOUS ORTHODOXY.

WE are all familiar with the troubles of the hen that, having hatched duck's eggs, sees with dismay her foster progeny betaking themselves to the water. Very similar, it seems to us, is the distress of mind which ecclesiastical authorities now and then display over the evident determination of the modern world to betake itself to the truths of science rather than to the dogmas of theology. From the ecclesiastical point of view the latter constitute *terra firma*; the former are nothing but a heaving sea of uncertainty—a treacherous element which threatens to ingulf all who trust themselves to it.

A conspicuous exhibition of this state of mind is furnished by an article in the Church Standard of Philadelphia from the pen of the Right Reverend Hugh Miller Thompson, D.D., LL.D., Episcopal Bishop of Mississippi. "The scientists," it appears from Bishop Thompson's article, have been professing that, in certain cases of hopeless disease, a period should mercifully be put at once to life and to suffering. This is perfectly terrible. It is true Bishop Thompson does not tell us who the scientists are who have made this inhuman proposition; but that is all the better, as the odium can thus be spread evenly over all of them. Neither does he give the exact terms of the proposition; and that again is all the better, as it enables him to expand and vary it at will—to give us such versions of it, for example, as the following: "When a man's father becomes toothless and childish, the son will lovingly give him the happy dispatch, and enter on possession of his estates. When the mother becomes feeble and old, the loving daughter, with her own gentle hands, will drop into the spoon and carry to the lips that kissed her baby face the precious dose that will put the dear old soul out of the way of troubling her longer." In a word, the right reverend bishop has a good time of it banging away at "the scientists" through a four-column article made up almost wholly of just such inconsequent verbiage as we have quoted.

The broad fact which writers of this class all seek to ignore is that it is precisely since science began to be a power in the world that there has been the most notable improvement in the manners and morals of mankind. The bishop tells us that, "if man be a development from the primeval slime, an improved oyster or ape," he fails to see "where there is any room to talk about the sacredness of human life." It seems to us that, far more important than *talking* about the sacredness of human life, is it to treat human life as sacred; and if the bishop will pretend that there is any comparison between the *practice* of the present day in this respect and that, say, of the eighteenth, seventeenth, and sixteenth centuries, not to go further back, we shall be very much surprised. What science, or, in other words, the progress of knowledge, does is to give the human mind scope and verge for the exercise of its faculties; and it is this enlarged intellectual activity which leads to the improvement of life in general. If it is impossible to-day to read any history of past ages without shuddering at the butcheries and cruelties which form so large a part of the record, it is not because those ages were not in possession of a well-established and firmly believed theology; it is not because any modern scientific views had arisen to weaken the sense of the sacredness of human life. It was simply and purely because a very inferior degree of sacredness—all theoretical reasons to the contrary notwithstanding—was in reality attached to human life. Men's minds had not then been expanded and enlarged, nor had their sympathies been quickened, as they have been since knowledge began to grow by leaps and bounds. Certain theological doctrines, moreover, which then universally prevailed, had a direct tendency to deaden sympathy and pervert all natural standards of right and wrong; we refer especially to that conception of hell which was the fundamental motive of all persecutions for heresy and witchcraft. The sum of human misery which must be attributed to this one cause baffles calculation. On the other hand, no fact in history is more overwhelmingly attested than that an increase in humanity has accompanied, and continues to accompany, a relaxation of the rigors of theological belief.

In that whimsical book, The Green Carnation, there is a parson introduced who, on the word science being mentioned, immediately remarks, "Indeed, I have no opinion of science." Our bishop, however, is not content with having "no opinion of science"; he goes further and has "no opinion," or, to be more accurate, a shockingly bad opinion, of Nature. Let us listen to this episcopal teacher: "There is *nothing* sacred in Nature. Certainly she treats life with very scant reverence, be it vegetable or animal. Nature's forces ruthlessly trample out and trample down life in all its forms. She is the bloodiest-handed of all murderers. She ravens in beak and claw." A little while ago it was Prof. James who was describing Nature as a harlot; to-day the Bishop of Mississippi finds that the most appropriate epithet he can bestow on it is "the bloodiest-handed of all murderers." What says Matthew Arnold?

"And patiently exact,
This universal God,
Alike to any act,
Proceeds at any nod,
And quietly declaims the curses of himself."

The Harvard professor curses in the interest of his pessimism; the divine, in the interest of his theology; and neither seems in the least alive to the humor of the situation. While they curse, the sun shines and the wind blows, the great processes of Nature go on, and the drama of human destiny develops itself just as if there was no such thing in the world as a pessimistic professor or a damnatory divine. Nature does not ask any one to admire or belaud her. She has given, or the power behind her has given, to countless tribes a share in what we call life. She guarantees nothing save the permanence of law; but she has set in operation certain principles of development which, in the case of man, have carried him, under favoring circumstances, to a high degree of eminence over the rest of the creation. Man thus finds himself possessed of self-consciousness and the power of adapting means to ends, of reading the secrets of Nature, and greatly increasing his resources for happiness and progress. At what point in man's evolution from "the primeval slime" which the bishop so dislikes to think about—though the scriptural "dust" would only require a little moistening to make a fair article of slime—at what point, we say, of man's evolution the social instincts began to emerge it is not necessary to determine. It is enough to know that they did emerge, and that, having emerged, they became capable of doing as much for his moral and emotional nature as the recognition of law, which also emerged at a given moment, was capable of doing for his intellectual nature. To-day, in moral and intellectual man—in other words, in the higher types of the human race—the world begins to have a worthy tenant and master, one in whose eyes a "splendid purpose" may be read—the purpose of governing wisely and justly and mercifully the heritage into possession of which he has come.

The practical question then is just this: whether because the bishop's theology is not enjoying quite as much prestige as it did of old, and because the emancipated human spirit is seeking knowledge everywhere, even in regard to matters which the bishop thinks ought to be accepted as authoritatively settled, there is any reason to apprehend that the bonds of society and of the family are going to be loosed, that the humane instincts, which for generations have been gaining in strength, are going to fall into decay, and that man, under the influence of scientific teachings, is destined to become a mere cunning compound of cruelty and self-indulgence. Well, for our part, we don't believe it; there is nothing in past history to render such a result probable, everything to render it improbable. What the most distant future may have in store for our race, we know not; but of this we feel persuaded, that the future which lies immediately before us will be an era of greater justice, of greater humanity, and at the same time of greater intellectual liberty, than any the world has yet seen. All the signs point that way.

"*GROWING ILLITERACY.*"

Where? Why, here, in these United States, and in that most favored portion of them which sends its youths to Eastern colleges and universities. But who talks of "growing illiteracy"?—surely some very ill-informed individual who does not know what splendid work our public schools are doing. By no means; but we may as well, without further ado, explain the matter.

For a good while past the colleges and universities of the country have been finding it harder and harder to put up with the very inferior preparation, particularly as regards knowledge of the English language, of the youths who go up from the secondary schools for matriculation. Harvard is in open rebellion against the annoyance; and a committee of the Overseers lately made the suggestion that it would be a good thing to print the papers of these ill-taught youths, and give the names of the schools from which they had come. At this the principals of a number of the leading schools took alarm; and it was in the protest which they published that the ominous words we have quoted appeared. "While we regret," they say, "the growing illiteracy of American boys, we can not feel that the schools should be held solely responsible for the evils, which are chiefly due to the absence of literary interest and of literary standards in the community." In other words, there is a growing illiteracy among boys, because, broadly speaking, illiteracy has taken possession of the country. The parents of the boys—who themselves had the benefit of public-school training—have, for the most part, no literary interests and recognize no literary standards. These high-school principals ought to know whereof they affirm; we do not know who would be in a position to gauge the acquirements of American boys, and the domestic influences which have guided their development, if not they.

If the universities, by bringing pressure to bear on the secondary schools, can do anything to remedy this state of things they certainly should do it. If the principals are right, however, the outlook is not hopeful. Our own impression is that they are right, and that there is throughout the country a growing indifference to correct speech and a growing lack of appreciation of the higher uses to which language can be put. The testimony of the principals is enforced by that of a Western teacher, who writes to The Nation to explain the peculiar difficulties under which the schools labor as regards the teaching of English. The pupils, he says, have, *out of school*, been studying English for fifteen or sixteen years before they reach the high school. "They suppose themselves to be entirely competent, their habits of expression are fixed, and no two of them are alike. . . . The home, the very cheap newspaper, the street, have furnished them with their common speech; and, although the first may sometimes be all that can be desired, very often the balance of power belongs to the others. . . . Under favorable circumstances the teacher of composition is allowed forty-five minutes a day, for three years, in which, besides teaching something of the history of literature, he is to counteract influences that have fifteen years the start of him, and fifteen times as great present opportunity. The only remarkable thing is that, under such circumstances, he accomplishes anything at all."

The important thing is to have a right understanding of the situation, and the remarks we have just quoted are very much to the point. Large masses of people are apt to be rebellious in matters of grammar, and, in general, indifferent to established laws of speech. Language which they use for everyday purposes is, in their opinion, "good enough" if it serves those purposes. It is the coin of thought, and so long as it passes current they are satisfied, however clipped or debased it may be. There are no great literary monuments in the background, as it were, of the national consciousness which tend to keep language to a classic form. There is nothing, for example, which exercises at all the same influence upon us as a people as the Homeric poems and the works of the great dramatists—but particularly the Homeric poems—did upon the ancient Greeks. Even if we had any works which stood in something like the same relation to our national life, the printing press has made it unnecessary for us to enrich or burden (as we may consider it) our memories with any portions of such literature. When books were scarce, people had to make books of their minds, but in these days of public libraries no such drudgery as that is necessary; we want our minds for other things.

How powerless the public school is to hold the nation together in the matter of speech is proved by nothing more than by the fact that an ever-increasing number of novels and tales of domestic production are written in "dialect." Occasionally we witness learned and most academic discussions as to whether a particular writer has got the "dialect" of a particular region in perfect shape. Poets of considerable note have labored to give currency to very degraded forms of speech. Children are encouraged to slur their words by having the conversation of other children who do likewise served up to them in story books. Public-school teachers themselves in many cases give evidence in their speech that all the scholastic training to which they have been subjected has not sufficed to counterbalance the influence of their everyday surroundings: they will recite a rule of grammar and violate it in the same breath.

Now, we do not belong to the school of those who think that the ultimate appeal in all questions of language must be to the usage of the past, and who contend for the standard forms of speech as a man might for "the faith once delivered to the saints." We agree rather with a great historian and admirable writer, Sir Francis Palgrave, who says that few have done so much harm to literature as "the martinets of language"; adding that "whenever the era arrives in which artificial rules for style or language are accurately laid down and painfully obeyed, then literature is approaching her climacteric." We agree, too, with the more ancient author of The Art of Poetry, who says in effect that happy experiments in enriching a language, at one time with words recovered from antiquity and at another with new and expressive words struggling for recognition, are always in order. It is one thing, however, to do as Palgrave advises, and set the expression of thought and feeling above the mere observation of artificial rules; it is another to disregard all rules through simple indolence and lack of idealism—lack of respect for the vehicle of thought. It is one thing to do as Horace advises and strive to strengthen and enrich the speech we use, and another to throw the door open to every vulgar invention and conceit of the hour.

We can not better define the evil with which we have to contend than by describing it (in words just used) as a total "lack of idealism" in the use of language. Considering that articulate and significant speech forms the great line of distinction between man and the brutes, considering the infinite riches of thought and feeling, the treasures of experience, the varied presentments of human life that are stored up in language, it would not seem excessive if something of reverence toward language considered as an exalted power and prerogative of the human mind were imparted to the young and made through education a common possession of all normal human beings in a civilized state. That, however, would appear to be, in any broad sense, past hoping for. But what the many pass by with indifference, if not contempt, the few may if they like appropriate. The question which some at least ought to consider is whether there are not great and solid advantages connected with an accurate knowledge and practical mastery of the English language. Of course, we believe very strongly that there are, and it would not be difficult to discuss these advantages at length under the three heads of intellectual, moral, and æsthetic. Accuracy and precision of speech means, or at least tends strongly toward, accuracy and precision of thought. Many persons have but little distinct consciousness of the words they use, and to try to hold them to any precise meaning is hopeless. The way to remedy such defect of thought is through careful and strenuous drill in the verbal expression of thought—such drill as language studies properly conducted will bestow—aided by scientific drill in the observation of facts. To what extent mental dishonesty is favored by vagueness and indefiniteness of speech it is almost needless to observe. Taking finally the æsthetic view, if any value is set upon distinction of mind, upon purity of taste, upon sensibility to the harmonies of which language is capable, and sympathy with all the nobler phases of human thought and emotion which literature records, how are these to be secured and developed save through a careful cultivation of the language sense?

It might not be impossible, we think, through a proper setting forth of this aspect of the case, if not to stem the rising tide of illiteracy, to engage the interests and the sentiments of a respectable minority in favor of such a study of the English language and its literature as should confer the benefits we have mentioned. The word culture has been much abused, but it has a meaning with which we can not dispense; and, as an instrument of culture—of genuine emancipation and elevation of mind—there is no line of study which we can place before that which raises a mind fairly to the level of a great language and a great literature.

Scientific Literature.

SPECIAL BOOKS.

THE query that Prof. *Trowbridge* takes as the title of his recent book is one of the most difficult to give a direct answer to that have been propounded to modern science.* The answer given in this volume presents electricity to the adult reader from a much different point of view than was afforded by the treatise of his school or college days—say, ten to thirty years ago. Our author has designed his book to give a popular presentation of Maxwell's theory of the electro-magnetic origin of light and heat, for he holds that by studying the transformations of energy involved in this theory we can obtain the best idea of what electricity is. The plan of the volume is to treat in successive chapters the leading phases of the subject as illustrated by important processes or pieces of apparatus. In the short chapter on measurements in electricity he shows that gravitation is used to measure all our electrical manifestations, and then passes to a discussion of the nature of gravitation itself. In dealing with magnetism he quotes the expressions of Franklin and his contemporary, Prof. Winthrop, on this subject, and some of Count Rumford's views on the transformation of energy—a subject that bears a fundamental relation to the modern science of electricity. Passing to later times, he shows that it is to considerations of the nature of the surrounding medium that we owe the chief advances in our knowledge of magnetism. His account of the dynamo machine begins with a comparison of Faraday's galvanometer with one of the present day. This is followed by a description of the construction of a simple piece of apparatus by means of which the essential features of the dynamo can be explained. Subjects of other chapters are: Alternating Currents, Transmission of Power by Electricity, The Leyden Jar, Step-up Transformers, The Electro-magnetic Theory of Light and the Ether, The X Rays, and The Sun. The book is popular but not elementary. The treatment is everywhere philosophical, though by this we are far from meaning

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* What is Electricity? By John Trowbridge, S. D. International Scientific Series, vol. lxxv. New York: D. Appleton & Co. Pp. 315, 12mo. Price, $1.50.

metaphysical. Technological applications appear only by way of illustration. The volume contains some fifty diagrams and a frontispiece plate.

For an elementary and thoroughly popular account of electrical phenomena the reader should go to the Library of Useful Stories. We feel safe in saying that every electrical contrivance known to the general public is described and explained in the little book by Mr. *Munro*.* The chapters on applications of electricity are preceded by accounts of the apparatus and processes employed in the several modes of generating the electric force. Throughout the volume is enough of history and anecdote to justify the title of "Story," and enough of fundamental principles to base an intelligent acquaintance with the phenomena of this branch of science upon. Where the history of discoveries and inventions is being told, the reader should remember that the author is English, and has a full share of the amusing insular notion that everything worth mentioning was done first by an Englishman. In the matter of terminology the book has been edited so as to make it conform to American usage; some changes have been made in the cuts also, and new matter has been added to the same end. There are a hundred illustrations and an adequate index.

It is a little startling to see a renowned chemist described in the title of a biography as "Poet and Philosopher."† Davy, however, was certainly occupied with "natural philosophy," and the designation of poet is far from misapplied. The pleasing character of the Century Science Series is admirably maintained by the attractive life-history of him that Dr. Thorpe has prepared. Of the talents that characterized Davy's adult life the first to be manifested in his boyhood was his poetic faculty. His best school exercises, we are told, were his translations into English verse, and he was often called upon by his schoolmates to write valentines and similar effusions for them. Later it was undoubtedly the vivid imagery and sympathetic mode of expression derived from this faculty which made his popular lectures the salvation of the Royal Institution before that establishment had his brilliant discoveries to lean upon. Our author evidently has assumed that his readers wish to know about Davy's scientific career, and this thread runs unbroken throughout the volume. At the same time the human side of the man is shown in references to his fondness for angling, his devotion to his mother, his friendship with Coleridge, Maria Edgeworth, and other persons of intellect, the incidents of his marriage, and the characteristics of his disposition. Davy's last important discovery, the principle of the miner's safety lamp, as well as his first, the anæsthetic property of laughing gas, have a practical value that easily commands popular appreciation, while his isolation of the metals of the alkalies, his demonstration of the elementary character of chlorine, and his researches on iodine give him a permanently high rank among chemists. Dr. Thorpe has relied largely upon the memoirs of Dr. Paris and of Dr. John Davy, brother of Sir Humphry, carefully weighing one against the other where they disagree, and he has had much other material in the form of letters, journals,

* The Story of Electricity. By John Munro. New York: D. Appleton & Co. Pp. 187, 16mo. Price, 40 cents.

† Humphry Davy, Poet and Philosopher. By T. E. Thorpe, LL. D., F. R. S. New York: The Macmillan Company. Pp. 240, 12mo. Price, $1.25.

and memoirs of contemporaries, records of societies, pamphlets of the time, etc.

At the age when the child comes under the care of the teacher some of his mental faculties are already well advanced on the path of development. One must go back of this age in order to get a full understanding of the way in which his mind unfolds. Prof. *Compayré* goes back to the moment of birth,* and even quotes inferences of several observers as to the psychology of prenatal existence. There is a good deal of physiology in the chapter on the newborn child and in that on movements, the first forms of activity. From the pains that the author takes with fundamental considerations one would almost think he was a German instead of a Frenchman. He sums up the history of the child's motions as "irresistible, blind, fatal impulses at the start; then, little by little, conscious desires, thoughtless, but lit up by an intellectual representation, by the idea of an end to be attained; finally, will and efforts." The statement of the child's muscular needs given in this book ought to convince any reader of the cruelty of enforcing the command to "sit still" upon young children. Prof. Compayré next considers the development of sight, showing that the child is half blind at birth, and only gradually gains the full use of his eyes. The author (or translator) is rather too literal in interpreting photophobia as "fear" of light, and the same inaccuracy is observable in other writers on this subject. The newborn child has no real *fear* of light; the proper term is *intolerance of light*. The other senses are also rudimentary at birth, that of touch being best developed. In discussing the emotions our author affirms that the pleasures early exceed the pains in the child's experience. The natural modes of expressing the feelings can be readily observed in children, who do not restrain such manifestations. Prof. Compayré finds the first evidences of memory in the nursling's recognition of familiar faces. The acquirement of language, which itself depends upon a certain development of the memory, he regards as greatly quickening the further growth of this faculty. The imagination, consciousness, attention, and association of ideas are described in the two remaining chapters of this volume. The concluding part of the work will deal with reasoning, learning to talk, the development of the moral sense, and related topics.

GENERAL NOTICES.

This book will be the first complete illustrated botany published in this country.† Its aim is to represent and describe every species, from the ferns upward, mentioned as distinct by botanists and growing wild within the area adopted. It is intended, also, to complete the work within such moderate limits of size and cost as shall make it accessible to the public generally, so that it may serve as an independent handbook of our Northern flora, and as a work of general reference, or as an adjunct and supplement to the manuals of systematic botany in current use. The utility of a completely illustrated manual, both to the botanist and to the non-expert, is apparent. The most minute and accurate description may leave a doubt which the comparison of pictures of the species will solve. Persons who are not familiar with botanical terms and the methods of botan-

* The Intellectual and Moral Development of the Child. Part I. By Gabriel Compayré. International Education Series, vol. xxxv. New York: D. Appleton & Co. Pp. 298, 12mo. Price, $1.50.

† An Illustrated Flora of the Northern United States and Canada and the British Possessions. By Nathaniel Lord Britton, Ph. D., and Hon. Addison Brown. In 3 vols. Vol. I. New York: Charles Scribner's Sons. Pp. 612. Price, $6.

ical analysis may find in the illustrations a ready means for the identification of the plants that grow around them, and through the accompanying descriptions they will at the same time acquire a familiarity with botanical language. The enterprise of preparing this work was projected by Judge Brown, who is President of the Torrey Botanical Club, and has been diligently prosecuted for six years under the supervision of Dr. Britton, and, as to the text, mainly by him; while the work in all its parts has been carefully revised by both authors. The latest matured results of botanical studies, here and in Europe, have been availed of for the work, so as to bring it fully abreast of the knowledge and scientific conceptions of the time, and make it answer present needs. The area treated of has been so liberally defined as practically to include the entire flora of the northern portion of the Great Plains. Most of the arctic plants are also included, for there are only a few of them which may not be found within the limits prescribed for the work. The figures are all from original drawings for this book, either from fresh plants or from herbarium specimens. All have been first drawn of natural size from medium-sized specimens and afterward reduced to a proportion which is indicated. Hence they do not suffer from the use of a magnifier, but are rather improved by it. The systematic arrangement has been revised so as to correspond as nearly as may be with the order of nature as now understood—as an order of evolution from the more simple to the more complex—and the sequence of families adopted by Engler and Prantl has been closely followed. The nomenclature is according to the code devised by the Paris Botanical Congress in 1867, as modified by the rules adopted by the Botanical Club of the American Association. English names are given as far as possible, but, in the confusion that exists in respect to these, great exercise of judgment in selection has been called for.

In the *Social Forces in German Literature*,* Dr. *Kuno Francke*, of Harvard University, attempts to define what seem to him the essential features of German literature from the point of view of the student of civilization rather than from that of the linguistic scholar or literary critic. By his studies and various influences he has been led to look at the substance rather than the form of literature, to see in it primarily the working of popular forces, to consider it chiefly as an expression of national culture. His effort is to supply what seems to be a decided need of a book which, based upon an original study of the sources, should give a coherent account of the great intellectual movements of German life as expressed in literature, and point out the mutual relation of action and reaction between these movements and social and political conditions. To his view all literary development is determined by the incessant conflict between the tendency toward personal freedom and the tendency toward collective organization. The subject is considered under this view in connection with the period of the migrations, from the fifth to the ninth century; with the growth of mediæval hierarchy and feudalism, the height of chivalric culture, the rise of the middle classes, the era of the Reformation, and the several epochs since, whose characteristics have been reflected in literary development; the whole constituting an admirable and instructive study of this phase of the history of civilization.

A very useful little book on *How to Feed Children** has recently come to us from Mrs. *Louise E. Hogan*. The framework for the book consisted of a number of magazine articles that have appeared during the last two years in various journals. The author's aim has been to offer in a practical form a few suggestions concerning the application of the principles of dietetics to feeding in the nursery and throughout the period of childhood. All the material can of course be found in technical manuals in a much more extended form, and there is no claim of originality; but an attempt has been made to select the most important and general rules, and to present and apply them in a simple and practical way. While the close relations between physiology and dietetics are generally

* Social Forces in German Literature. By Kuno Francke, Ph. D. New York: Henry Holt & Co. Pp. 556. Price, $2 net.

* How to Feed Children. By Louise E. Hogan. Pp. 236, 12mo. Philadelphia: J. B. Lippincott Co. Price, $1.

recognized, very little account is usually taken of them in cooking, and the worst results from their non-observance naturally occur among children whose digestive tract is less able to deal with unsuitable material. The first six chapters deal with the proper food for infants, and its preparation. Laxative foods are given a chapter. Nursery diet, fat in food, diet in illness, and diet for school children are all chapters of special interest. There are about twenty pages of receipts, as well as a good index, appended.

An Inductive Manual of the Straight Line and the Circle, by *William J. Meyers*, has arisen through the difficulty which the author has found in dealing with his own classes in geometry by the ordinary method, which is a purely deductive one. He believes that the inductive method will yield as extensive and exact a knowledge in the same length of time, a much greater readiness in the application of the knowledge obtained, and a more thorough "training of the imagination, invention, and judgment." Instead of a series of written proofs to memorize, such as, for instance, the sum of the three angles of a triangle is equal to two right angles, the student takes the triangle, and, with suggestions from the teacher where necessary, works out the various relations between its sides and angles for himself. The method seems a great improvement on that usually adopted. (The author, Fort Collins, Col.)

Nature Study, by *W. S. Jackman*, was written, says the author, for the purpose of aiding the elementary teacher in imparting this very important branch of knowledge to the younger pupils. The close relation between Nature study and the other subjects in the common-school course, and a few of the more general and essential facts and laws of natural science, are chiefly dwelt on. The book is accompanied by a series of charts, bound separately, which present "a conspectus of selected work in Nature study for each month of the entire year." (The author, Chicago, 85 cents.)

The second series of *Life Histories of North American Birds*—Special Bulletin No. 3 of the United States National Museum—by *Charles Bendire*, relates to the parrots, cuckoos, anis, trogons, kingfishers, woodpeckers, goatsuckers, etc.; swifts, hummingbirds, cotingas, tyrant flycatchers, larks, crows, jays, magpies, starlings, blackbirds, orioles, and grackles; while the former series (Bulletin No. 1) included the gallinaceous birds, pigeons, doves, and birds of prey. The descriptions have especial reference to the breeding habits and eggs of the birds, and are based on the collections in the museum. The classification of the American Ornithologists' Union has been followed. The seven plates contain more than two hundred representations of eggs, reproduced by chromolithography from original water-color drawings. We are informed that the oölogical collection of the museum has been increased by the acquisition by gift of the collection of seven thousand specimens of Dr. William L. Ralph, of Utica, N. Y. We hope the collections of all the ornithologists will be completed soon, and that the rest of the eggs may be allowed to become birds. The very first sentence of the first description in this book tells a story that should make all collectors pause. It is that the range of the bird in question—the only representative of its family in the United States—is yearly becoming more and more restricted.

The *Sixteenth Report of the United States Geological Survey*, the first issued under the direction of Mr. Charles D. Walcott, appears in four large, handsome volumes. From the report of the director in the first volume we learn that he has not made any radical changes in either the policy or *personnel* of the survey. Such modifications as have been made are intended to bring his bureau more in touch with some of the economic and educational interests of the country. They include improving the quality of the topographic maps and marking the subdivision lines and the township and section corners on those of States containing public lands; placing the entire topographic force within the classified civil service; obtaining authority from Congress to print and sell topographic maps with text for educational purposes; enlarging the Divisions of Hydrography and of Mineral Resources; and the making of reconnaissance surveys of regions supposed to contain important economic resources, in order to obtain information which, under the ordinary plan of awaiting a complete survey of the region, would be delayed for years. Following this report are papers on The Dinosaurs of North America, by O. C. Marsh; Glacier Bay and its Glaciers, by H. F. Reid; Some Analogies in the Lower Cretaceous of Europe and America, by L. F. Ward; Structural Details in the Green Mountain Region and in Eastern New York, by T. N. Dale; and one of three hundred pages on Principles of Pre-Cambrian North American Geology, by C. R. Van Hise. All of these are adequately illustrated, that of Prof. Marsh having eighty-five plates. The second volume is devoted to papers of an economic character, an account of the Geology and Mining Industries of the Cripple Creek District, Colorado, having first place. The general geology of the district is set forth by Whitman Cross in considerable detail. The plan followed involves giving the character of the various rock formations, the evidences of action by the ancient Cripple Creek volcano, and descriptions of the rocks forming each of the hills in the camp and vicinity. R. A. F. Penrose, Jr., describes the mining geology of the district, telling what ores are met with, how they occur, and the way in which they were deposited. He also gives detailed descriptions of the ore deposits of the various hills and gulches, and frequently describes the veins followed by individual mines. Prof. N. S. Shaler contributes a paper on the Geology of the Road-building Stones of Massachusetts, giving the results of tests made on a considerable variety of stones, with some discussion of the value of the different kinds under various practical conditions. The Economic Geology of the Mercur Mining District, Utah, is treated by J. E. Spurr. There are two monographs bearing on irrigation: The Public Lands and their Water Supply, by Frederick H. Newell, and Water Resources of a Portion of the Great Plains, by Robert Hay. The former of these papers tells the character of the remaining public lands and in what States they are located, and gives the available sources of water in each State. The latter gives the results of an investigation on a strip of country lying along the eastern boundary of Colorado, this district being chosen as typical of the Great Plains region. The volume is adequately illustrated with maps, diagrams, photographic views, etc. The report on the Mineral Resources of the United States, with which the name of David T. Day has been for many years identified, appears for 1894 in a new form. It constitutes the third and fourth of the royal octavo volumes of the general Report of the Survey. Mr. Day has utilized the greatly increased space allowed him by producing a much more valuable work in his field than ever before. Iron is the first of the minerals to be considered, and in addition to the statistics for the United States there is an account of the production of iron ores in various parts of the world, by John Birkinbine, and a statement of the operations of the iron and steel industries in all countries, by James M. Swank. Other metals are treated by various specialists or by the editor. The second of Mr. Day's volumes is devoted to non-metallic products. Here the account of coal production, by Edward P. Parker, has first place. The manufacture of coke and the production of petroleum and natural gas are presented by Joseph D. Weeks. William C. Day tells of the year's operations in the stone industry, Heinrich Ries contributes an account of the technology of the clay industry, while minor products are treated by various hands. The first appearance of monazite in these reports is made the occasion for a historical and chemical account of the substance by H. B. C. Nitze. This is the mineral used in making incandescent mantles for gas-burners.

The idea that it is well to become acquainted with the beings that they are to do their professional work upon has now taken firm hold upon the teachers of this country. They are absorbing the many books on the psychology of children that are offered to them and demanding other treatises on special topics not yet fully or clearly dealt with. A volume that undertakes the inconspicuous but fundamental task of supplying facts from which the characteristics of children may be learned is the collection of *Child Observations* made by students of the State Normal School at Worcester, Mass., and edited by Miss *Ellen M. Haskell* (Heath, $1.50). The twelve hundred examples of children's doings here presented are purposely confined to Imitation and Allied Activities. The design of the book is fully explained in an introduction contributed by Mr. E. H. Russell, principal of the normal school. "The records," he says, "make no scientific pretensions whatever. They are printed in response to many requests and with the hope of awakening or quickening interest in children simply as children, not as pupils or as 'material' for psychological or anthropological study." Mr. Russell calls attention to the evidence in these observations of the interest with which children repeat their imitative acts, this interest being sustained by their vivid fancy. Their spontaneous activity—muscular and mental—is another notable characteristic that he mentions. He also gives a caution against too much seeking for uniformity in children. A second volume, embracing another class of these observations, will be forthcoming if the demand should appear to warrant it.

The recent political campaign was remarkably productive of books which have more than an ephemeral interest. Among these is *The Monetary and Banking Problem*, by *Logan G. McPherson* (Appletons, $1), consisting of three articles contributed to this magazine early in 1896, with additional chapters on bimetallism and on the standard of value. Mr. McPherson maintains that, while gold and silver were suitable for money in past conditions of the world's trade, they are very crude instruments for our present commerce. The use of both together is made impracticable by natural laws unless one is subsidiary to the other. They are being steadily superseded by paper representatives of value, and the author looks forward to the adoption of a new unit which shall be not a specified weight of metal but a quantity of human effort. The reasons for the position taken by him are clearly stated, and the problem which still confronts the United States in spite of the verdict of the recent election is discussed practically and understandingly.

Believers in the gold standard will regard as pertinent to the times the new edition of *Fiat Money Inflation in France*, by *Andrew D. White* (Appletons, paper, 25 cents), which was one of the books of the recent campaign. Doubtless many persons will devote some of their leisure this winter to a further study of monetary questions, and to them this bit of history can not fail to be instructive. The present issue contains an extract from Macaulay on effects of cheap coinage, and an introduction showing the resemblance of the scheme tried by France to that proposed for the United States.

The volume of *Proceedings of the Indiana Academy of Sciences* just issued contains about three hundred pages and a number of plates. Among the more notable articles are Call's Revision of the Parvus Group of Unionidæ, Everman and Scovell's Fishes of the Missouri River Basin, and Investigations concerning the Redfish. The notable feature of the Biological Survey Reports is the series of reports on Turkey Lake. This, the largest inland lake of Indiana, has been chosen as the seat of the Indiana University Biological Station. The lake is being studied as a unit of environment with the variation of its inhabitants. The scope of the report as indicated by the titles is about as follows: Report on the physical features; hydrographic map, with contours for every ten feet of depth; temperatures; the inhabitants, by Eigenmann, Ridgley, Kellicott, Birge, Hay, Call, Atkinson, Reddick, and Chamberlain; methods of studying variation, by Eigenmann; and the variation of *Etheostoma caprodes*, by Moenkhaus.

The instructor who has had for several years a large class of beginners in organic chemistry knows how much of his time is required to initiate his neophytes into the new kind of laboratory work that they are taking up. He will not need to be told the value of a book that could give the necessary directions clearly, briefly, and without the omission of any essential caution or qualification. Such a book Dr. *Ludwig Gattermann* aimed to produce in his *Practical Methods of Organic Chemistry*, and with so much success that a translation into English has seemed warranted (Macmillan, $1.60). Dr. Gattermann describes first such general operations as crystallization, simple distillation, distillation with steam, etc., not omitting the drying and cleaning of vessels. In this general part are included qualitative tests and the quantitative determination of carbon, hydrogen, nitrogen, sulphur, and the halogens. Passing to special preparations, the author gives directions for thirteen reactions in the aliphatic series, forty-two in the aromatic, and one example each with a substance in the pyridine and quinoline series. Directions for preparing a few inorganic reagents are also given. The attention of the student is called to the significance of each reaction described, so that his knowledge shall be something more than empirical. The volume is illustrated with eighty-two cuts of apparatus.

"I sometimes wonder whuther it's bein' good thet makes some folks infidils, er whuther it's bein' infidils thet makes some folks so good," remarks one of the characters in *The Reason Why*, and in the association of these ideas strikes the keynote of the story. In his preface the author, *Ernest E. Russell*, says, "There was a time when such a story as I have tried to write would have helped me," and in an unquestionably genuine desire to help others he makes his story a vehicle for the reasons that lead many thoughtful men and women to reject the Christian religion. These reasons are quite fully stated, chapters and parts of chapters being devoted to the inherent probability or improbability of the Scriptures, the action of early councils of the Church in forming the canon and the creeds, the Arian "heresy," the Nestorian "heresy," the return to Augustine in the Reformation, miracles, possession by evil spirits, and kindred topics. Several minor matters are touched upon in passing, such as the beneficial influence of industry, the wreck of happiness likely to follow the marriage of persons having opposite religious beliefs when one has the proselyting spirit, the rightfulness of doing to a human being what we regard as an act of mercy to a brute, namely, shortening the suffering that precedes death, etc. The thread of story is sufficient to give coherence to the book, while the characters, who are country people of a generation ago and educated young persons of rural origin, are excellently portrayed. Thoughtful persons who have drifted away from early religious teaching will enjoy and profit by *The Reason Why*. (The author, 13 Astor Place, New York.)

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Fragments of Science.

Education and Industrial Prosperity.—For several years past there has been a growing appreciation of the close relation between the general educational system of a country and its industrial prosperity. The striking advance in the latter respect which has occurred in Germany, and the perfection of her universities and mechanical schools, have formed a valuable object lesson, which, although surprisingly slow in doing its work, seems at last to have awakened English scientists and economists to the pressing need for action. For a number of years large sums have been spent annually in providing technical schools in England, but they have apparently had little effect in helping her to retain the commercial supremacy of which she had for so many years been the possessor. Mr. William's book, "Made in Germany," seems to have started the discussion anew, and Prof. William Ramsay has recently published an article, apparently suggested by Dr. Ostwald's letter in the Times (describing the methods of instruction in physics and chemistry in German universities), in which he attempts to locate the cause of the failure of the English school system. In Prof. Ramsay's opinion, it is the English university which is at fault, and more especially its examination system. He says: "In Germany, as shown by Prof. Ostwald, little importance is attached to examinations. The student, after spending a year and a half or two years in mastering the general aspects of his subject, proceeds to carry out some research. . . . During all this time he is not pestered with having to prepare for periodical examinations, requiring the rapid assimilation of a sufficient number of facts to enable him to pass. Even at the end of his career the examination is considered of secondary importance. . . . The result of this freedom from mental worry is that the student is able to imbibe that spirit of love of knowledge for its own sake, and that enthusiasm for its advancement, which lie at the base of all true progress in science. From among such students the German manufacturers are drawn. . . . In England we have no such incentive to a university career. . . . The aim of most of our students is a degree, and the degree is awarded on the results of frequent examinations." This latter state of mind can obviously have but one result in the great majority of cases, namely, that of making the knowledge gained simply the means of obtaining a degree, and uot an end in itself—a something to be used and then thrown aside and forgotten. The absolute inability of most students to make any practical application of their college learning, or to see the connection and interdependence between its various branches, is a clear indication of the light in which they regard it. The same conditions which prevail in the English schools are even more pronounced in the United States, and while Prof. Ramsay's *causa vera* is only part of the story, his article as well as Dr. Ostwald's letter deserves the thoughtful attention of our educators and economists, for, while we have no commercial supremacy to lose, we have, what is perhaps more important, one to gain.

Prospective Railway Routes in Africa.—In describing, before the Geographical Section of the British Association, the probable railroad routes in Africa, Major Leonard Darwin, president of the section, mentioned the routes up the Nile and into parts of the central Soudan as among the most important. In the Nile route, the river itself would afford a large part of the medium of communication; but the region of the cataracts, covering several hundred miles, would have to be spanned by a railway connecting the lower river with Berber. Above Berber is a navigable waterway at high Nile for fourteen hundred miles to the Fels rapids, besides between four hundred and six hundred miles on the Blue Nile and the Bahr-el-Gazal. There is, perhaps, only one other place in Africa where an equal expenditure would open up such a large tract of country as between Suakim and Berber. Two routes for railways from the coast to the Victoria Nyanza have been proposed, one running through the British and the other through the German sphere of influence. The German route would be the shorter of the two; but there is some reason to think that the British line will open up more country east of the lake which will be suitable for prolonged residence by white men. A line from the south end of Lake Tanganyika to the northern end of Lake Nyassa and thence to the coast would open up a vast extent of territory, and would, especially if eventually connected with the Victoria Nyanza, be more valuable than any other line in Africa in putting an end to the slave trade. On the west coast, the Congo points to the most important line of communication. After a hundred and fifty miles of navigable waterway we come to two hundred miles of rapids, along which a hundred and seventeen miles of rails are already laid. Then, on entering Stanley Pool there are, according to the Belgian estimates, seven thousand miles of waterway. If all the representations are correct, there is no place in all Africa where two hundred miles of railway may be expected to produce such marked results. Another region of great promise is that of the Niger, but the political conditions of the country—it lying on the border land between the Mohammedan and the pagan tribes—make the early execution of railways somewhat problematical. Formidable mountain ranges being few, the chief impediments to railway construction in Africa are the drifting sands, wide tracts of rocky country, the dampness of the forest causing rapid decay of material, and the deadly nature of the climate.

The Evolution of Aseptic Surgery.—A part of the presidential address of Sir Joseph Lister at the British Association was devoted to the story of the development of the author's system of aseptic treatment of wounds. It began with the publication of the results of Pasteur's researches on fermentation, by which it was proved that putrefaction was not produced by any chemical action of the atmosphere, but by germs. Sir Joseph then sought for some substance that would prevent the development of germs in the bodily tissues without harming the tissues themselves, and found it in carbolic acid. Diluted with water, this substance when applied quickly transferred itself to the tissues and attacked the germs. In cases to which the watery solution was not adapted, or where it was too irritating, a solution in some organic substance, not parting with the carbolic acid so readily, was found to be bland and unirritating, and served as a reliable store of the antiseptic. While continuing his experiments in confirmation of Pasteur's theory, Sir Joseph found that blood drawn with antiseptic precautions into sterilized vessels might remain free from microbes for an indefinite time, even when exposed to the access of air or with ordinary water added to it. He even found that if very putrid blood was largely diluted with sterilized water, so as to diffuse its microbes widely and wash them clean of their acrid products, a drop of such dilution added to pure blood might leave it unchanged for days at the temperature of the body, although a trace of the septic liquid undiluted caused intense putrefaction within twenty-four hours. Hence he was led to conclude that it was the grosser forms of septic mischief, rather than microbes in the attenuated condition in which they exist in the atmosphere, that were to be dreaded in surgical practice. He hinted to the London Medical Congress in 1881 that it might turn out possible to disregard the atmospheric dust altogether, but did not venture to practice upon the hint till 1890, when he brought forward, at the Berlin Congress, what he believed to be absolute demonstration of the harmlessness of atmospheric dust in surgical operations. "This conclusion has been justified by subsequent experience. The irritation of the wound by antiseptic irrigation and washing may therefore now be avoided, and Nature left quite undisturbed to carry out her best methods of repair, while the surgeon may conduct his operations as simply as in former days, provided always that, deeply impressed with the tremendous importance of his object, and inspiring the same conviction in all his assistants, he vigilantly maintains from first to last, with a care that, once learned, becomes instinctive, but for the want of which nothing else can compensate, the use of the simple means which will suffice to exclude from the wound the coarser forms of septic impurity."

The Iron Age in Aboriginal Art.—Prof. O. T. Mason has been led, from his studies of aboriginal art, to attach great importance to the influence on the native American mind of the iron age, which he defines in the American Anthropologist as "the conservative folk age, the middle age as distinguished from the Renaissance, which replaced the old in progressive Europe." It is almost impossible, Prof. Mason says, for one looking over a collection of *Americana*, "to decide positively whether he is regarding the unadulterated Western hemisphere, or mediæval Europe, or native Africa, or some happy combination of these. In the New World during four centuries, as in the Old World, the activities, the whole life, of the native people were partly such as belong to a common humanity, such as arise through a partnership and co-operation between any group of human beings and their environment, and such as came to them from foreign lands living in the iron age of Europe. . . . There is hardly a tribe on this continent that has never heard of iron; there are tribes of Americans that preserve only a vestige of native life. Even the archæologist is often in doubt regarding buried specimens. Shell heaps, mounds, caves, and cemeteries often hide iron-made products among the goodly stuff, exciting a reasonable doubt concerning the probable authorship of the works themselves."

Value of Horseless Vehicles.—In a paper in the British Association, Mr. A. R. Sennett traced the history of mechanical locomotion from the sixteenth century, when horseless vehicles were run by means of springs, touched upon the automotors of succeeding centuries, cited the instance of a light wind-propelled vehicle which made the journey between Bristol and London in the early part of this century, and led up to the self-propelled vehicles of the present day. He pointed out that horseless locomotion on the European continent was looked upon more from the point of view of sport than of adaptation to transport in commercial and industrial operations. The author predicated, however, that we should enter upon the subject in a far more serious manner. Notwithstanding the immense mileage of railroads in England (and in the United States, too, we may add), a considerable proportion of the mileage of good common roads is represented by roads connecting towns situated at a considerable distance from railway stations. Such towns and outlying stations could be far more efficiently served by judiciously organized systems of horseless road locomotives than ever could be done by the most elaborate system of light railways. Whether we took the case of the heavy and slow haulage of the farmer and the team owner, or the light and rapid delivery required by the tradesman, we should find that economy is upon the side of mechanical propulsion. Horseless vehicles were believed to compare favorably in point of cost and depreciation with horse vehicles.

The Work of Physical Chemistry.—Prof. William A. Noyes, as Vice-President for the Chemical Section of the American Association, opened his section with a very interesting and suggestive review and forecast of the achievements of physical chemistry. Though the progress of this branch seems slow in comparison with what we may conceive as ultimately possible, notable advance has been made through the efforts of the numerous investigators who have been industriously working in it. Light has been cast upon many problems, and it is now possible to predict phenomena of which the operator could formerly have knowledge only by experiment. The older methods have given place to mathematical determinations, and new regions of investigation have been opened to chemists. We have still before us, however, the vast task of learning how to save and utilize the immense proportion of the power—far exceeding that which is saved—which now goes to waste in all our operations. To make good as large a part as possible of that which is now lost should be the object of future work in physical chemistry.

A Woman among African Cannibals.—Miss Kingsley, who returned to England in the fall of 1895, after a journey of nearly a year in the Cameroons, collecting fishes, relates stories of thrilling adventures, particularly among the Fangwe cannibals living between the Ogowe and Rembwe Rivers. These people are always at war with one another, and are one of the few tribes in Africa that eat their own dead. As her little band of three Fangwe "elephant men" and four Djuma men approached each Fangwe town, it was found to be in a state of defense, and the leader of the band invariably fell into some trap which the inhabitants had laid outside the town for the enemy. At almost every town the Fangwe stopped the expedition and wanted to eat the Fangwe elephant men, who were of a hostile section. Miss Kingsley had guaranteed the elephant men safety, and sometimes by persuasion, sometimes by threats of punishment, and sometimes by a little present, they were saved. Not one burial place was found in the country, but pieces of human bodies are kept in most of the native mud huts just as civilized people keep eatables in their larders. The Adjumas, on the other hand, bury their dead in the forest. Miss Kingsley climbed the Cameroons Peak, 13,700 feet high. At an altitude near 10,000 feet, she came across the great crater. There are about seventy craters in the Cameroons Mountains, and from the largest of these the peak shoots up almost perpendicularly on the sea side; hence it has to be reached from the other side. Inland from the Cameroons the Rumbi Mountains are inhabited up to about 7,000 feet, and Miss Kingsley found shelter in native huts. In the higher ascent she had to sleep on the ground in the open air, and was frequently drenched by the heavy rains, but suffered no injury to health thereby. In the canoe journey up the Ogowe, the craft was upset and its occupants thrown into the water nearly a dozen times. Miss Kingsley had several narrow escapes, and was saved more than once by clutching the rocks in the rapids and holding on to them till the natives righted the canoe.

Drifting Fruits.—For nearly three hundred years a curious fruit has been found drifting along the coasts of the West Indies, concerning the origin and nature of which nothing could be determined. It was first noticed, described, and pictured by Clusius in the *Exoticorum libri decem* in 1605. The next reference to it was by Johannes Jonston, in his Latin history of trees and fruits, in 1662. It was noticed again in 1680, and thence down to 1764, after which it does not seem to have been mentioned till 1884, when Mr. D. Morris collected specimens of it near Kingston, Jamaica; and in 1887 a specimen was picked up on the shore of Bigborough Bay, in the south of England. In March, 1889, it was identified by Mr. J. H. Hart, Superintendent of the Botanic Gardens at Trinidad, as the fruit of *Sacoglottis amazonica*, or, locally, *cojon de burro*, a tree very rare in Trinidad, but more abundant in the delta of the Amazon. From one or both of these localities, says Mr. Morris, who describes the fruit and gives its history in Nature. "The fruits are carried by the waters of the Gulf Stream into the Caribbean Sea, and either thrown ashore on the West Indian Islands or carried still farther, as in the case of many other similar fruits, across the North Atlantic and east on the shores of western Europe." Of these other similar fruits, Mr. Morris mentions the *Laodicea* of the Seychelles—known as *coco de mer*—which was first found floating; the "sea apples" or "sea cocoanut"—fruits of the Bursu palm—which drift in the West Indian seas; the large brown beans of the Cocoon, or *Entada scandens*, which are cast ashore in various parts of the world; and a specimen of *Cæsalpinia bonduc*.

An Experiment in Irrigation.—The results of experiments in irrigation of garden crops are given by Prof. Byron D. Halsted in the report of the Botanical Department of the New Jersey Agricultural Experiment Station. The water was applied in the latter part of the season, and therefore only to the later crops; to the second crop of golden wax bean, and to pepper, turnips, egg plant, and celery. The yield of beans from similar plots was as 17 pounds and 1 ounce not irrigated to 45 pounds irrigated; of peppers, 717 fruits to 1,277 fruits. The peppers from the unirrigated belt, moreover, filled only six and a half peach baskets, with a total weight of 80 pounds, while those from the irrigated belt filled eleven and a quarter like baskets, with a total weight of 147 pounds. Further, the irrigated peppers were plumper and better colored and of far superior quality and brought much more in the market. In the plants themselves the leaves of the unirrigated belts looked wilted and limp, while those of the irrigated plants stood up fresh and strong. Irrigation prolonged the season of fruitage and the frosts caught the plants still blooming and bearing fruits in all stages of growth. With egg plants and tomatoes the experiments were made too late for the most satisfactory results. Those crops want midsummer rather than autumn irrigation. Irrigation of turnips caused vigorous growth of the plants, but increased the tendency to club. Better effects may be expected in land free from the club-root fungus. The crop of celery was increased in the irrigated rows to two and a half times that upon the rows not receiving the water. In marketable product, in pounds, the difference was three to one, and in marketable value about eight to one in favor of irrigation.

Significance of Morphological Botany.—The problem of morphological botany was characterized by Dr. D. H. Scott, of Kew Gardens, in his sectional address at the British Association, as a purely histological one, and perfectly distinct from any of the questions with which physiology has to do. Yet there is a close relation between these two branches of biology, at any rate to those who maintain the Darwinian position, for from that point of view we see that all the characters which the morphologist has to compare are, or have been, adaptive. Hence, it is impossible for the morphologist to ignore the functions of those organs of which he is studying the homologies. There is no essential difference between adaptive and morphological characters, but the physiologist is interested in the question how organs work; the morphologist asks, What is their history? The origin of the great groups of plants is perhaps an insoluble problem, but all that can be directly observed or experimented upon is the occurrence of variations. Such investigations can but throw a side light on the historical question of the origin of the existing orders of living things, and the morphologist must use other methods of research. In judging of the affinities of fossil plants vegetative characters must be made use of, and especially characters drawn from anatomical structure. In many specimens the anatomical features are the only ones known, and in cases where the reproductive structures have been discovered the conclusions drawn from anatomical characters have been confirmed. The study of fossil botany is thus likely to call attention to points of structure formerly passed over. Anatomical characters are being made use of in the classification of the higher plants, and thus an effort is being made to place the classification on a broader basis. They are undeniably adaptive, but it is a mistake to suppose that they are necessarily the expression of recent adaptations; on the contrary, there are examples of marked peculiarities which have become the property of large groups of plants. A given anatomical character may be of a high degree of constancy in one group, while extremely variable in another; and characters are often most constant when most adaptive.

Hornbooks.—Hornbooks—those leaflets containing the alphabet, the a-b-abs, a text for exorcism, the Lord's Prayer, and the Roman numerals, framed and covered with transparent horn as with a glass—with which the first lessons in reading were administered to our ancestors, have disappeared so entirely that they are hardly known except to antiquaries, yet they were common in England down to the time of George II, and were introduced into America in the seventeenth century. Mr. Andrew W. Tuer, who has written their history, says that the preservation of many of those which have come down to us is due to the tricks of little boys, who dropped the hateful things through cracks in the floor or wainscoting, to be brought to light again when the house was pulled down. The earliest hornbook known to be left, which is assigned to the middle of the sixteenth century, was found behind the paneling of a farmhouse. A hornbook called the Middleton was discovered in 1828 in the thatch of an old cottage. As spelling books came more and more into use, hornbooks became obsolete; and when they were no longer in demand it is said that a million and a half were destroyed in one warehouse. They could, however, be found in use in the country villages down into the present century; and there may be people still living who took their first lessons from them, and had scholastic chastisement administered with the backs of them. As they became scarce, specimens of them rose in value; and while the usual price of them had been a penny, three halfpence, or twopence, a famous copy—the Bateman Hornbook—was sold at auction for three hundred and twenty-five dollars. This book was three inches and three quarters high and two inches and seven eighths wide, with a handle an inch long, and was covered, except the handle, with leather. The alphabet was preceded by the Cross, and this was the case with most of the hornbooks. Hence the phrase, "criss-cross row." The back was stamped with a figure of Charles I, bareheaded and in armor, on horseback. At the top corner and facing the king was a large celestial crown, issuing from a cloud above his head, and in the other corner an angel's face and wings. The book bore other marks of less interest. Some of the hornbooks were costly. Queen Elizabeth gave one of silver filigree to Lord Chancellor Egerton, and others were made of ivory and bone. Finally, we come to the gingerbread hornbook, which seems once to have been a common baker's dainty. Of it Prior wrote:

> To Master John the English Maid
> A Hornbook gives of gingerbread;
> And that the Child may learn the better
> As he can name, he eats the Letter.

Hornbooks may be seen portrayed in pictures by the German and Dutch masters, as in Rembrandt's "Christ Blessing Little Children" and the works of Jan Steen and Van Ostade.

Value of "Useless" Research.—The report of the British Association's committee on the establishment of a national physical laboratory, after referring to what is done and what can be done for promoting research by the universities and schools and other existing institutions, specifies particular types of investigation which are outside the range of effort possible for such institutions or for an individual—such as observations of natural phenomena, the study of which must be protracted through periods longer than the average duration of human life; testing and verification of physical instruments and preservation of standards; and the systematic and accurate determination of physical constants and numerical data which may be useful for scientific or industrial purposes. In the discussion of this report, Prof. Fitzgerald opposed divorcing the universities from research, but hoped they would teach the usefulness of "useless" research, while investigations of commercial importance should be relegated to a national laboratory. Prof. Kohlrausch, of the Physical Training Institute (the Reichsanstalt) at Berlin, showed how completely that institution was answering the purposes for which it was founded, as illustrated in the great development of the technical glass industry, particularly of thermometer-making; the improvement of photometers and standards for measuring light; and researches in apparatus for measuring furnace temperatures. Scientific discovery, he declared, whether costly or cheap, is, in its results, beyond price, for you never know whether the abstract discovery will not lead to inventions of great industrial importance. He could point to quite small physical discoveries which later received great technical applications. When Huygens investigated the singular double refraction of calcareous spar, no one supposed that so small a point in physics would have a commercial value over the whole world in the sugar industry and in brewing.

Agricultural Depression.—A recent editorial in Garden and Forest, under the above title, deserves the careful attention of the farmer. It is based on an address delivered by Prof. Bailey before a horticultural school in this State. Prof. Bailey protested, in the first place, against the prevalent idea that the farmer is suffering more than other members of the community. He is suffering from the general stagnation of business, and is no worse off than his neighbor. There is no special road to renewed prosperity for the farmer unless the condition of the whole country is improved, and any legislation designed to aid farmers as a class would be not only ineffective but pernicious. The farms of New York State average from three thousand to five thousand dollars in value, and with this capital invested prudent farmers are able to support their families, while it is doubtful if the same amount of capital invested in business would average as much. Prof. Bailey added that under the homestead act great areas of free and railroad lands were taken possession of by numbers of immigrants who rushed into the West to make homes for themselves. The area of cultivated land increased at a much more rapid rate than the population grew, and a surplus of breadstuffs soon caused depressed prices. Since the greater part of our arable lands are now occupied, the population is growing more rapidly than the area of cultivated land is expanding, so that we may look for the time in the near future when the demand for food will, in some measure, equal the supply, and then the stringency will cease and the farmer may expect a greater reward for his labor; and not only this, but we may expect a great advance in agricultural and horticultural science and practice in the next few years. "Phosphates from rock and potash from the Stassfurt mines are already cheap, and even now it is announced that German investigators are on the eve of perfecting processes for drawing upon the vast stores of nitrogen in the air, so as to make that most expensive element of plant food as cheap as the others. Prof. Nobbe, of Saxony, the distinguished plant physiologist, claims that he has produced on a commercial scale pure cultures of the different bacteria which are efficient in affixing the free nitrogen of the air in a form available for plant food, and has them for sale in small glass bottles. It is claimed that the soil can be inoculated with these organisms for the modest sum of one dollar and twenty-five cents an acre. Of course, it may be premature to place much confidence in this new method of securing fertility, but it has long been considered probable, and is of enough importance to have been made the subject of several papers read before the Royal Agricultural Society of England."

Exploration of Spitzbergen.—The exploring expedition of Sir Martin Conway and Mr. Trevor-Battye to Spitzbergen had among its members a geologist, a naturalist, and an artist—three factors to the production of as complete a picture as possible of what they saw. The object of the journey was to penetrate into the interior of the island, of which the coast was already fairly well known. The spectacle as they entered one of the western fiords was described by Sir Martin Conway in the British Association as having been extraordinarily brilliant. "They thought Spitzbergen must be in heaven." They had anticipated, from what had been written of the country, that they would have to cross either glaciers or a snow sheet, and had therefore provided themselves with Nansen sledges. But as they proceeded it proved that their journey was to be over broken stones and bogs. On the first day, when they had journeyed half a mile, they found that their path lay between a slope on the right and cliffs on the left, while every four or five hundred yards there was a deep gully with practically vertical sides. These gullies were filled with rotten snow. On the first day they covered about three miles, and their progress through the island was a repetition of that experience. They had gone too early. If they had started at the end of August instead of the end of June, the snow would have been melted, and they would have made better headway. Eventually they got some distance inland, and then they turned southeast in the direction of Advent Bay. On their way they found a peak near them, which they climbed. The rock was rotten, there were large holes through it, and the whole seemed to tremble with the weight of a single man. On reaching the top they found that the white plains they had seen on landing consisted of a number of plateaus, and that valleys of much greater extent lay between. Descending, they entered a large valley which was enveloped in cloud, and for five or six hours were passing, sometimes up to their knees, sometimes up to their waists, through some exceedingly soft slush. In time they reached the foot of a very remarkable glacier which afforded some valuable observations on the nature of glacier advance. Returning from Advent Bay the way they came, they next made a journey eastward across the island. They encountered the same conditions till they came to a wall of ice, which proved to be the side of a glacier. Crossing this the next day, they reached the sea, thus completing the passage across the island. The main geographical point to be noticed in connection with their journey was that while both in the north and the south of the island there was a complete ice sheet, the central region consisted of a great bog—"a mere pudding of ice and stones."

Evolution of the Bicycle.—"At the end of the seventeenth century, in 1693," says M. Baudry de Saunier, who is quoted by M. Gaston Tissandier in *La Nature*, "Ozanam, a member of the Royal Academy of Sciences, spoke of a mechanical vehicle in the possession of a friend of his, a doctor in La Rochelle. A servant, mounted behind, made it go, resting on two pieces of wood which communicated with two wheels working the axle." In 1796, M. de Sivrae, realizing that the simplest construction was the most efficient, devised a machine of three wooden parts—a solid beam and two wheels. The beam was furnished in front and back with two forks, between the branches of which the wheels turned; to these were added a seat and a cushion. This vehicle was called the *célérifère*, or carry-fast (Latin, *celer*, fast, and *ferre*, to bear). In 1818, M. le Baron de Drais de Sauerbon, farmer and engineer, modified the celérifère by cutting the front away from the beam on which the rider was supported, and reattaching it with a pivot, which permitted it to be turned to the right or the left. Henceforth it was not necessary, as it had been before, to knock the front wheel of the machine with the hand to the right or left, whenever the rider wished to turn it, but the wheel itself became a readily acting rudder. Baron Drais rejoiced much in the contemplation of his carriage, and giving it his name, called it the *Draisienne*, or Draisian, and ordered his servant to exhibit it and display its methods of working before the sightseers in the Tivoli Garden. The servant proved awkward at the business, and only succeeded in giving himself many knocks and having the children run and shout after him. Discouraged and annoyed by the caricatures of his experiment which were published, Baron Drais went to live in a convent at Carlsruhe, where he died in 1851. The English modified his idea, and, substituting iron for wood, which had the faults of swelling and shrinking and cracking, made of the Draisian the pedestrian-horse, or hobby-horse, which was much in vogue for a considerable time. None of these machines were really ridden; they were simply contrivances to expedite walking. They were propelled by kicking, and the riders seldom let both their feet leave the ground at once, or, if they did, only for a very short time; but with their aid every step became considerably more than a pace, and the ground was got over much more rapidly.

American Women's Art.—Artistic wood carving, according to Mr. Benn Pitman, secured its first distinct recognition as woman's work in 1872, when examples of carved furniture, doors, and baseboards executed by women of the author's family were shown at an exhibition in Cincinnati. Much interest was aroused by the display, and a general desire was created in other women to do similar work. In 1873 a practical art department was established in connection with the Art Academy, to which Mr. Pitman and his daughter gave their services gratuitously. The experiment was regarded with great interest, and more than sixty ladies, "representing the culture and intelligence of the city," began practical designing and carving. The class grew and numbered one hundred and even more for years. Ninety-five per cent of the pupils were women. Etching and hammered metal work were soon added to the studies, and china painting was taken up in 1875. In the fall of that year a considerable sum of money was raised by gift and the sale of beautiful examples of china painting, which went to the fund for the erection of the Woman's Pavilion of the Philadelphia Centennial Exhibition. More than one hundred specimens of china painting were included in the Cincinnati school exhibit at Philadelphia. No woman's product, distinctively American, has perhaps attained such repute as the Rockwood pottery of Cincinnati. "Its celebrity is due to varied causes. Excellence in material, form, firing, and glaze are points of superiority necessary to success, but that which has mainly contributed to its renown is unquestionably its realistic style of decoration," which "appeals to a newly awakened intelligence which appreciates original, careful, and truthful studies from Nature."

An Ethnological Storehouse.—An "ethnological storehouse" is urged by Prof. W. J. Flinders Petrie as necessary by reason of the impossibility of preserving more than a small portion of the material for anthropology in the very limited area of London or town museums. This leaves only two alternatives—the destruction of material which can never be replaced, illustrative of modern races now fast disappearing, and ancient races as revealed by excavation; or the storing of such materials accessible in a locality and a manner which shall yield the greatest possible storage space for a given expenditure. Such a repertory might be solely anthropological, including an example of every variety of object of human work of all ages, or it might be extended to zoölogy, mineralogy, and geology. The least to be expected from such a place would be to store the surplus objects which can not find place in existing museums. Its greatest development, however, would be to form a systematic collection of man's work, ancient and modern, reserving to existing museums such objects as illustrate the subject best to the general public, and such as need the protection due to their market value; and these could be properly represented in the repository collection by photographs. If fully developed, such a repository would become a center for study and higher scientific education. The author proposed a site of five hundred acres within easy reach of London, on which buildings could be erected as needed. The features in favor of the project and against it were discussed in the British Association, and some substitute propositions were offered; but Prof. Petrie pronounced the last mere palliatives, which did not touch the broad view.

Insect Enemies of the Grape.—An interesting article by C. L. Marlatt on the Principal Enemies of the Grape has recently appeared in the Year Book of the United States Department of Agriculture. The rapid growth of the vine industry in this country and the increasing cultivation of the less vigorous European grapes have combined to make the above subject one of considerable commercial importance. Nearly two hundred different insects have already been listed as occurring on the vine in this country; few of these, however, are very serious enemies, being either of rare occurrence or seldom numerous. The principal enemies of the grape-grower are the grape phylloxera, the grapevine fidia, both chiefly destructive to the roots; the cane borer, destructive particularly to the young shoots; the leaf hopper, the flea beetle, rose chafer with its allies, and leaf folder, together with hawk moths and cut worms, and the grape-berry moth, the principal fruit pest. The extent of the loss that frequently results from the ravages of these insects is something enormous. The phylloxera, when at its worst, had destroyed in France some 2,500,000 acres of vineyards, representing an annual loss in wine products of the value of $150,-000,000, and the French Government had expended up to 1895 in phylloxera work over $4,500,000, and remitted taxes to the amount of $3,000,000 more. The leaf defoliators, as the rose chafer and flea beetle, frequently destroy or vastly injure the crops over large districts, and the little leaf hopper, though rarely preventing a partial crop, is so uniformly present and widely distributed as to probably levy a heavier tribute on the grape in this country than any other insect. These insects are, however, all amenable to treatment, and the loss may be very considerably limited if the proper methods of control are followed out. Mr. Marlatt gives a description of the above insects, with illustrations of the various stages of each, and finally the remedies, and methods of employing them which have been found most efficient in combating each pest.

MINOR PARAGRAPHS.

The winter courses of Saturday evening lectures (1896–'97) at Columbia University, in co-operation with the American Museum of Natural History, began in December with a course on the Mountain Ranges of Western North America. The course for January will be upon Anthropology and Ethnology, and will include lectures on The Oldest Signs of Man in America, by Dr. D. G. Brinton; The Native Industrial Arts of the Indians of the United States, by Prof. Otis T. Mason; Art of the North American Indians, by Dr. Franz Boas; The Organization of the Family, by Livingston Ferrand; and Some Peculiar Peoples of Southern France, by Dr. William Z. Ripley. In February four lectures on Alcohol and Alcoholic Beverages will be given by Mr. C. E. Pellew. The lectures in March will consist of botanical studies—Among the Lower Fungi and The Haunts and Habits of Ferns, by Prof. Lucien M. Underwood; and Edible and Poisonous Mushrooms and Medicinal Plants, by Prof. Smith Ely Jelliffe. The lectures will be illustrated. Tickets of admission may be obtained without charge by application to the secretary of Columbia University.

M. Berthelot observed, in his address at the opening of the International Congress of Chemists, that the progress of mankind has heretofore been accounted for by historians as the combined effects of inner evolution of ideas and the external and empirical intervention of fortuitous events reacting upon the collective passions, feelings, and interests of men. However such views may have been justified to a certain extent by the study of the past, they fail to account for what results now from the ever-increasing influence of science, or deliberate reflection and reason as determined by the observation of facts and experimentation. In evidence of this view, M. Berthelot cites the changes that have taken place in Europe in the last half century in consequence of the increased facilities of communication, as by railroads, the telegraph, and the telephone. These changes are the rational result of facts and laws discovered in scientific laboratories.

The liability to error in even the best-made thermometers, is well known, and the numerous cheaply made affairs with which the market is flooded are almost worthless on this account. Dr. T. L. Phipson calls attention in the Chemical News to the dangers which may result from the use of inaccurate thermometers in the sick-room, and gives the following instance as an illustration: "A patient, eighty years of age, suffering from bronchitis, did not cough or suffer from prostration when the thermometer registered from 68° to 70° F., but fell into an alarming state of prostration when it rose to 72° or 73°. Now, many thermometers, both mercurial and spirit, which I have examined of recent years have shown errors of 4° or 5° F., and sometimes even more, and it is hence very essential that all such instruments used for taking the temperature of sick-rooms should be carefully compared from time to time with a standard instrument of known accuracy."

It is reported in Nature that letters have been received from Prof. Sollas which show that, so far as the main object of the coral-reef boring expedition is concerned, the effort has been an almost complete failure. They reached Funafuti safely, set up the apparatus, and a bore hole was carried down to a depth of about sixty-five feet, when further progress was stopped by the drills running into a material like quicksand, which choked the bore hole. Very little solid coral rock was pierced. Another boring was attempted, with the same result, at seventy-two feet. The material struck was a kind of quicksand containing "bowlders of coral." As fast as the sand was got out fresh material poured in, and the water pumped down the tube with a view of cleaning it actually flowed out into the surrounding bed. So far as the reef was pierced, it proved to be not solid coral, but more like a vast coarse sponge of coral, with wide interstices either empty or sand filled.

Signor Luigi Palmieri, the famous Italian meteorologist, who died September 10th, was especially renowned for his observations of the volcanic phenomena of Mount Vesuvius, where he was director of the observatory for forty-two years. He was born at Faicchio, Italy, in 1807, and was Professor of Mathematics successively at Salerno, Campobasso, and Avelino, and afterward Professor of Physics at the Normal School and in the University of Naples. He was appointed to the Observatory of Mount Vesuvius, where he spent the remainder of his life, in 1854. He invented some extremely delicate instruments in the course of his researches—a bifilar electrometer, used in the study of atmospheric electricity; a pluviometer; and a seismometer for the detection and measurement of ground vibrations. With the last instrument he was able to detect extremely slight movements of the ground and to predict the eruptions of the volcano. During the eruption of 1872, while every one else fled as far from the mountain as he could, he stayed at his post and wrote a description of every phase of the phenomena.

The death was announced in September, 1896, of M. Armand Hippolyte Louis Fizeau, a French physicist, eminently distinguished for his experimental determinations of the velocity of light. He was born in 1819, the son of a distinguished physician, and, having an independent fortune, was able to devote himself mainly to science. He communicated the results of his experiments in numerous memoirs to the Academy of Sciences and to the *Annales de physique et chimie*. Many of these were very important. He received in 1856 the grand prize of one hundred thousand francs awarded by the Academy of Sciences. One of the most interesting of his discoveries was that of the means of determining by means of the alteration of the wave-lengths as revealed through the spectroscope the direction and velocity of motion of bodies advancing or receding along the line of vision, a method which has been much used by astronomers in late years with very fruitful results.

Dr. Harley pointed out, in the British Association, that an understanding of the fast-dying system in Australia of conveying ideas by horizontal straight lines might afford a clew to the better interpretation of the ancient Irish oghams, as these two systems are identical in form and to a certain extent in modes of arrangement. The Gilas of central Asia had also the same linear forms of writing, the same grouping of the characters, and a distinctly columnar arrangement. The author thought that the Australian aborigines had advanced one stage beyond the ancient Irish, inasmuch as they possessed two distinctly different kinds of line characters—small and large—analogous to our capital letters, and also adopted the plan of emphasizing the small characters by turning them into a kind of Italics. All the natives did not write alike.

In view of the anticipated exhaustion of the quarries of lithographic stone at Solenhofen, Bavaria, the use of aluminum as a substitute in engraving has been suggested, and the German journal, *Neueste Erfindungen und Erfahrungen*, enumerates the qualities that may render that metal suitable for the purpose. The Natianal Druggist, of St. Louis, points out, however, that there are lithographic quarries in Tennessee which can furnish immense quantities of stone fully equal, for purposes of engraving, to the best Solenhofen.

M. Félix Tisserand, Director of the Observatory at Paris and professor in the scientific faculty, whose death has been recently announced, was one of the most famous French astronomers and the author of important works. He was born in 1845, and obtained the degree of Doctor in Science in 1869. In 1875 he was appointed by Le Verrier Director of the Observatory at Toulouse, and was also Professor of Rational Mechanics there. He became astronomer adjunct at the Paris Observatory in 1878, Professor of Astronomy in 1883, and Director of the Observatory in 1892. In his works he treats of the most complex and arduous astronomical questions. He was a member of the commission to observe the great solar eclipse of 1868 and the transits of Venus of 1874 and 1882. His most considerable book was the *Traité de Mécanique Céleste*, which was published in 1890, and has become an authority on the subject. His other principal books are the Lunar Tables; a treatise on the Movement of the Planets around the Sun, according to Weber's Electrodynamic Law; a work on Shooting Stars; Observations of the Sun Spots at Toulouse in 1874 and 1875; and a collection of Exercises on the Infinitesimal Calculus.

Bacteriologists, says Sir Joseph Lister, are now universally agreed that, although various other conditions are necessary to the production of an attack of cholera than the mere presence of Koch's comma bacillus or vibrio, yet it is the essential substance of the disease; and it is by the aid of the diagnosis which its presence in any case of true cholera enables the bacteriologist to make that threatened invasions of this awful disease have of late years been so successfully repelled from English shores. "If bacteriology had done nothing more for us than this, it might well have earned our gratitude."

NOTES.

The observation made by Mr. Alfred Springer five years ago that the acoustical properties of aluminum are approximate to those of wood, has been verified by continued experiments with sound-boards of that metal, and the author exhibited in the American Association several aluminum violins, together with a device, called a bass bar, by means of which the quality of the tone produced by the instrument can be controlled.

According to President T. Kirk, of the Wellington (New Zealand) Philosophical Society, the chief agents, next to man, in the destruction of native species of plants in the colony, whereby the way is cleared for introduced species, are sheep, rabbits, and the black rat. These animals have almost laid several districts bare, leaving only the sturdiest and most persistent growers. Introduced plants—silenes, whiteweed, docks and sorrels, chess, and velvet grass—have nearly driven out the original littoral vegetation in some places. Even more destructive are the ravages caused by the parasites which these strangers bring with them. While the first catalogue of naturalized plants in New Zealand, published in 1855, comprised forty-four species, the present number is put by Mr. Kirk at three hundred and four, and by others at three hundred and eighty-two.

The ruins of Tepoztlan are regarded by Mr. H. Saville as especially important because they are the only American ruins to which a definite date can be attached. The sign of Ahuizotl, the immediate predecessor of Montezuma, is engraved on one of two slabs in the walls, and on the other the date, ten Tochtli, which corresponds to 1502.

Dr. H. C. Hovey called attention in the American Association to certain old monuments in colonial graveyards, particularly at Byfield and Newbury, Mass., and also to some milestones and stones in the foundations of old houses, which were carved in a style very unlike that of Puritan monuments. The symbols on them are pagan rather than Christian, and include disks, whorls, *fleur-de-lis*, phallic signs, and a design representing the sun-gods' bride with a sunburst over it. It may be suggested as a solution of the enigma they present that the maker of them had seen figures of the kind somewhere, or pictures of them, and copied them in the desire to offer something new and striking.

In one of his papers on the history of Niagara Falls, read in the American Association, Mr. G. K. Gilbert presented evidence of a former outlet of Lake Algonkin draining the upper lakes, heading at Kirkfield, Ontario, and following the Trent River to Lake Ontario, which belonged to an earlier date than the outlet through Lake Nipissing and the Ottawa River. There appear, therefore, to have been two periods after the origin of the Niagara River in which it was an outlet for the Erie basin only, and did not carry the waters of the upper lakes.

The making of the Mammoth Cave is attributed by the Rev. H. C. Hovey, D. D., in a paper read before the American Association, wholly to the solvent action of water upon the limestone. No earthquake disturbance or pot-hole action in the deep parts of the cave can be considered as having had any important effect upon the excavation.

"What is the bark?" is asked in a paper read before the American Association by C. R. Barnes, who calls attention to the varying use made of the term bark by different botanists. The Germans use *Borke* and *Rinde* to denote respectively the external tissue of the root or stem which dries up, and the entire mass of tissue outside the cambium. In this they are followed by the English; and the American usage, except as modified by foreign influence, assigns the name bark to the entire mass of tissue outside the cambium. In this use we are followed by the French. The author advocated the use of the word bark in this sense, and of cortex to designate certain parts of the bark, indicated by a preceding adjective.

Formaldehyde is commended by E. A. de Schweinitz as possessing many good points as a disinfectant. Anthrax, tetanus, etc., are destroyed by it. It is a good deodorizer, for which use only very small quantities are required, which may be applied by spraying. It is a good preventive of decomposition. The sharp odor it leaves, the length of time necessary to remove which constitutes the chief objection to its use, can be counteracted by spraying with ammonia.

An experimental race was recently made in a French office between a skillful typewriter and an expert penman, the test being the number of times a phrase of eight words could be reproduced in five minutes. The typewriter scored thirty-seven and the penman twenty-three.

From experiments on four coal-tar colors —methyl orange, coralline yellow, saffroline, and magenta—H. A. Weber has found that no one of these affects both peptic and pancreatic digestion, but that each affects seriously one form or the other. In the discussion of this paper in the American Association it was held that too much importance was attached to such experiments, for the quantities of the substance in question used in food stuffs are extremely small.

It has been discovered by Surgeon-Major Bruce that the tsetse fly—the terror of equatorial and South African colonists, on account of the deadly effect of its sting on cattle—is itself innocuous, and is fatal to animals only when it introduces a flagellated infusorian or hæmatozoon into the blood of its victims.

The Botanical Society of America, at its recent annual meeting at Buffalo, elected Prof. John M. Coulter as its next president, and Charles R. Barnes, of the University of Wisconsin, secretary. President C. E. Bessey was appointed to confer with a committee of the National Educational Association regarding the unification of requirements in botany for entrance to colleges. The address of retiring President Trelease was on Botanical Opportunity.

Prof. Benjamin Apthorp Gould, one of the most eminent of American and of the world's astronomers, died at his home in Cambridge, Mass., November 26th, from the effects of a fall downstairs. He was seventy-two years old. An excellent sketch of his life and the work which made him famous and increased the glory of American science was given by Erving Winslow, with a portrait, in the Popular Science Monthly for March, 1882. An account of his great work at the observatory of Cordoba, Argentine Republic, given by Prof. W. A. Rogers in 1886, showed that he had then made two catalogues of stars—one a general catalogue extending to the south pole, containing 34,000 stars, and a catalogue of zone stars, numbering 73,000; the two catalogues representing about 250,000 observations, a large part of the work on which was done by Prof. Gould personally. The whole number of stars in the two Cordoba catalogues was nearly three times as great as in any catalogue that had been till that time constructed. The results of these observations and those of the meteorological observations instituted by Prof. Gould at places in all parts of the Argentine Republic are embodied in several large quarto volumes published in sumptuous style by the Government of that country.

Sir Ferdinand von Müller, colonial botanist of Victoria, who died in Melbourne, October 9th, was born in Rostock in 1825, was educated at Kiel, and emigrated to Australia in the hope of improving his health. Having established his residence in Melbourne, he became an indefatigable botanist and explorer. He was a member of several scientific expeditions in central and western Australia, traversed much hitherto unknown country, and made important collections. He acted as an adviser to the Government in matters of exploration, and took great interest in the opening up of New Guinea to science and commerce and in antarctic research. He became director of the Melbourne Botanic Garden in 1852, and when removed from that post in 1873 to give way to a practical gardener he was appointed colonial botanist. He made elaborate studies of the Australian flora, and when he found that he was not able, on account of his remoteness from the great libraries and collections of Europe, to make the best of his material, he sent it to Mr. Bentham, to be used in the preparation of the *Flora Australiensis*. His researches lay in the direction of descriptive and applied rather than morphological botany. He was a fellow of the Royal Society, and received one of its royal medals in 1863. He was a knight of the C. M. G., was made a baron by the King of Würtemberg, and received decorations of some kind from nearly every civilized government—of which he was proud.

In a paper on the sailing flight of birds, read in the British Association, Mr. G. H. Ryan pointed out that the support of a bird indefinitely in the air without flapping its wings is apparently contrary to the law of the conservation of energy, and must be due to either upward air currents, variation of wind velocity with altitude, variation of wind velocity with time, or the presence of vortices in the air. In the discussion of these theories, each of which was considered, the author expressed the opinion that birds in flight are often carried up by a side gust of wind, and that this is one of the causes of the phenomena presented by the sailing bird.

MARIA MITCHELL.

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HERBERT SPENCER: THE MAN AND HIS WORK.

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IN a famous passage in his autobiography, Edward Gibbon has told us of the mingled emotions with which, on a memorable night in June, 1787, he penned the last lines of the last page of his History, and thus closed the undertaking of many laborious years. In a somewhat similar, though at once more dignified and more touching strain, Mr. Spencer, in the preface to his recently published third volume of the Principles of Sociology, has set on record his feelings on reviewing his finished life-work —a work beside which even the vast enterprise of Gibbon sinks into insignficance: "Doubtless in earlier years some exultation would have resulted; but as age creeps on feelings weaken, and now my chief pleasure is in my emancipation. Still, there is satisfaction in the consciousness that losses, discouragements, and shattered health have not prevented me from fulfilling the purpose of my life."

The Synthetic Philosophy, then, is to-day an accomplished fact. When Mr. Spencer first entered upon his work, he estimated that it would commit him to at least twenty years of regular and persistent toil, allowing two years to each of the ten stout volumes called for by his plan. Reckoning from the publication of the initial installment of First Principles in October, 1860, it has actually occupied just thirty-six years. Commenced with little encouragement from the cultured world, and even against the more cautious judgment of immediate advisers, at a time when its author was already broken down in health, with uncertain financial outlook and narrowly limited working powers, it has been pushed slowly and painfully toward completion in the face of difficulties that might well have seemed not merely stupendous but insuperable. Only those who have closely watched the progress of the undertaking—perhaps even only those who have been privileged to step behind the curtain and learn at first hand the conditions under which the work has been done—can really be in a position to appreciate the man's high courage, steady perseverance, and single-hearted devotion to a cherished ideal. Obstacles of many kinds he had foreseen from the outset, but these were as little in comparison with the unlooked-for impediments which he was presumably to find blocking his way. For a time the practical support yielded him by the reading public was so slight that he seriously contemplated the abandonment of his labors altogether. After this interruptions occurred with increasing frequency in various unexpected ways. He was forced to pause in the methodical unfolding of his plan, to explain, restate, clear up misconceptions, and reply to criticisms. His energies were on several occasions drawn off into other, though in most cases directly subsidiary, lines of work. The supervision of the compilation of the Descriptive Sociology, itself an enormous task; the writing for the International Scientific Series of his Study of Sociology; the publication of a number of timely essays (such as those making up The Man *versus* the State), rendered necessary, as Mr. Spencer felt, by the conditions and tendencies of public affairs—all these things, valuable as we know them to be, none the less delayed the prosecution of the larger design. And, worse than all, his physical powers, as the years went on, in spite of temporary fluctuations and improvements, continued, upon the whole, steadily to decline. He had reckoned, in starting, on a regular working day of three hours. The calculation, moderate as it appeared to be, was presently proved altogether extravagant. Only by the most careful husbanding of his energies has sustained labor been possible to him at all. Absolute inaction has often been forced upon him as the sole means of recuperating his overtaxed strength, while through many a lengthy period of sleeplessness and prostration the dictation of a paragraph or two each morning has represented the extreme reach of his productive capacity. That under such circumstances as these the majestic edifice which he had designed should have continued to rise, stone by stone, is itself a fact not easily paralleled in the history of philosophy or letters; nor is it wonderful that, till within a short time since, most of us should have regarded the ultimate crowning of the structure as almost, if not quite, an impossibility. Two years ago, in a biographical sketch of Mr. Spencer, I wrote skeptically of such a consummation, adding, however, as a word of encouragement, that from a man of his extraordinary resolution and perseverance much might still be looked for. And now the event has justified my half-doubtful prediction, and the Synthetic Philosophy has been rounded off to a completed whole.

Of the importance of this finished work as a fact in the intellectual annals of the nineteenth century much might, of course, be said. That it is in itself the largest, most comprehensive, and most ambitious plan conceived and wrought out by any single thinker of our time is obvious to all; nor will it be less obvious to those who concern themselves in any way with the progress of thought that, measured alike by the constructive genius manifested in, and the far-reaching influence exerted by it, the Synthetic Philosophy towers superbly above all other philosophic achievements of the age. There is no field of mental activity that Mr. Spencer has not to some extent made his own; no line of inquiry in which his power has not been felt. Even those who differ the most radically from him are at the same time compelled to define their positions in relation to his arguments and conclusions, while his speculations constitute a common point of departure for the most curiously divergent developments of thought. To write the history of opinion in regard to his work would indeed be scarcely less than to write the history of biology, psychology, sociology, ethics, and political theory during the past thirty years. But it would be trite and therefore needless to dwell here on all these facts. It will be more to the point to seize the occasion offered by the closing of the Synthetic series to speak a little of the career and personality of the philosopher, and to outline in the broadest possible way some of the underlying principles of his organized system of thought.

The chief matters of importance in Herbert Spencer's externally uneventful life are by this time sufficiently well known to demand no more than the briefest recapitulation. Born in Derby, England, on the 27th of April, 1820, he came of a stock in which intellectual integrity, fearlessness, and independence were strongly pronounced characteristics. His father was by profession a teacher, holding views, however, of the aims and methods of education greatly in advance of the average scholastic theories of his time. It has been commonly said that it was owing largely to the child's precarious health that he was permitted to grow into boyhood without being subjected to the mental cramming and coercion then so much in vogue. The truth of the matter, however, is that he was not particularly delicate in early years, and that his father's wiser course of procedure was simply the result of experience, and of a dread of overtaxing the immature mind by the ordinary forcing system, to which he was totally opposed.* Young Spencer was kept at home till he was just fourteen, thus reaping the advantage of his father's personal training and attention, and breathing an intellectual atmosphere unusually clear and stimulating. He was then placed in charge of his uncle, the Rev. Thomas Spencer, at that time perpetual curate of the parish of Hinton Charterhouse, near Bath. With this relative, who, it should be said, though an Episcopal clergyman, was a vigorous thinker and an energetic social reformer, he spent three years, making little of Greek Testament and Latin grammar, but manifesting extraordinary originality in the mathematical and mechanical studies to which a portion of his attention was devoted.

The design at this period entertained by Thomas Spencer, himself an academic honors man and to a certain extent an advocate of classical culture, of sending Herbert to Cambridge, was gradually relinquished as impracticable, and Spencer thus adds another to the long list of English leaders of thought who owe nothing directly to one or other of the great institutions of learning. On leaving Hinton the lad returned to his father's house, where he spent what was, to outward seeming, an idle and profitless year. Then, after a brief experiment in teaching, he made his real start in life in a profession to which the bias of his interests and the line of his studies alike pointed—that of the civil engineer. This was in the autumn of 1837. It was then the early days of the railroad excitement, and for a time the career he had chosen continued to offer a promising field. But presently the tide of activity ebbed gradually away, and after eight or ten years of intermittent work Spencer finally abandoned a calling in which he now saw little chance of substantial success, and thus at twenty-six found himself but slightly advanced toward a definite settlement in life.

Meanwhile, the expansion of his thought had already begun. At the age of twenty, while engaged on the Birmingham and Gloucester Railway, he had read Lyell's Principles of Geology, and had espoused what was then known as the Development Hypothesis; accepting the Lamarckian view (combated by Lyell) so far as to believe in the evolution of species, but rejecting all the great Frenchman's theories save that of the adaptation of the organism to its environment by the inheritance of acquired characters. His first piece of philosophical reasoning had also seen the light. In 1842 he had contributed to a paper called The Nonconformist a series of letters, subsequently revised and reissued in pamphlet form, on The Proper Sphere of Govern-

* In this and a few other matters I am able, through the kindness of Mr. Spencer himself, to correct not only some current misapprehensions, but also several errors of detail in the biographical chapter in my Introduction to the Philosophy of Herbert Spencer.

ment. In this early discussion of a question on which he was to have so much to say by and by, Spencer is to be found already vigorously insisting on "the limitation of state action to the maintenance of equitable relations among citizens."

After spending some time at home in what must have been a condition of great uncertainty, Spencer presently removed to London, where he secured an appointment on The Examiner newspaper, of which in 1848 he became subeditor. This position he held till 1853. In the meantime, in the intervals of comparative leisure afforded by the routine of his office work, he had written his first important book, Social Statics, published in 1850. Shortly after this he began his connection with the Westminster Review, to the pages of which, during the course of the next few years, he contributed a number of essays, valuable in themselves, and now particularly interesting as marking the development and consolidation of many of the fundamental elements of his later thought. In 1855 appeared a large volume on The Principles of Psychology (afterward incorporated into his more extended treatise on the same subject in the regular system); and in this book (be it remarked, four years before the publication of The Origin of Species) the problems of mind were throughout approached and discussed from the evolutionary point of view. It is probably due to the fact that Mr. Spencer had in this way pushed so far ahead of the most advanced thinkers of his generation that the Psychology, though respectfully received, attracted no widespread attention, and was certainly not regarded, even by specialists, as we regard it to-day, as a work of epoch-making character.

Almost simultaneously with the publication of this volume, and mainly as the direct result of overexertion in the writing of it, came Mr. Spencer's serious nervous breakdown, which for eighteen months incapacitated him for work altogether, and finally left him in that condition of semi-invalidism to which allusion has already been made. When, on partial restoration to health, he returned to his dropped undertakings, his first concern was to finish the essay on Progress, in which he expounded in detail that conception of evolution as a universal process which he had already reached in the Psychology. A year later (1858), he published a long defense of the Nebular Hypothesis; and it was during the preparation of this article that the scheme of the Synthetic Philosophy took shape in his mind. Hitherto, he had dealt with the phenomena of life and society in a fragmentary manner; now he realized the possibility of taking the doctrine of evolution as the basis of a system of thought, and of thus unifying knowledge by the affiliation of its various branches upon the ultimate laws underlying them all. The prospectus of the proposed enterprise was drawn up in 1859, and distributed in the March of the following year.

The history of the man from this time on is almost entirely merged in the history of his work; the dates of importance for the outside world being those marked by the publication of the various portions and volumes of the promised series. Of Mr. Spencer himself, through all this long period during which the rare qualities of his genius have been more and more fully recognized, and the power of his thought has shown a steady growth, the public at large has known less perhaps than of any of his notable contemporaries. He has lived, rather by necessity than by choice, a very quiet and secluded life, saving all his available strength for the task he had set himself to accomplish; while, hating as he does the nauseating personalities of modern journalism, he has not only never courted notoriety, but has firmly resisted attempts frequently made to thrust notoriety upon him. This does not mean, and must not be taken to imply, that there is anything in him of the ascetic or recluse. He is by nature what Johnson described as a thoroughly "clubable" man enjoying so far as health would permit the *menus propos* of the dinner table, and social intercourse with congenial spirits. Himself a delightful conversationist and capital story-teller, fond of his joke, and with a ready laugh for the good sayings of others, he certainly does not remind those who are privileged to know him well of the dry, abstracted, unemotional philos pher of vulgar tradition, though doubtless a stranger would pronounce him cold and reserved. Before his nervous trouble assumed its more serious form a few years since, he took much pleasure in fishing, quoits, and especially billiards, and was a regular *habitué* of the Athenæum Club. But for a long time past these and similar amusements have been out of the question, and, being a rather impatient reader of general literature, he has derived his greatest solace from music, of which he has always been passionately fond. Without intruding, as I have no wish to do, upon the sanctities of private life, I feel that I am justified in saying this much, and in adding that in my own familiar relations with Mr. Spencer there is nothing that has impressed me more strongly than his lofty idea of rectitude, his fine sense of justice, and the transparency and charming simplicity of his character. Kind and considerate to those about him, despite the strain of insomnia and constant ill health, if he makes large demands upon the rationality and integrity of others, as he undoubtedly does, he claims no more from them than for his own part he is always ready to give. His standard of individual conduct is an extremely high one, but, unlike many theorists, he applies it to his own life as severely as he does to the lives of other people.

But it is time, turning from the man to his work, to proceed to the exposition of some of the fundamental principles of the Spencerian system of philosophy.

It is important, in the first place, to make clear the meaning which Mr. Spencer attaches to the word philosophy, as this will define for us the scope and purpose of his undertaking. By philosophy, then, to begin with a negative statement of his position, he does not understand an effort to solve the ultimate problem of the universe. He recognizes two categories—the Unknowable and the Knowable; and to the former of these, the proper domain of religion, he relegates all those final questions concerning Absolute Being, and the why and wherefore of the cosmos, which have largely absorbed the attention of the metaphysicians—questions which, owing to the conditions under which all our thinking has to be done, lie forever beyond the scope of human intelligence. The true subject-matter of philosophy, therefore, is not the problem of absolute cause and end, but of secondary causes and ends —not noumenal and unconditioned existence, but the manifestations of the noumenal in and through the conditioned and phenomenal. What, then, do we demand from philosophy? Not an explanation of the universe in terms of Being as distinguished from Appearance; but a complete co-ordination or systematic organization of those cosmical laws by which we symbolize the processes of the universe, and the interrelations of the various phenomena of which the universe, as revealed to us, is actually composed.* The old antithesis between common knowledge and what we call science, on the one hand, and philosophy on the other, forthwith disappears. They are not essentially unlike; their differences are differences of degree in generality and unification. "As each widest generalization of science comprehends and consolidates the narrower generalizations of its own division, so the generalizations of philosophy comprehend and consolidate the widest generalizations of science." Philosophy is thus presented as "the final product of that process which begins with a mere colligation of crude observations, goes on establishing propositions that are broader and more separated from particular cases, and ends in universal propositions. Or, to bring the definition to its simplest and clearest form: knowledge of the lowest kind is *ununified* knowledge; science is *partially unified* knowledge; philosophy is *completely unified* knowledge." †

Now, if philosophy is to undertake this complete unification of

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* Here, and in a few other places in this brief outline, I have not scrupled to make use of the very phrases that I have employed in the more extended treatment of the same subject in my Introduction to the Philosophy of Herbert Spencer.

† First Principles, § 37.

knowledge, it must establish some ultimate proposition which includes and consolidates all the results of experience. It would obviously be infeasible in the space now at our disposal to follow Mr. Spencer step by step in the long and subtle argument by which this ultimate proposition is reached. We must content ourselves with the merest statement of results. Assuming, then, as we must ever continue to assume (for otherwise all thought would be impossible), that in the manifestations of the Unknowable in and through the phenomenal universe, congruities and incongruities exist and are cognizable by us, Mr. Spencer shows that in the last analysis all classes of likeness and unlikeness merge in one great difference—the difference between object and subject. "The profoundest distinction among the manifestations of the Unknowable," to quote his own words, "we recognize by grouping them into *self* and *not-self*." * His postulates, therefore, are "an Unknowable Power; the existence of knowable likenesses and differences among the manifestations of that Power; and a resulting segregation of those manifestations into those of subject and object." † From these postulates philosophy has to proceed to the achievement of its purpose as above set forth.

Pushing the argument through a consideration of space, time, matter, motion, force, the indestructibility of matter, and the continuity of force, Mr. Spencer at length reaches his ultimate dictum—the persistence of force; a dictum which possesses the highest kind of axiomatic certitude for two reasons: it constitutes the required foundation for all other general truths, and it remains stable and unresolvable—the one inexpugnable yet inexplicable element of consciousness. Force is thus, for Mr. Spencer, the ultimate conception, and the persistence of force furnishes the universal criterion of his system of thought. Of such persistence of force under the forms of matter and motion, all phenomena are necessary results. Eliminate this conception, and consciousness collapses. "The sole truth which transcends experience by underlying it, is thus the Persistence of Force. This being the basis of experience must be the basis of any scientific organization of experiences. To this an ultimate analysis brings us down, and on this a rational synthesis must build up." ‡

The first deduction drawn from this ultimate universal truth is that of the persistence of relations among forces—otherwise, the uniformity of law; whence we pass to the necessary corollaries, the doctrines of the transformation and equivalence of forces, and of the rhythm of motion. Both these principles are shown to hold good throughout the whole range of phenomena, from the physical and chemical to the psychical and social. These

* First Principles, § 44. † Ibid., § 45. ‡ Ibid, § 62.

truths, then, have the character of universality which constitutes them parts of philosophy, properly so called. "They are truths which unify concrete phenomena belonging to all divisions of Nature, and so must be components of that complete coherent conception of things which Philosophy seeks."* But none the less they are truths of the analytical order, and "no number of analytical truths will make up that synthesis of thought which alone can be an interpretation of the synthesis of things."† The problem now before us will be set in clearer light if we remember the relation, already stated, between the partially unified knowledge which we call science, and the completely unified knowledge which is the aim of philosophy. The various sciences advance from the resolution of their phenomena into the actions of certain factors, to the larger question—how from such combined actions result the given phenomena in all their complexity? They thus arrive at special syntheses. But such syntheses, even up to the most general, are more or less independent of one another. The business of philosophy, as now defined, is therefore to establish a universal synthesis comprehending and consolidating such special syntheses. "Having seen that matter is indestructible, motion continuous, and force persistent—having seen that forces are everywhere undergoing transformation, and that motion, always following the line of least resistance, is invariably rhythmic, it remains to discover the similarly invariable formula expressing the combined consequences of the actions thus separately formulated."‡

It is from this point that Mr. Spencer proceeds to reduce to systematic and comprehensive expression the laws of that continuous redistribution of matter and motion which is going on throughout the universe in general and in detail. All sensible existences, and the aggregates which they compose, have their history, and this history covers the entire period between their emergence from the imperceptible and their final disappearance again into the imperceptible. The redistribution of matter and motion which brings about this passage from the imperceptible, through the various stages of the perceptible, and back to the imperceptible, comprises two antagonistic processes: one characterized by the integration of matter and the dissipation of motion; the other by the absorption of motion and the disintegration of matter. The former produces consolidation and definiteness; the latter, diffusion and incoherence. These two universal antagonistic processes are evolution and dissolution. The entire universe is in a state of continual change, and it is in terms of these processes that all changes, small or great, inor-

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* First Principles, § 89. † Ibid., § 90. ‡ Ibid., § 92.

ganic, organic, physical, vital, psychical, social, have to be interpreted.

In order to deprive the law of evolution, hereupon formulated, of any merely empirical character, Mr. Spencer shows at length that there are all-pervading principles underlying the all-pervading process. But of this reduction of inductive results to the deductive form we shall find it more convenient to speak presently when we come to deal with the general method of the Spencerian philosophy. Our immediate concern is to understand a little more clearly what we mean by evolution.*

We have already stated the matter in a broad and general way. Dissolution is disintegration; evolution is integration. But this definition takes note only of the primary element in the evolutionary process. Evolution means always an integration of matter and concomitant dissipation of motion, or, in other words, increasing coherence to definiteness; but it commonly implies much more than this. We must recognize the secondary changes by which this primary change is habitually complicated before the formula of evolution can be set down as complete.

These secondary changes are indeed the most conspicuous characteristics of the evolutionary process; and it is not surprising, therefore, that it was from these that Mr. Spencer started, that it was with these that he remained for a long time preoccupied, that it was these which he first defined in philosophic terminology. A simple plan for us to adopt in the present exposition will be to follow him very rapidly along the line of investigation by which the full law of evolution was gradually reached.

Approaching, as he did, the general problem of things by way of ethical and sociological inquiries, Mr. Spencer found himself confronted at the outset by the special fact of the development of man individually and in society—that is, with the fact of progress. What, then, is progress? This was the specific question to

* It is, of course, a necessary corollary from the doctrine of the rhythm of motion that the processes of evolution and dissolution are continually in conflict, locally and generally: and in no theory of the evolution of things—whether we consider individual existences, or aggregates of such, or the total aggregate that we call the cosmos—is it possible, therefore, to leave the process of dissolution out of the account. Individuals die, organisms disintegrate, societies collapse, races and civilizations are extinguished; while we are bound to acknowledge that for our earth itself, and the system of which it forms a part, and the universe in its entirety, the hour of dissolution must at length be sounded—the disintegrating force must finally begin to undo the work of eons upon eons of slow and gradual integration. In the life and death of a gnat we find a tiny symbol of the pulsations that produce the rise and decay of worlds. But in our own system and on our planet, however certain the ultimate course of things may seem to be, the process of evolution has long predominated, and still predominates, over the process of dissolution; and it is upon the former process, therefore, that we fix attention, though the rhythm of motion and the flux of existence reveal themselves wherever we look.

which, for a number of years, he was slowly feeling his way to an answer. In his earliest publication—the Letters on the Proper Sphere of Government—there was already implied the belief that societies are not manufactured, but grow; and it was from the side of natural law, therefore, that this question of progress was at once approached. It was in the pages of Social Statics that he elaborated his first reply. There, borrowing from Coleridge the theory that Coleridge in turn had derived from German speculation—that life is "a tendency toward individuation"—he undertook to show that it is in the fulfillment of this tendency that all progress will be found to consist. Individuation, then, was the master-principle of his thought. But, examined closely, this tendency toward individuation resolves itself into two closely related processes: one making for more and more sharply defined separateness; the other for increasing unity of organization. Universal specialization, with resulting development of complexity, represents one side of the movement we call progress; increasing interdependence among the specialized parts of the organism represents the other.

Progress, therefore—or, to substitute the proper word, evolution—was already recognized by Mr. Spencer as a double-sided process, comprising differentiation, with consequent growth in complexity, and integration, with consequent growth in unification. But though this second-named element—unification—was never entirely lost sight of by him, and is given clear statement, for example, in the essays on The Philosophy of Style and The Genesis of Science, it was upon the former element—differentiation—that for a time his attention was fixed. Taking this principle by itself, and detaching it from all other considerations, he attempted, in his essay on Progress: its Law and Cause, to expand it into a complete theory of universal evolution. In this he was helped by von Baer's law, with which he had become acquainted in 1852—"that the series of changes gone through during the development of a seed into a tree, or an ovum into an animal, constitute an advance from homogeneity of structure to heterogeneity of structure." Overlooking the principle of integration, Mr. Spencer announces this generalization as his text. "We propose," he writes, in the early part of his essay, "to show that this law of organic progress is the law of all progress." In other words, evolution is made to consist wholly in the increase of complexity—in the transformation of the homogeneous into the heterogeneous by successive differentiations.

Satisfied that he had now reached not only *a* law of evolution, but also *the* law of evolution, Mr. Spencer, when he began work on the Synthetic Philosophy, proceeded to elaborate his thesis in the first edition of First Principles. Further thought, however, convinced him that he had fallen into error—that the transformation of the homogeneous into the heterogeneous does not sum up the whole of evolution, but only the most conspicuous part of the secondary redistribution of matter and motion constituting it. Many changes in the direction of increasing heterogeneity—e. g., the rise of a cancer in the individual organism, or of a revolution in the state—obviously tend not to evolution, but to dissolution. When, then, does increase in complexity mean evolution? The answer to this question, found in a return to the principle of integration, is, when increase of complexity is accompanied by more and more complete interdependence among the specialized parts—by increase in organic unification. Evolution, therefore, may be roughly defined as change toward multiformity in unity, brought about by the rise of unlikenesses (differentiation) and the concentration of the unlike parts, through mutual dependence, into an organized whole (integration); or, to phrase the doctrine philosophically in Mr. Spencer's world-famous formula, as "an integration of matter and concomitant dissipation of motion; during which the matter passes from an indefinite incoherent homogeneity to a definite coherent heterogeneity, and during which the retained motion undergoes a parallel transformation."

But with the formulation of this all-pervading process, we reach only the starting-point of a fresh investigation. Philosophy—the complete unification of knowledge—demands the restatement of the law of evolution in deductive form. Such being the transformations manifested by all classes of concrete phenomena, we ask, Why this continuous metamorphosis? We must seek the *rationale* of the universal changes inductively set forth, must undertake to interpret them as necessary consequences of some deeper law.

Incidentally we may notice here the firm, logical consistency of the Spencerian system. While it presents us with a history of the knowable universe in empirical generalizations, it also affiliates these all-embracing generalizations upon ultimate principles, derives them from its final dictum, and thus furnishes a rational history of the knowable universe as well. Undertaking, therefore, the task of presenting the phenomena of evolution in synthetic order, Mr. Spencer arrives at the law of the instability of any finite homogeneous aggregate owing to the unequal exposure of its parts to incident forces, and proceeds to show, first, that "every mass, or part of a mass, on which a force falls subdivides and differentiates that force, which thereupon proceeds to work a variety of changes"; and, secondly, that the process of segregation, "tending ever to separate unlike units and to bring together like units," serves constantly "to sharpen or make definite differentiations otherwise caused." Finally, these laws—the instability of the homogeneous, the multiplication of effects, and segregation—are exhibited as corollaries from the ultimate law, as inevitable results of the persistence of force under its forms of matter and motion. In this way the circle of induction and deduction is made complete.

In this connection it will be interesting to say something about the course of thought by which Mr. Spencer was gradually led to the fundamental principles above summarized. I am fortunate in having before me as I write a letter in which he was kind enough to outline for me the important stages in his progress toward the great doctrines of the synthetic philosophy.* If, in following his account and in occasionally reproducing, as I shall venture to do, his own words, I am forced to touch again upon points already brought out, this will scarcely be deemed ground for regret, since the slight repetition involved will serve perhaps to throw the whole subject into clearer relief.

The simple nucleus of his philosophic system first made its appearance in Social Statics, where, in the chapter entitled General Considerations, mention is made of the biological truth that low types of animals are composed of many like parts not mutually dependent, while higher animals are composed of parts that are unlike and are mutually dependent. This, he writes, "was an induction which I had reached in the course of biological studies—mainly, I fancy, while attending Professor Owen's lectures on the Vertebrate Skeleton." With this was joined the statement that the same is true of societies, "which begin with many like parts not mutually dependent and end with many like parts that are mutually dependent." This also was an induction. "And then in the joining of these came the induction that the individual organism and the social organism followed this law." Thus the radical conception of the entire system took shape before Mr. Spencer had become acquainted with von Baer's law, which, as we have seen, did not occur till two years later. This law, though applying to the unfolding of the individual only, had none the less its use. In furnishing the expression "from homogeneity to heterogeneity," it presented a more convenient intellectual implement. "By its brevity and its applicability to all orders of phenomena, it served for thinking much better than the preceding generalization, which contained the same essential thought." The essays which followed Social Statics were marked by the establishment of various separate inductions in which other groups of

* In this letter Mr. Spencer called my attention to the fact that certain paragraphs in my Introduction (chapter iii, § ii) would, taken by themselves, be likely to leave the reader with a mistaken impression of the philosophic method pursued by him. For this reason I am glad to have the opportunity of returning to the matter here.

phenomena were brought under this large principle, while in the first edition of the Psychology not only was this same principle shown to comprehend mental phenomena, but there was also recognized the primary law of evolution—integration and increase of definiteness. What followed may best be given in Mr. Spencer's own words: "Then it was that there suddenly arose in me the conception that the law which I had separately recognized in various groups of phenomena was a universal law applying to the whole Cosmos: the many small inductions were merged in the large inductions. And only after this largest induction had been formed did there arise the question—Why? Only then did I see that the universal cause for the universal transformations was the multiplication of effects, and that they might be deduced from the law of the multiplication of effects. The same thing happened at later stages. The generalization which immediately preceded the publication of the essay on Progress: its Law and Cause—the instability of the homogeneous—was also an induction. So was the direction of motion and the rhythm of motion. Then having arrived at these *derivative* causes of the universal transformation, it presently dawned upon me (in consequence of the recent promulgation of the doctrine of the conservation of force) that all these derivative causes were sequences from that universal cause. The question had, I believe, arisen, Why these several derivative laws? and that came as the answer. Only then did there arise the idea of developing the whole of the universal transformation from the persistence of force. So you see the process began by being inductive and ended by being deductive; and this is the peculiarity of the method followed. On the one hand, I was never content with any truth remaining in the inductive form. On the other hand, I was never content with allowing a deductive interpretation to go unverified by reference to the facts."

It remains for us now, so far as space will permit, to pass in rapid review a few of the most salient features of the evolutionary philosophy thus wrought into a firmly knit, logical whole—a philosophy which, as a science of the sciences resting upon universal law, is properly called Synthetic.*

To the exposition and elaboration in their broadest aspects of the all-comprehensive truths above epitomized, Mr. Spencer devotes the initial volume of his series—First Principles. Such a presentation of arguments and results constitutes what he defines

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* Readers who desire to know something of Mr. Spencer's reasons for the selection of the term Synthetic Philosophy as the general title of his system will find a good deal of information in Mr. John Fiske's extremely interesting life of Edward Livingston Youmans. See especially pages 233, 290, and 291.

as General Philosophy. The nine following volumes of the system are devoted to Special Philosophy—that is, to the task of carrying these universal truths, as an organon, forward into the particular phenomena which form the subject-matter of biology, psychology, sociology, and ethics, and of interpreting such particular phenomena by them.

Strictly speaking, of course, at the very opening of this serial undertaking a large gap remains unfilled, since the application of the fundamental principles already established should first of all be made to inorganic Nature. But this great division is passed over entirely, "partly," to quote the words of the prospectus, "because, even without it, the scheme is too extensive; and partly because the interpretation of organic Nature after the proposed method is of more immediate importance." We thus enter at once, in The Principles of Biology, the field of organic life; the purpose of the two volumes composing this work being, as stated in the preface, "to set forth the general truths of biology as illustrative of and as interpreted by the laws of evolution." Due notice should be taken of the phrase here employed—"the general truths of biology." To write a detailed and exhaustive treatise on the subject was manifestly no part of Mr. Spencer's plan, which called only for such a co-ordination and synthesis of fundamental principles as, expressed in terms of the universal laws of the redistribution of matter and motion, and finally affiliated upon the ultimate truth, the persistence of force, would present in broadest outline the science of life.

From the historical point of view no part of this masterly work is of greater interest than the closing division of the first volume, in which Mr. Spencer, after dismissing the special-creation theory of things as untenable, displays at length the *a priori* and *a posteriori* evidences of organic evolution. To appreciate the full significance of his arguments, it is necessary to remember that at the time when the chapters containing them were written, the doctrine of development was currently regarded, even by the large body of naturalists, as a more or less fantastic hypothesis. But while thus presenting the case for evolution in its inductive and deductive aspects, Mr. Spencer did much more than this. He showed that the processes observable in the world of organic life are but phases of the universal cosmical processes formulated in First Principles; and that thus the deepest laws of morphological and physiological development are, deductively viewed, necessary corollaries from the doctrines already established. Even the Darwinian principle of natural selection (or, as Mr. Spencer called it, the survival of the fittest in the struggle for existence) is exhibited as falling into its place as a single manifestation of a far wider law—the law of equilibration.

As here developed in its biological aspects, this law of equilibration * deserves the closest attention. Life is defined by Mr. Spencer as "the continuous adjustment of internal relations to external relations"; and he shows that the degree of life varies as the correspondence varies between organism and environment; the highest point being reached where the correspondence exhibits a maximum of complexity, rapidity, and length. Lack of correspondence—that is, inability on the part of an organism to balance external actions by internal actions—means death; absolutely perfect adjustment, on the other hand, would be absolutely perfect life. Now, equilibration, biologically considered, expresses the tendency on the part of an organism to adapt itself to its environment, the environment itself being, it must be remembered, in a state of constant change; and such equilibration is *direct* where the organism responds immediately to the demands of its surroundings, and *indirect* where variations which are in the line of greater correspondence are gathered up and transmitted to following generations. Under the one head, it is manifest, we formulate the doctrine of use and disuse; under the other, the doctrine of natural selection. Nor is this all. Followed through its wider sweep of meaning, the law of equilibration is found to throw a flood of fresh light on the vexed question of population. Individuation and genesis are in necessary antagonism; and while "excess of fertility has itself rendered the process of civilization inevitable," the process of civilization must in turn "inevitably diminish fertility, and at last destroy its excess." † Gradual approach will thus be made toward an equilibrium "between the number of new individuals produced and the number which survive and propagate." ‡

From The Principles of Biology we pass to The Principles of Psychology, the massive superstructure of which is firmly reared on the general foundations already laid. Life at large is the genus; what we distinguish as bodily life and mental life respectively are species; and though if, after the ordinary fashion, we insist on contemplating only the extreme forms of the two, it would appear that the hardest line of demarcation is to be drawn between them, such line necessarily vanishes the moment the evolutionary point of view is assumed. Acceptance of this point of view, furthermore, enables us to realize that mind can be understood only in the light of its evolution. "If creatures of the

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* The general law is worked out in full in First Principles (Part II, chapter xxii). The question is there raised, Can the changes constituting evolution go on without limit? And the answer is, No. "The changes go on until there is reached an equilibrium between the forces which all parts of the aggregate are exposed to, and the forces these parts oppose to them."

† Principles of Biology, § 376.

‡ Ibid., § 377.

most elevated kinds have reached those highly integrated, very definite, and extremely heterogeneous organizations they possess, through modifications upon modifications accumulated during an immeasurable past—if the developed nervous systems of such creatures have gained their complex structures and functions little by little; then, necessarily, the involved forms of consciousness which are the correlatives of these complex structures and functions must have arisen by degrees. And as it is impossible truly to comprehend the organization of the body in general, or of the nervous system in particular, without tracing its successive stages of complication; so it must be impossible to comprehend mental organization without similarly tracing its stages." *

As in The Principles of Biology the general truths of life were interpreted through the fundamental laws of evolution, so, therefore, in The Principles of Psychology the general facts and problems of mind are elucidated in the same way. The work opens with a consideration of data and inductions, and then—given the psychical shock which Mr. Spencer distinguishes as the primordial and unresolvable element, or ultimate unit, of consciousness—proceeds to trace the evolution of intelligence, stage by stage, through reflex action, instinct, memory, reason, the feelings, and the will. This progress is then exhibited as part of evolution at large; the phenomena belonging to the intellectual, as contradistinguished from the emotional life, are examined in detail; and the ultimate question of the relation between thought and things—between subject and object—is raised and dealt with. Finally, a number of extremely suggestive chapters are devoted to corollaries concerning the expression of feeling, sociality and sympathy, egoistic, ego-altruistic, and altruistic sentiments, and the evolution of æsthetic activities and gratifications—all these matters being of great importance in the synthetic system as developing that special part of human psychology upon which sociology and ethics must rely for their foundations.

With the way thus prepared, Mr. Spencer enters upon what, quantitatively considered, represents by far the largest portion of his undertaking—the application of the laws of evolution to the phenomena of society. The Principles of Sociology as actually completed exhibit the only important departure of the author from the prospectus issued thirty-six years ago; for the volume in which linguistic, intellectual, moral, and æsthetic progress was to have been traced out, is left unwritten. Sundry of the more momentous questions connected with these phases of human development, however, are touched upon in other parts of the system, and the hiatus is, therefore, by no means a serious one.

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* Principles of Psychology, § 129.

On the other hand, the remaining divisions of the work have, in the writing, undergone unlooked-for expansion; the three bulky volumes now before us containing, in addition to nearly six hundred pages setting forth data and inductions, elaborate treatises on domestic, ceremonial, political, ecclesiastical, professional, and industrial institutions, their genesis, growth, characteristics, significance, and probable future developments.

Of the direct bearings of these volumes upon the urgent problems of modern social life, this is, unfortunately, not the place to speak; though we may note in passing that here, as elsewhere, the Spencerian philosophy reveals its eminently practical qualities. No matter to what profound depths its arguments may take us, its doctrines relate themselves at every point with vital issues, and thus, in Lord Bacon's phrase, come home to men's business and bosoms. We feel, in following its speculations, that, remote and labyrinthine as these must necessarily sometimes seem to be, we are never, after all, very far away from the broad highway of human affairs. But if we must not now dwell upon this particular point, still less must we allow ourselves, in connection with it, to be drawn off into any discussion of Mr. Spencer's individualism.* We must confine ourselves to the merest statement of the purpose of the Sociology, taken as a whole.

Such purpose is, of course, in a word, the interpretation of the phenomena of social growth and organization, from the simplest to the most intricate, in terms of universal evolution. Societies are organisms—evolving aggregates; and their progress is clearly marked by even greater and greater multiformity in unity—that is, by gradual advance from the comparative homogeneity, indefiniteness, and incoherence of the simple tribe, to the constantly increasing heterogeneity, definiteness, and coherence of the civilized nation. To work out this continuous process of integration and differentiation along the great lines of social structure and function; to make clear that the transformations everywhere going on, from the minutest change in a tribal group to the far-reaching metamorphoses of modern civilization, are at bottom exemplifications of the ultimate laws of evolution; and to show that the complex play of forces in the superorganic, no less than in the organic, world tends inevitably toward equilibration; in such a general consensus of results, then, the various detailed portions of the Sociology all merge; in such a consensus the fun-

* I may perhaps be allowed to refer the reader who is interested in this special matter to the chapter on The Spencerian Sociology in my Introduction. I there endeavored to show that Mr. Spencer's political views grow naturally out of the body of his thought, and constitute an essential part of his general doctrine of evolution. The subject is a vast one for brief treatment, and I was, therefore, the more gratified when Mr. Spencer expressed entire satisfaction with my analysis of his arguments and conclusions.

damental connecting link is to be found between the work in its totality and the other divisions of the Synthetic Philosophy.

One large aspect of universal evolution remains to be considered before the organization of knowledge demanded by philosophy can be taken as complete; and this aspect—of such importance as to lead Mr. Spencer to describe all other parts of his work as subsidiary to its interpretation *— we at length reach in the concluding two volumes of the series comprising The Principles of Ethics. To the student of the earlier divisions of the Spencerian system the point of view adopted in the elucidation of the facts and problems of conduct will appear a matter of course. Ethics necessarily depends upon the simpler sciences, and generalizations furnished by these must be accepted as data for the systematization of the principles of right living. Moreover, conduct at large, including those portions of it which form the subject-matter of morality, can be fully understood only when regarded as one phase of evolving life. This conception of things will now seem so natural as to call for nothing beyond the baldest statement.

In his work of reconstructing ethical theory along the lines thus indicated, and in harmony with the fundamental doctrines of his philosophy, Mr. Spencer takes a great and most important step in advance of the results reached by the various schools of scientific moralists in the past. His system is, of course, hedonistic or utilitarian—that is, the final criterion and ultimate end of conduct is for him happiness, pleasure, or well-being. But he was naturally discontent with the merely empirical conclusions in which the older utilitarians had been willing to rest. They had not pushed beyond the inductive stage of inquiry; and their generalizations, however interesting and valuable they might be, were merely generalizations after all—statements founded simply upon accumulated observations of results. But, though every science begins with such observations and generalizations, it has no claim to be considered a developed science until the principle of causation is fully recognized and inductive results are set forth in deductive form. It is the scientific presentation of ethical principles, in this strict sense of the word scientific, that Mr. Spencer has, therefore, undertaken. He has sought to convert the laws of conduct from truths of the empirical into truths of the rational order. As he wrote in his letter to Mill: † "I conceive it to be the business of moral science to deduce from the laws of life and the conditions of existence what kinds of action necessarily tend to produce happiness and what kinds to produce

* See original preface to The Data of Ethics (1879).

† Reprinted in The Principles of Ethics, § 21.

unhappiness. Having done this, its deductions are to be recognized as laws of conduct, and are to be conformed to, irrespective of a direct estimation of happiness or misery."

If it is asked toward what general conclusions regarding the moral prospects of the race the Spencerian ethics may be said to point, the broadest answer will be found in the statement of the universal law, already frequently referred to—the law of equilibration. We bring with us into life instincts and impulses which we derive from our long line of animal and barbarous ancestry: our natures are very imperfectly adjusted to the demands of social life. But the influences of advancing civilization have throughout human evolution been gradually molding character into more and more complete harmony with the sum-total of the conditions under which we live. Hence we may anticipate a time, far distant though it must needs be, when the internal forces which we know as feelings will be in fairly perfect balance with the external forces which they encounter; when, in other words, the nature of man will have become fully adapted to the associated state. Mr. Spencer has, indeed, within recent years spoken less optimistically about this consummation than he did when, in Social Statics, he asserted the evanescence of evil. But he still looks forward to an "approximately complete adjustment" * of constitution to conditions as the goal of moral evolution, toward which we are actually, if slowly, moving.

And now, even in so slight a sketch as this, we can not leave the synthetic system without broaching one last issue of the profoundest importance. What are the bearings of the Spencerian philosophy upon the ultimate questions of religion?

We have seen that on the very threshold of his undertaking Mr. Spencer cleared the way for constructive effort by defining philosophy as knowledge of the highest generality, and thus asserting its limitations within the sphere of the phenomenal. Ontological speculations are thus abandoned, and our concern is not with the absolute, the unconditioned, the infinite, but with the relative, the conditioned, the finite. We have seen, furthermore, that in the application of the universal laws of evolution to the various phenomena of the sciences we have to seek the final interpretation of even the highest manifestations of psychical life in terms of matter, motion, force. To what general conclusions do we thus seem to stand committed? Surely, it may be urged, there is but one inference possible. Our philosophy is a philosophy of materialism pure and simple.

Such an inference, however, though often loudly proclaimed by the ignorant and the perverse, is one that the careful student,

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* The Principles of Ethics, § 244.

recalling the many luminous passages in which Mr. Spencer has stated and restated his position, will of necessity refuse to indorse. So frequently, indeed, has our author repudiated, not by phrases only, but by arguments, the charges made against him on this popular count, that repetition of them must be taken to imply either oversight, or misconception, or deliberate attempt to force upon him, for polemical purposes, opinions which he has consistently disowned and even vigorously opposed. How, then, we may ask, turning directly to his own writings, does the case really stand?

Briefly thus. The chemist can not explain the ultimate nature of matter, nor the physicist the ultimate nature of motion, nor the psychologist the ultimate nature of mind. Matter, motion, mind are but symbols, expressing for us the manifestations of an unknown power, and, pushed to the utmost limits of simplification, the symbols remain symbols still. The question at issue between spiritualists and materialists, therefore, viewed from the Spencerian standpoint, resolves itself into a question of these symbols, and any answer that can conceivably be given leaves us as completely outside the reality as we were at first. Spirit and matter must thus be regarded simply as signs of the ultimate existence which underlies both; and though we may lean to the spiritualistic rather than to the materialistic side—though of the two it may seem "easier to translate so-called matter into so-called spirit than to translate so-called spirit into so-called matter (which latter is indeed wholly impossible" *), yet we must remember that no such translation will carry us beyond our symbols into a knowledge of that for which they stand.

Manifestly, then, the absolute and unconditioned existence which transcends human intelligence and in which the subject, object, spirit, matter of our finite consciousness merge and are united, is not for Mr. Spencer mere zero—a negation of thought. It is a positive fact of the profoundest certitude; or rather let us say it is *the* final fact sustaining all others—the fact which science finds at the back of its widest generalizations and beneath its deepest truths. And this final fact of science, this ultimate datum of consciousness, upon which all knowledge depends, this cause of all causes in the universe as it is revealed to us, is the permanent foundation of all religion as well. Here the ancient foes meet in complete reconciliation. Science must necessarily end in the mystery with which religion begins. "That which persists unchanging in quantity but ever changing in form," under the sensible appearances "which the universe presents to us," is an "unknown and unknowable power which we are obliged to recog-

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* The Principles of Psychology, § 63.

nize as without limit in space and without beginning or end in time," and this noumenal power of philosophy, of which all phenomena are but manifestations, is the God of religion—"the infinite and eternal energy from which all things proceed."

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(Lowell Institute Lectures, 1896.)

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I.—LANGUAGE, NATIONALITY, AND RACE.

THE historian of The Norman Conquest of England was very fond of contrasting the east and the west of Europe. He maintained that the political unrest which underlies the Eastern question was due to the utter lack of physical assimilation among the people of the Balkan states; that, in other words, nationality had no foundation in race. This was undoubtedly true to some extent; and yet even in the west, the formation of these boasted nationalities is so recent that it accords but slightly with the lines of physical descent. A slight scratch of the skin of neighbors suffices to reveal radical differences of blood, so that the west is merely a step in advance of the east after all. It is a trite observation that all over Europe population has been laid down in different strata more or less horizontal. In the east of Europe this stratification is recent and distinct. West of the Austro-Hungarian Empire the primitive layers have become metamorphosed, to borrow a geological term, by the fusing heat of nationality and the pressure of civilization. The population of the east of Europe structurally is as different from that of the west to the naked eye as, to complete our simile, sandstone is from granite; nevertheless, despite their apparent homogeneity on analysis we may still read the history of these western nations by the aid of natural science from the purely physical characteristics of their people alone.

To the ordinary observer a uniform layer of population is spread over the continent as waters cover the earth. In reality, while apparently at rest, this great body of men reveals itself to-day in constant motion internally. Currents and counter-currents sweep hither and thither, some rising and others falling, with now and then a quiet pool or eddy where alone population is really in a quiescent state. These movements are not transient; they have been going on for centuries, determined by the economic character and the geography of the continent. They are shifting suddenly now with modern industrial life, but they have persisted until the present through generations. Proof of this antiquity we have; where Nature has isolated little pools since, of population, we may still find men with an unbroken ancestral lineage reaching back to a time when the climate, the flora and fauna of Europe were far different from those which prevail to-day. This may be shown, not by historical documents, for these men antedate all written history, but by physical traits which are older than institutions and outlast them all as well.

This varied population, as we see it to-day, is in its racial composition the effect of a long train of circumstances, historical upon the surface, social it may be in part, but at bottom also geographical. From these effects, and from the migrations even now going on, we may seek out the causes—many of which have hitherto been neglected by students of institutions—which have been operative for centuries, and which have gone on in spite of political events or else have indirectly given rise to them. Progress in social life has not been cataclysmic; it has not taken place by kangaroo-leaps of political or social reforms on paper; but it has gone on slowly, painfully perhaps, and almost imperceptibly, by the constant pressure of slight but fixed causes. Our problem is to examine certain of these fundamental mainsprings of movement, especially the influence of the physical environment; and to do it by means of the calipers, the measuring tape, and the color scale. Science proceeds best from the known present to the remote past, in anthropology as in geology or astronomy. The study of living men should precede that of the dead. This shall be our method. Fixing our attention upon the present population, we shall then be prepared to interpret the physical migrations and to some extent the social movements which have been going on for generations in the past.

Let us at the outset avoid the error of confusing community of language with identity of race. Nationality may often follow linguistic boundaries, but race bears no necessary relation whatever to them. Two essentials of political unity are bound up in identity of language—namely, the necessity of a free interchange of ideas by means of a common mental circulating medium; and, secondly, the possession of a fund of common traditions in history or literature. The first is largely a practical consideration; the second forms the subtle essence of nationality itself. For these reasons we shall find language corresponding with political affiliations far more often than with ethnic boundaries.* Politics

* A full discussion of this point is offered in Bulletin de la Société d'Anthropologie, Paris, 1862, p. 264. *Vide* also Journal of the Anthropological Institute, vol. v, p. 212; and Mittheilungen der anthropologischen Gesellschaft, Wien, Supp. I, p. viii.

may indeed become a factor in the physical sense, especially when re-enforced by language. It can not be denied that assimilation in blood often depends upon identity of speech, or that political frontiers sometimes coincide with a racial differentiation of population. The canton of Schaffhausen lies north of the Rhine, a deep inset into the grand duchy of Baden, yet its people, though isolated from their Swiss countrymen across the river, are intensely patriotic. In race as in political affairs they are distinctly divided from their immediate German neighbors. Mentally holding to the Swiss people, they have unconsciously generated a physical individuality akin to them as well. Thus it is possible that a sense of nationality once aroused may become an active factor through selection in the anthropological sense. Nevertheless, this phenomenon requires more time than most political history has at its disposition, so that in the main our proposition remains true. Despite the political hatred of the French for the German, no appreciable effect in a physical sense has yet resulted, nor will it until the lapse of generations.

Consideration of our linguistic map of the southwest of Europe will serve to illustrate some of the potent political influences which make for community of language without thereby indicating any influence of race. The Iberian Peninsula, now divided between two nationalities, the Spanish and the Portuguese, is, as we shall subsequently show, in the main homogeneous racially—more so, in fact, than any other equally large area of Europe. The only exception is in the case of the Basques, whom we must consider by themselves. This physically uniform population, exclusive of the Basque, makes use to-day of three distinct languages, all Romance or Latin in their origin, to be sure, but so far differentiated from one another as to be mutually unintelligible. It is said, for example, that the Castilian peasant can more readily understand Italian than the dialect of his neighbor and compatriot, the Catalan. The gap between the Portuguese and the Castilian or true Spanish is less deep and wide, perhaps; but the two are still very distinct and radically different from the language spoken in the eastern provinces of Spain. The Catalan speech is, as the related tints upon our map imply, only a sub-variety of the Provençal or southern French language. The people of the Balearic Islands speaking this Catalan tongue differ from the French in language but little more than do the Corsicans.*

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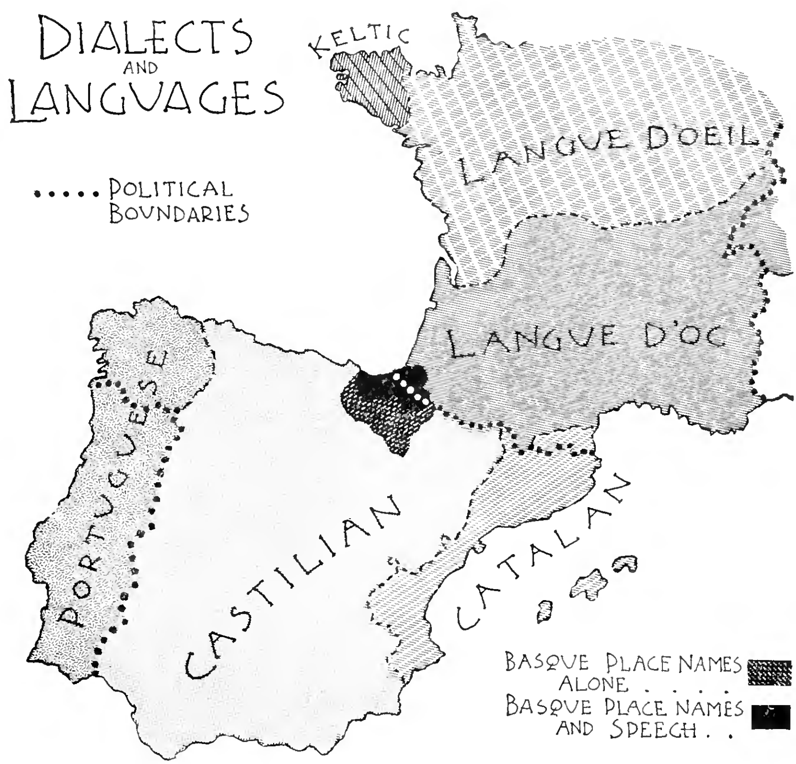
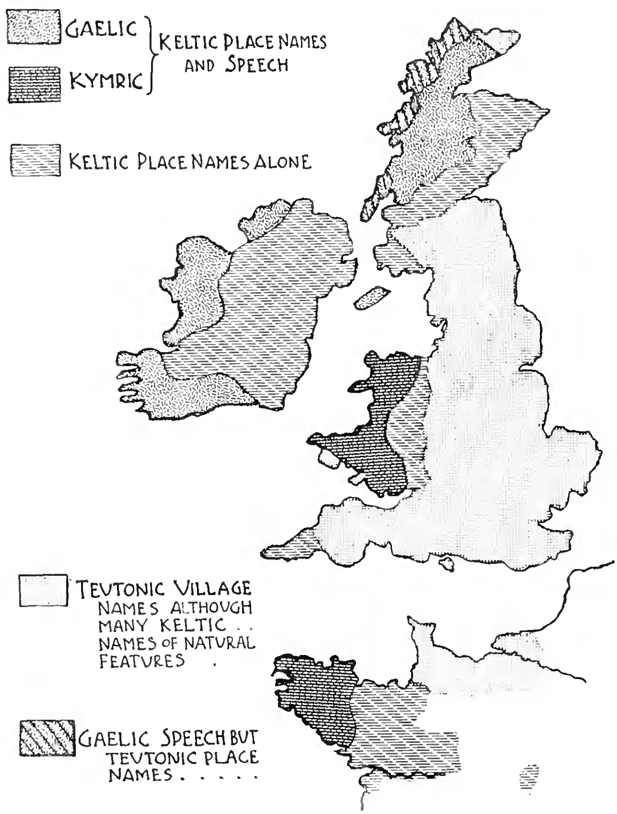
* For the Basque language boundary, *vide* Revue d'Anthropologie, Paris, series 1, iv, p. 1. The Catalan boundary in France is mapped in Revue mensuelle de l'École d'Anthropologie, Paris, vol. i, p. 143; Encyclopædia Britannica, vol. xxii, p. 350, gives details for Spain. The dialect boundary of the Langue d'Oc is traced geographically in Revue mensuelle, etc., i, p. 219; *vide* also Bulletin de la Société d'Anthropologie, 1879, p. 68.

At first glance all this seems to belie our assertion that unity of language is often a historical product of political causes. For it may justly be objected that the Portuguese type of language, although in general limited by the political boundary along the east, has crossed the northern frontier and now prevails throughout the Spanish province of Galicia; or again, that the French-Spanish political frontier has been powerless to restrain the advance, far toward the Strait of Gibraltar, of the Catalan speech, closely allied as we have said to the dialects of Provence



in southern France; that not even the slight line of demarcation between these last two lies along the Pyrenean political boundary, but considerably to the north of it, so that Catalan is to-day spoken over nearly a whole department in France; and, lastly, that the Basque language, utterly removed from any affiliation with all the rest, lies neither on one side nor the other of this same Pyrenean frontier, but extends down both slopes of the mountain range, an insert into both national domains of France and Spain. These objections are, however, the very basis of our contention that language and nationality often stand in a definite relation to one another: for, if we examine the history of Spain and Portugal, we shall discover that historical causes alone have determined this curious linguistic distribution.

The three great languages in the Iberian Peninsula—Castilian or Spanish, Portuguese, and Catalan—correspond respectively to the three political agencies which drove out the Moorish invaders from the ninth century onward from three different directions and from distinct geographical centers. The mountains of Galicia, in the extreme northwest, served as the nucleus of the resistant power which afterward merged itself in the Portuguese



monarchy. Castile in the central north was the asylum of the refugees, expelled from the south by the Saracens, who afterward reasserted themselves in force under the leadership of the kings of Castile. Aragon in the northeast, whose people were mainly of Catalan speech, which they had derived from the south of France, during their temporary forced sojourn in that country while the Moors were in active control of Spain, was a base of supplies for the third organized opposition to the invaders. Each of these political units, as it reconquered territory from the Moors, imposed its official speech upon the people, where it remains to-day. Were the present Spanish nation old enough and sufficiently unified; were the component parts of it more firmly knitted together by education, modern means of transport, and economic interests; this disunity of speech might disappear. Unfortunately, the character of the Iberian Peninsula is such—arid, infertile, and sparsely populated in the interior—that these languages socially and commercially turn their backs to one another. Of necessity, they do this also along the frontier between Spain and Portugal. The eyes of each community are directed not toward Madrid, but toward the sea; for there on the fertile littoral alone, is there the economic possibility of a population sufficiently dense for unification. Thus the divergence of language is truly the expression of natural causes working through political ones, which promise to perpetuate the differences for some time. As for the Basques, they have been politically independent both of the French and the Spaniards until within a few years, and have been enabled to preserve their unique speech largely for this reason. But now that their political autonomy has begun to disappear, the official Spanish is pressing the Basque language so forcibly that it seems to be everywhere on the retreat.

We have seen that community of language is often imposed as a result of political unity. But it is, after all, rather a by-product, so that it often fails even here to indicate nationality. Its irresponsibility in respect both of nationality and of race is clearly indicated by the present linguistic status of the British Isles.* As our map shows, the Keltic language is now spoken in the remote and mountainous portions of Wales, Scotland, and Ireland, as well as across the English Channel in French Brittany. Are we to infer from this that in these several places we have to do with vestiges of a so-called Keltic race which possesses any physical traits in common? Far from it! For, although in a few places racial differences occur somewhere near the linguistic frontiers, as in Wales and Brittany, they are all the more misleading elsewhere for that reason. Within the narrow confines of this spoken Keltic language are to be found populations characterized by all the extremes of the races of Europe. The dark-haired, round-faced Breton peasant speaking the Kymric branch of the Keltic tongue is, as we shall hope to demonstrate, physically as far removed from the Welshman who uses the same language, as from the tall and blue-eyed Norman neighbor in France

* For exact details and maps of the spoken languages, *vide* Ravenstein in Journal of the Royal Statistical Society, London, vol. xlii, p. 579, for Great Britain. The limits in France are mapped in Mémoires de la Société d'Anthropologie, Paris, series i, iii, pp. 147 *seq.* The place names are mapped in Canon Taylor's Names and Places. Also Bull. Soc., 1878, p. 236.

who knows nothing of a Keltic speech at all. The Welshman in turn is physically allied to the Irish and distinct from many of the Gaelic-speaking Scotch, although these last two speak even the same subtype of the Keltic language. Such racial affinity as obtains between certain of these people is in utter defiance of the bonds of speech. The Breton should be more at home among his own folk in the high Alps in respect of race, even although he could hold no converse with the Swiss people in their own tongue.

If these examples be not enough, turn to other parts of Europe. The Walloons and the Flemish, component parts of the Belgian nation, are indeed quite distinct in race and in language alike.* It is only an accident. For if we turn to Switzerland, seeking for physical differences along the boundary of the French- and German-speaking cantons, they are not to be found.† In northern Italy to-day there are considerable communities still bearing the German speech and customs, evidence of the Teutonic invasions of historic times. These people have become so completely absorbed that they are not distinguishable physically from their Italian neighbors. There are indeed spots in Italy where German racial traits survive, but they are quite remote from these islets of Teutonic language.‡

Nor in eastern Europe is the picture less confusing. The Bulgarian language, spoken by people so outlandish to Europeans that they gave the word "bogie" to our nurses wherewith to frighten children, went first. Now it is the Roumanian speech which, in its turn, is disappearing before the Slavic tongue.# Magyar, the language of the Hungarians, spreading toward the east, displaced by German, which is forcing its way in from the northwest, is also on the move. Beneath all this hurry-skurry of speech the racial lines remain as fixed as ever. Language, in short, as a great philologist has put it, "is not a test of race. It is a test of social contact." Waves of language have swept over Europe, leaving its racial foundations as undisturbed as are the

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* Annales de Demographie, iv, p. 224; or more fully, with maps by the author, in Publications of the American Statistical Association, v, p. 28.

† The French and German portions of Switzerland are shown in Forschungen zur Deutschen Landes- und Volkskunde, viii, No. 5, 1894; and Rundschau für Geographie und Statistik, xiii, p. 337, appendix map.

‡ Map in Petermann's Geographische Mittheilungen, 1877, plate 17; *vide* also Globus, lxvi, p. 165; and Journal of the Anthropological Institute, ii, p. 108.

\# Revue de Geographie, xxxvii, p. 321. Perhaps the best compilation of references to ethnological maps extant, bringing them down to 1885, is given by Dr. Andrée in Mittheilungen des Vereins für Erdkunde zu Leipzig, 1885, pp. 173 *seq.*; less fully to 1879 in Archiv für Anthropologie, xi, p. 454. The editor confesses that nearly all of them are indeed not ethnological, but merely "speech" maps.

sands of the sea during a storm. The linguistic status of the British Isles, above described, shows us one of these waves—the Keltic—which is, to put it somewhat flippantly, now upon its last lap on the shores of the western ocean.

We may discover how slippery speech is upon men's tongues in yet another way—namely, by observing it actually on the move in a physically quiescent population, leaving a trail behind to mark its passage. Language becomes truly sedentary when a distinctive name is given by men to a place of settlement; it may be a clearing in the virgin wilderness or a renaming of a village after a clearing away by conquest of the former possessors. In either case the result is the same. The name, be it Slavic, Keltic, or other, tends to remain as a permanent witness that a people speaking such a tongue once passed that way. A place name of this kind may and often does outlive the spoken language in that locality. It remains as a monument to mark the former confines of the speech, since it can no more migrate than can the houses and barns within the town. Of course, newcomers may adapt the old name to the peculiar pronunciation of their own tongue, but the savor of antiquity gives it a persistent power which is very great. For this reason we find that after every migration of a spoken language there follows a trail of such place names to indicate a former condition. Our maps, both of the British Isles and of Spain, show this phenomenon very clearly. In the one case the Keltic speech has receded before the Teutonic influence, leaving a belt of its peculiar village names behind. In the other the Basque place names, far outside the present limits of the spoken Basque, indicate no less clearly that the speech is on the move toward the north, where no such intermediate zone exists.

Then, after the village names have been replaced by the newcomers, or else become so far mutilated as to lose their identity, there still linger the names of rivers, mountains, bays, headlands, and other natural features of the country. Hallowed by folklore or superstition, their outlandish sounds only serve the more to insure them against disturbance. All over England such names are not uncommon, pointing to a remote past when the Keltic speech was omnipresent. Nay, more, not only from all over the British Isles, but from a large area of the mainland of Europe as well, comes testimony of this kind to a former wide expansion of this Keltic language. Such geographical names represent the third and final stage of the erosion of language prior to its utter disappearance. Nevertheless, as we shall show, the physical features of men outlive even these, so inherent and deep rooted have they become. It is indeed true, as Rhys, himself a linguist, has aptly put it, that "skulls are harder than consonants, and races lurk behind when languages slip away."

It appears that language rests even more lightly upon men than do traditions and folk customs. We find that it disappears first, under pressure, leaving these others along with physical traits perhaps as sole survivors. There are several reasons for this mobility. One is that languages rarely coalesce.* They may borrow and mutilate, but they seldom mix if very distinct in type. The superior, or perhaps official, language simply crowds the other out by force. Organization in this case counts for more than numbers. In this way the language of the Isle de France has prevailed over the whole country despite its once limited area, because it had an aggressive dynasty behind it. Language, moreover, requires for its maintenance unanimous consent and not mere majority rule; for, so soon as the majority changes its speech, the minority must acquiesce. Not so with folk tales or fireside customs. People cling to these all the more pertinaciously as they become rare. And still less so with physical traits of race. Many of these last are not apparent to the eye. They are sometimes unsuspected until they have well-nigh disappeared. Men mingle their blood freely. They intermarry, and a mixed type results. Thus racially organization avails nothing against the force of numbers. In linguistic affairs nothing succeeds like success; but in anthropology impetus counts for nothing.

This does not mean that we are justified to measure race by the geographical distribution of arts or customs, for they also migrate in complete independence of physical traits. With the Keltic language spread the use of polished stone implements and possibly the custom of incineration, but this did not entail a new race of men. At times a change of culture appears, accompanied by a new physical type, as when bronze was introduced into Britain, or when the European races brought the use of iron to America. Of course, contact is always implied in such migration, although a few stragglers may readily have been the cause of the spread of the custom. This may not be true in respect to the migration of religions, or in any similar case where determined opposition has to be overcome and where conquest means substitution; but in simple arts of immediate obvious application, copying takes place naturally. The art spreads in direct proportion to its immediate value to the people concerned. No missionaries are needed to introduce firearms among the aborigines. The art speedily outruns race. Moreover, cultures like languages seldom mix as men do. Parts may be accepted here and there, but complete amalgamation seldom results. The main effect of

* *Vide* interesting discussion of this point in detail in A. H. Keane, Ethnology, pp. 198 *seq.*

the contact of two distinct cultures is to produce stratification. The common people become the conservators of the old; the upper classes hold to the new. It is a case of folklore and superstition *versus* progressive ideas. Here, as in respect of language, arts and customs become reliable as a test of race only when found fixed in the soil or in some other way prevented from migration.

Furthermore, let us not attach too much importance to the statements of historical and classical writers in their accounts of migrations and of conquests. We should beware of the travelers' tales of the ancients. Pliny describes a people of Africa with no heads and with eyes and mouth in the breast—a statement which to the anthropologist appears to be open to the suspicion of exaggeration. Even when conquest has undoubtedly taken place, it does not imply a change of physical type in the region affected. We are dealing with great masses of men near the soil to whom it matters little whether the emperor be Macedonian, Roman, or Turk. Till comparatively recent times the peasantry of Europe were as little affected by changes of dynasty as the Chinese people have been touched by the recent war in the East. To them personally, victory or defeat meant little except a change of tax-gatherers.

In this connection it should be borne in mind that conquest often affected but a small area of each country—namely, its richest and most populous portions. The foreigner seldom penetrated the outlying districts. He went, as did the Spaniards in South America, where gold was gathered in the great cities. France, as we know, was affected very unevenly by the Roman conquest. It was not the portion nearest to Rome, but the richest though remote one, which yielded to the Roman rule to the greatest extent. At all events, the Roman colonists in Gaul and Brittany have disappeared, to leave no trace. The Vandals in Africa have left no sign—neither hide nor hair, in a literal sense —nor is there evidence of the long English rule in Aquitaine. The Burgundian kingdom was changed merely in respect to its rulers; and spots in Italy like Benevento, ruled by the Lombards for five hundred years, are to-day precisely like all the region round about them.

The truth is that migrations or conquests to be physically effective must be domestic and not military. Colonization must take place by wholesale, and it must include men, women, and children. The Roman conquests seldom proceeded thus, in sharp contrast to the people of the East, who migrated in hordes, colonizing incidentally on the way. England was not affected by her Roman invasion, nor until the Teutons came by thousands. In anthropology as in jurisprudence, possession is nine points of the law. Everything is on the side, physically speaking, of the native. He has been acclimated, developing peculiarities proper to his surroundings. He is free from the costly work of transporting helpless women and children. The immense majority of his fellows are like him in habits, tastes, and circumstances. The invader, if he remains at all, dilutes his blood by half as soon as he marries and settles, with the prospect that it will be quartered in the next generation. He can not exterminate the vanquished as savages do, even if he would. Nay, more, it is not to his advantage to do so, for labor is too valuable to sacrifice in that way. Self-interest triumphs over race hatred. He may kill off a score or two of the leading men and call it exterminating a tribe, as the great anthropologist Broca put it, but the probability is that all the women and most of the men remain. In the subsequent process of acclimatization, moreover, his ranks are decimated. He struggles against the combined distrust of most of his neighbors as well as with the migratory instinct which brought him there in the first place. If he excels in intelligence, he may continue to rule, but his line is doomed to extinction unless kept alive by constant re-enforcements. It has been well said that the greatest obstacle to the spread of man is man. One of the objects of our study will be to show, as Dr. Collignon affirms, that "when a race is well seated in a region, fixed to the soil by agriculture, acclimatized by natural selection, and sufficiently dense, it opposes an enormous resistance to absorption by newcomers, whoever they may be."

Population being thus persistent by reason of its indestructibility, a peculiar province of our study will be to show the relation which has arisen between the geography of a country and the character of its people. Historians have not failed in the past to point out the ways in which the migrations and conquests of nations have been determined by mountain chains and rivers. They have too often been content merely to show that the immediate direction of the movement has been dependent upon topographical features. We endeavor to go a step further in indicating the manner in which the ethnic character of the population has been determined by its environment, entirely apart from political or historical events as such, and as a result of social forces which are still at work. Thus we shall show that the physical character of the population often changes at the line which divides the hills from the plains. The national boundary may run along the crest of the mountain chain, while the ethnic lines skirt its base where the economic character of the country changes. In other cases, the racial may be equally far from the political boundary, since the river bed may delimit the state, while the racial divisions follow the watershed.

Modern political boundaries will, therefore, avail us but little; they are entirely a superficial product; for, as we insist, nationality bears no constant or necessary relation whatever to race. It is an artificial result of political causes to a great extent. From the moment an individual is born into the world, he finds himself exposed to a series of concentric influences which swing in upon him with overwhelming force. The ties of family lie nearest: the bonds and prejudices of caste follow close upon; then comes the circle of party affiliations and of religious denomination. Language encompasses all these about. The element of nationality lying outside of them all is as largely the result of historical and social causes as any of the others, with the sole exception of family perhaps. Race may conceivably cut across all these lines at right angles. It underlies them all. It is, so to speak, the raw material from which each of these social patterns is made up. It may become an agent to determine their intensity and motive, as the nature of the fiber determines the design woven in the stuff. It may proceed in utter independence. Race harmonizes, at all events, less with the bounds of nationality than with any other—certainly less so than with those either of social caste or religious affiliation. That nearly a half of France, while peopled by ardent patriots, is as purely Teutonic racially as the half of Germany itself is a sufficient example of the truth of our assertion. The best illustration of the greater force of religious prejudices to give rise to a distinct physical type is afforded by the Jews. Social ostracism, based upon differences of belief in great measure, has sufficed to keep them truer to a single racial standard, perhaps, than any other people of Europe. Another example of religious isolation, re-enforced by geographical seclusion, may be seen among the followers of the mediæval reformer, Juan Valdés. Persecuted for generations, driven high up into the Alps of northwestern Italy, these people show to-day a notable difference in physical type from all their neighbors.*

Political geography is, for all these reasons, entirely distinct from racial and social geography, as well in its principles as in its results. Many years ago a course was delivered before this Lowell Institute by M. Guyot, the great geographer, subsequently published under the caption The Earth and Man. It created a profound sensation at the time, as it pointed out the intimate relation which exists between geography and history; but it was of necessity extremely vague, and its results were in the main unsatisfactory. Its value lay mainly in its novel point of view. Since this time a completely new science dealing with man has arisen,

* Archivio per l'Antropologia, xx, pp. 61 *et seq.*; also R. Livi, Anthropometria militaire, p. 135.

capable of as great precision as any of the other natural sciences. It has humanized geography, so to speak, even as M. Guyot did in his time and generation; and it has enriched history and sociology in a new and unexpected way.

Historians have of late shown a distinct tendency toward a fuller appreciation of the importance of physical environment in human affairs.* The movement is probably at one with the newer conceptions of the pre-potency of social over political factors in the making of history. At all events, geography and history have been drawing nearer to one another under the distinguished leadership of the authors of The American Commonwealth, and of The Norman Conquest of England in the Old World. In America our own Justin Winsor has contributed manfully to the same end. We have now to bring still other elements —anthropology and sociology—into touch with these other two, to form a combination possessed of singular suggestiveness. It affords at once a means for the quantitative measurement of racial migrations and social movements; and it yields a living picture of the population—the raw material—in and through which all history must of necessity work. Studing men as merely physical types of the higher animals, we are able to trace their movements as we do those of the lower species; we may correlate these results with the physical geography and the economic character of the environment; and then, at last, superpose the social phenomena in their geographical distribution. We attempt to discover relations either of cause and effect, or at least of parallelism and similarity due to a common cause which lies back of them all—perhaps in human nature itself. Anthropology, geography, sociology, correlated and combined, such is the effect.

Our study thus overlaps several fields of investigation which have stood quite remote from one another in the past; yet it draws its material from each, and then returns it again endowed with a new and living significance. Some one has rightly said that many great advances in human knowledge have been due to those who effected new combinations of ideas by bringing together results from widely separated sciences. Helmholtz stands as a great modern example, physiologist, mathematician, natural philosopher. Goethe, Spencer, and many more could be cited as well in defense of the same proposition. Science advances by the revelation of new relationships between things. In the present case the hope of perhaps striking a spark, by knocking these divers sciences together, has induced men to collect materials, often in ignorance of the exact use to which they might be

* For a full discussion of this topic, reference may be made to a paper by the author in he Political Science Quarterly, vol. x, p. 636.

ultimately put. To show the results which have already been achieved is the task to which we have to address ourselves.

The observations upon which our conclusions for Europe are to rest, cover some ten or more million individuals, the larger fraction being school children, a goodly proportion, however, consisting of conscripts taken from the soil directly to the recruiting commissions of the various European armies. The labor involved in merely collecting, to say nothing of tabulating, this mass of material is almost superhuman; and we can not too highly praise the scientific zeal which has made possible our comfortable work of comparing this accumulated data. As an example of the difficulties which have been encountered, let me quote from a personal letter from Dr. Ammon, one of the pioneers in this work, who measured thousands of recruits in the Black Forest of Germany. "One naturally," he writes, "is reluctant to undertake a four or six weeks' trip with the commission in winter, with snow a metre deep, living in the meanest inns in the little hamlets, and moving about every two to five days. The official inspectors must not be retarded in their work, as the Ministry of War attaches that condition to their permission to view the recruits. Many of those rejected for service are dismissed by the surgeons at a glance, but I must make measurements on all alike. Only when the doctor stops to make an auscultation or to test the vision do I have a moment's respite. They are sent to my room from the medical inspector at the rate of two hundred in three hours, sometimes two hundred and forty; and on all these men I must make many measurements, while rendering instant decision upon the color of the hair and eyes. The mental effort involved in forming so many separate judgments in such quick succession often brings me near fainting at the close of the session."

Of course, where observations are privately made, to obtain the consent of the owner of the characteristics is the main obstacle to be overcome. To make the subject understand what is wanted is impossible, for it would involve a full discussion of the Keltic question or of the origin of the Aryans, which, after the first one hundred cases, becomes tiresome. The color of the hair and eyes, of course, may be noted in passing, and observers may station themselves on crowded thoroughfares and easily collect a large mass of material. I have myself found profit and entertainment on the Fall River boats in running up some columns from my unsuspecting fellow-passengers. But to make head measurements is another matter. Dr. Beddoe adopted an ingenious device which I will describe in his own words: "Whenever a likely little squad of natives was encountered the two archæologists got up a dispute about the relative size and shape of their own heads, which I was called in to settle with the calipers. The unsuspecting Irishmen usually entered keenly into the debate, and before the little drama had been finished, were eagerly betting on the sizes of their own heads, and begging to have their wagers determined in the same manner."

The figures gathered in this way from the schools and the armies have a peculiar value. They represent all classes of the population, but more especially the peasantry in all the nooks and corners of Europe wherever the long arm of the *Polizei Staat* reaches. The upper classes are less fully represented oftentimes, since they attend private schools or are better able to evade the military service by money payment or by educational test. This simplifies the matter, since it is the *proletariat* which alone clearly reflects the influence of race or of environment. They are the ones we wish to study. In this sense the observations upon these populations may aid the sociologist or the historian; for the greatest obstacle, heretofore, to the prosecution of the half-written history of the common people has been the lack of proper raw materials. There is a mine of information here which has barely been opened to view on the surface.

PRINCIPLES OF TAXATION.

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VI.—THE SPHERE OF TAXATION PECULIAR TO THE FEDERAL GOVERNMENT OF THE UNITED STATES.

THE United States presents the curious anomaly of a great nation existing under two systems, or dual forms of government; each having a sphere of action peculiar to itself, and both exercising the general functions of government, namely: the executive, the legislative, and the judicial. These two are the Federal or national Government, existing in virtue of an agreement of union entered into originally by thirteen separate and independent States, and known as the Federal Constitution; and next, a system of State or divisional governments, existing in virtue of certain original powers retained by the independent and sovereign parties to the above agreement, and not delegated by them, in entering the Federal Union, to any other or higher sovereignty. At the same time a concession of power to tax or compel contributions from persons, property, and business by each of these two forms of government, in order to defray their necessary expenditures, was obviously essential to their existence and continuance, and was so recognized from the first inception of any compact of union. But how to divide this power—the badge and symbol of sovereignty—between two distinct sovereignties of the same nation, namely, the Federal Congress and the Legislatures of the several States, and impose limitations in both cases on the exercise of a function so vast in its sweep and so imperative in its action, was one of the most difficult problems that confronted the framers of the Federal Constitution, and one without precedent in the world's history. The problem occasioned much discussion, and was really left unsettled—a general power being given to the national legislature, or Congress, "to lay and collect taxes, duties, imposts, and excises," with the limitation that "all duties, imposts, and excises shall be uniform throughout the United States"; that "no capitation or other direct tax shall be laid unless in proportion to the census"; that "no State shall, without the consent of Congress, lay any imposts or duties on imports or exports," and that no tax or duty shall under any circumstances be laid on articles *exported* from any State. Under such a loose and indefinite condition of things, a conflict of laws and of jurisdictions was inevitable, giving rise to controversies whose determination was really vital to the integrity and efficiency of the Federal Constitution. But happily, owing to the firmness and wisdom of the national tribunal (United States Supreme Court) before which these questions have been brought for adjudication, most of the difficulties which once seemed so formidable have been overcome, and are now mainly interesting as matters of history.

One of the earliest and most celebrated of these controversies culminated, as it were, in a case or suit known as McCulloch *vs.* Maryland, which came before the Supreme Court of the United States and was decided in 1819, under the following circumstances: Congress in 1815 chartered a national (United States) bank, which as a legitimate and authorized feature of its organization established branches in the States, with power to issue circulating notes. This measure proved unpopular in many of the States, and attempts were made by them to resist the various operations of this banking institution within their territory. Foremost among these was the State of Maryland, which, through an enactment of its Legislature, required every bank doing business in the State, and not chartered by the State, either to pay a stamp duty on every note issued, or pay a tax of $1,500 in gross per annum, and in addition imposed certain penalties on all the officers of a bank violating the law, and upon every person who had any agency in circulating such notes. Contemporaneously, also, the State of Ohio imposed an annual tax of $50,000 upon the branch bank of the United States established in that State.

The validity of the Maryland statute having been affirmed by the Court of Appeals, the highest court of law in that State, and an action having been brought for the enforcement of a penalty against an official of the Maryland branch (United States) bank for a violation of the State law, the defendant—one McCulloch, the cashier of the said branch bank—thereupon brought the case (as involving an interpretation of the Federal Constitution) by writ of error before the United States Supreme Court.

A little reflection will abundantly satisfy the reader that the question involved in this procedure was of the greatest importance, inasmuch as it necessitated certain rational and fundamental conclusions that had not previously been authoritatively reached and popularly accepted, respecting the nature and power of the Federal Government; and a definite interpretation of the letter and spirit of certain features of the Federal Constitution which, as the action of the States before noticed demonstrated, had, to say the least, been heretofore regarded as ambiguous. So that, whatever might be the decision of the court, the consequences were certain to be most momentous. Thus, if the right of a State to tax—which practically involved the right to destroy the instrumentalities of the Federal Government, was denied, then such Government rested on sure foundations. If, on the other hand, to quote the language of the court, "the right of the State to tax the means employed by the General Government be conceded, the declaration that the Constitution and laws made in pursuance thereof shall be the supreme law of the land is an empty and unmeaning declaration," and the United States, in the sense of a nation, would practically cease to exist. Taking also into account the increase in the number of States that would have to harmonize if anything was accomplished in a new constitutional convention, and the number of new antagonizing elements on the part of the several States that had arisen—the vexing question of the future tolerance and extension of slavery, which finally eventuated in civil war, the power of Congress to create banking corporations, and the right of the Legislatures of the States to subject them to taxation, and the like—and it is very doubtful whether any new Federal Constitution could have been established. As a matter of fact, the Federal Government and the union of the States came nearer disruption and dissolution in 1819 than when, forty-two years subsequently, Fort Sumter was fired upon and the flag of the Union forcibly hauled down—which latter events are generally regarded as constituting the leading features of the constitutional history of the United States. And this situation was so well recognized by Chief-Justice Marshall (to whom the nation is indebted for its preservation to a greater degree than has been generally recognized) as to draw from him the remark, preliminary to announcing the decision of the court, that "no tribunal could approach such a question as was involved without a deep sense of its importance and of the awful responsibility involved in the decision." *

The decision of the court was unanimous that "the States have no power, by taxation or otherwise, to retard, impede, burden, or in any manner control the operation of the constitutional laws enacted by Congress to carry into execution the powers vested in the General Government; and that the law passed by the Legislature of Maryland imposing a tax on the Bank of the United States is unconstitutional and void."

"If we apply," said the Chief Justice, "the principle for which the State of Maryland contends to the Constitution generally, we shall find it capable of changing totally the character of that instrument. We shall find it capable of arresting all the measures of the Government, and of prostrating it at the foot of the States. The American people have declared their Constitution and the laws made in pursuance thereof to be supreme; but this principle would transfer the supremacy, in fact, to the States. If the States may tax one instrument employed by the Government in the execution of its powers, they may tax any and every other instrument. They may tax the mail; they may tax patent rights; they may tax the papers of the custom house; they may tax judicial process; they may tax all the means employed by the Government, to an excess which would defeat all the ends of government. This was not intended by the American people. They did not design to make their Government dependent on the States."

The court, however, held that its decision did not deprive "the States of any resources which they originally possessed. It does not extend to a tax paid by the real property of the bank, in common with the other real property within the State, nor to a tax imposed on the interest which the citizens of Maryland may hold in this institution, in common with other property of the same description throughout the State. But this is a tax on the operation of the bank, and is consequently a tax on the operation of an instrument employed by the Government of the Union to carry its powers into execution. Such a tax must be unconstitutional." †

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* "No more impressive words are to be found in any English or American adjudication than those uttered by Chief-Justice Marshall as a preamble to the judgment in this most interesting and important case."—*Francis Hillard, The Law of Taxation.*

† The following additional extracts from the decision of the court in this celebrated case will help to a further elucidation of its involved subject-matters:

"In the case now to be determined," said the Chief Justice, "the defendant, a sovereign State, denies the obligation of a law enacted by the Legislature of the Union; and the plaintiff, on his part, contests the validity of an act which has been passed by the Legislature of that State. The Constitution of our country, in its most interesting and vital

The successful counsel in this case were Daniel Webster and William Pinkney, and in the course of his decision the Chief Justice complimented the counsel on both sides as maintaining the affirmative and negative with a splendor of eloquence and a strength of argument seldom, if ever, surpassed.

It may also be added that no decision of the United States Supreme Court, or of any other court in the United States, has since impugned the correctness of the principle upon which the case of McCulloch *vs.* Maryland was decided. A brief notice, however, of subsequent judicial proceedings is interesting and necessary to complete the history of this celebrated case.

Thus, the Legislature of Ohio having, as before stated, imposed an annual tax of $50,000 upon the branch of the Bank of the United States established in that State *before* the decision in the McCulloch case, the State officers, even *after* the decision, proceeded to levy and collect the tax. Thereupon the case was again brought before the United States Supreme Court on an application for injunction, and was reargued, with reliance upon the point that the bank was a mere private corporation, whose chief object was individual trade or profit. The court, however, at once reaffirmed its former judgment, and held that the bank was a public corporation, created for national purposes, and an instrument for carrying into effect the national powers. At the same time the opinion of the court in the McCulloch case, that its decision "did nct deprive a State of any resources it originally possessed," remained unaffected.

Subsequently a case came before the United States Supreme Court (Weston *vs.* the City of Charleston, S. C.) in which the question involved was the right of a State to tax stock issued for loans made to the United States, whether on the stock, *eo nomine* or included in the aggregate of the tax-payers' property to be valued at what it was worth. The court, by Chief-Justice Mar-

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parts, is to be considered; the conflicting powers of the Government of the Union and of its members are to be discussed; and an opinion given which may essentially influence the great operations of the Government. No tribunal can approach such a question without a deep sense of its importance and of the awful responsibility involved in its decision. But it must be decided peacefully, or remain a source of hostile legislation; perhaps of hostility of a still more serious nature; and if it is to be so decided, by this tribunal alone can the decision be made. On the Supreme Court of the United States has the Constitution of our country devolved this important duty. The sovereignty of a State extends to everything which exists by its own authority, or is introduced by its permission; but it does not extend to those means which are employed by Congress to carry into execution powers conferred on that body by the people of the United States. We think it demonstrable that it does not. These powers are not given by the people of a single State. They are given by the people of the United States to a Government whose laws, made in pursuance of the Constitution, are declared to be supreme. Consequently, the people of a single State can not confer a sovereignty which will extend over them."

shall, held "*that a tax on stock of the United States, held by an individual citizen of a State, is a tax on the power to borrow money on the credit of the United States, and can not be levied on the authority of a State consistently with the Constitution,*" and, further, "*that if the right to impose a tax exists, it is a right which, in its nature, acknowledges no limits. It may be carried to any extent within the jurisdiction of the State or corporation which imposes it, which the will of such State or corporation may prescribe.* Can anything," continued the Chief Justice, "be more dangerous or more injurious than the admission of a principle which authorizes every State and every corporation in the Union which possesses the right of taxation to burden the exercise of this (borrowing) power at their discretion?" A tax on the stock or bonds of a State is therefore a tax on the borrowing power of such State.

The court further held that a tax of this description was a tax upon contracts,* using the following language: "Congress has power to borrow money on the credit of the United States. The stock it issues is evidence of a debt created by the exercise of this power. *The tax in question is a tax upon the contract subsisting between the Government and the individual.* It bears directly upon the contract. While subsisting and in full force, the power operates upon the contract the instant it is framed, and must imply a right to affect that contract. If the States and corporations throughout the Union possess the power to tax a contract for the loan of money, what shall arrest the principle in its application to every other contract? What measure can Government adopt which will not be exposed to its influence? The right to tax the contract to any extent, when made, must operate upon the power to borrow before it is exercised, and have a sensible influence

* What interpretation the Supreme Court puts upon the word "*contract*," as found in that clause of the Constitution of the United States which provides "that no State shall pass any law impairing the obligations of contracts," is made clear by the following language employed by Chief-Justice Marshall in giving the opinion of the court in the celebrated case of the Trustees of Dartmouth College *vs.* Woodward: "The term contract must be understood as intended to guard against a power of at least doubtful utility, the abuse of which had been extensively felt, and to restrain the Legislature in future from violating the right to property; that anterior to the formation of the Constitution a course of legislation had prevailed in many if not all of the States which weakened the confidence of man in man, and embarrassed all transactions between individuals, by dispensing with a faithful performance of engagements. To correct this mischief by restraining the power which produced it, the State Legislatures were forbidden 'to pass any law impairing the obligations of contracts'—that is, of contracts respecting property, under which some individual could claim a right to something beneficial to himself; and that, since the clause in the Constitution must in construction receive some limitation, it may be confined, and ought to be confined, to cases of this description—to cases within the mischief it was intended to remedy."

on the contract. The extent of this influence depends on the will of a distinct government. To any extent, however inconsiderable, it is a burden on the operations of government. It may be carried to an extent which shall arrest them entirely."

As a sequence to these decisions of the United States Supreme Court, not only has the general principle that no State of the Federal Union can impose any tax upon any agency of the Federal Government—as its mails, its buildings, its lands, its ships, its money, and the like—come to be universally recognized as in the nature of an unquestionable law of the land, but the question of the application of the principle in respect to many cases to which some latitude of opinion was legitimate, has been specially and definitely determined. Thus, for example, it has been established, that a State can not impose license taxes upon persons passing through or coming into it merely for a temporary purpose, especially if connected with interstate commerce; a State, furthermore, can not enact any law or establish any regulation affecting interstate commerce, inasmuch as the same would be an unauthorized interference with the power given to Congress on the subject. Interstate commerce also can not be taxed at all by a State statute, even though the same amount of tax should be laid on commerce which is carried on solely within the State; and the negotiation of sales of goods, which are in another State, for the purpose of introducing them into the State into which said negotiation is made, has been held to be interstate commerce. A tax levied by the State of Michigan of one cent and a half a ton on iron ores, if taken out of the State for smelting, while exempt if smelted within the State, was held by the United States Supreme Court to be a tax on commerce and therefore void.

A State statute which levies a tax upon the gross receipts of railroads for the carriage of freights and passengers into, out of, or through a State has been held to be a tax upon commerce between the States, and therefore void. Under the provision of the Federal Constitution that "no State shall, without the consent of Congress, lay any imposts or duties on imports or exports, except what may be absolutely necessary for executing its inspection laws," some difficulty has been experienced in indicating with sufficient accuracy for practical purposes, the point of time at which articles brought into the country from abroad cease to be regarded as imports in the sense of constitutional protection, and become liable to State taxation. But it has been held by the United States Supreme Court that where the importer has so acted upon the thing imported that it has become incorporated and mixed up with the mass of property in the country, it has lost its distinctive character as an import, and become subject to the taxing power of the State; but while remaining the property of the importer, in his warehouse, in the original form or package in which it was imported, a tax upon it is too plainly a duty upon imports to escape the prohibition in the Constitution. The deductions from a contrary rule would be manifestly as follows: "No goods would be imported if none could be sold. The same power that imposes a light duty can impose one that amounts to prohibition. A duty on imports is a tax on the article, which is paid by the consumer. The great importing States would thus levy a tax on the nonimporting States," as was done under articles of the Confederation prior to the adoption of the Federal Constitution. "This would necessarily produce countervailing measures."

In the case of Brown *vs.* Maryland, where the latter State, for revenue purposes, required a merchant to take a license and pay fifty dollars before he should be allowed to sell a package of imported goods, the court (by Chief-Justice Marshall) held that this tax, *though indirect in form* (i. e., a license on the person of the importer), was in fact equivalent to a duty on imports, and therefore illegal; and that the right to import carried with it the right to sell.*

This decision has been carefully recognized by the authorities of the several States in dealing with imported liquors under local license acts. "Under its police powers there is no constitutional restraint on a State prohibiting the retail and internal traffic in ardent spirits. But a State is at the same time bound to receive and permit the sale by the importer of any article of merchandise which Congress authorizes to be imported, but it is not bound to abstain from the passage of laws which it deems proper to guard the health or morals of its citizens, although the effect of such laws may be to discourage importation, and diminish the profits of the importer and the revenue of the General Government."—*Burroughs, On Taxation.*

Limitations of the Taxing Power of the Federal Government.—If the States can not tax the agencies or instrumen-

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* As an extension of the history of this case the following futile criticism of a former chairman of the Board of Assessors of the City of Boston (report for 1871) is pertinent: "There is certainly a broad distinction between the prohibition of the right to *sell* an imported article and the right to *tax* the same as property. The decision of the United States Court was to the effect that the State could not enact a law that would prevent the sale of such property, and did not touch the question of the right to tax. In a recent decision of the Supreme Judicial Court of Massachusetts (Dunbar *vs.* Boston, 101 Mass., 317), where the question was raised that the Commonwealth could not tax a stock of liquors, the sale of which, by her laws, she had declared illegal, the court sustained the tax, upon the ground that the case did not show that the goods could not be legally sold. As the law stood at the time the decision was given, but one class of the plaintiff's stock of intoxicating liquors could legally be sold; and that was his *importations in the original packages.*"

talities by which the Federal Government performs its functions, it would seem clearly to follow that for like reasons the Federal Government can not tax State instrumentalities or agencies.

That such reciprocal limitations are natural and necessary, and exist by implication, not only in the Constitution of the United States, but also in the very structure of the Federal Union, must be evident, when one reflects that otherwise the Federal Government on the one hand, and the governments of the States on the other, might impose taxation to an extent that would cripple, if not wholly defeat, the operations of the two authorities, each within its respective and proper sphere of action. Or, in other words, if the Federal and the State governments had each unrestricted power to tax, or, what is equivalent, "the power to destroy," they might, and as experience proves they probably would, effectually destroy efficient government in both cases, and the necessity and validity of such reciprocal limitations have been recognized and enforced by the courts of the United States whenever this question has been brought before them for adjudication. Thus, in the case of Day *vs.* Buffington, United States Circuit Court, Massachusetts District, it was held that the salary of a State official, in this particular instance a judge of probate, could not be legally subjected to assessment for an income tax, under the laws of the United States authorizing the assessment and collection of internal revenue; and Congress, some years since, acting under the advice of the United States Supreme Court, repealed so much of an internal revenue act as previously required the affixing of stamps to State processes, warrants, commissions, etc. In the case of Warren *vs.* Paul, 22 Ind., 279, the court used the following language: "The Federal Government may tax the Governor of a State or the clerk of a State court and his transactions as an individual, but not as a State officer. This must be so, or the State may be annihilated at the pleasure of the Federal Government. The Federal Government may, perhaps, take by taxation most of the property in a State if exigencies require, but it has not a right by direct or indirect means to annihilate the functions of the State government."

In a recent debate in the United States Senate on a proposition to appropriate public money for the purpose of establishing and maintaining higher institutions of learning in the District of Columbia than were offered by its common schools, a leading Senator (John Sherman), others concurring, is reported as expressing himself as follows:

"I concur entirely in the opinion expressed by the Senator from Rhode Island (Mr. Aldrich) that we have no right to use the public money to establish business high schools. It is the duty of every community to give the children who are growing up a good common-school education, which covers a pretty wide range now, according to the general ideas of our people, and there the duty should stop. Money for this purpose should be contributed by private persons. We do our duty when we furnish a fair, common-school education to the children that are growing up among us"—i. e., in the District of Columbia—"and that is all we ought to contribute."

CAN CONGRESS AUTHORIZE THE STATES TO TAX NATIONAL INSTRUMENTALITIES?—In the popular discussions which have occurred in recent years in reference to the taxing of United States securities, the position has been not infrequently taken that it would have been just and expedient on the part of Congress, at the time of the creation of the present national debt, to have allowed the separate States to tax the evidences of such debt (i. e., the bonds) in the possession of their citizens, subject to a limitation that the same should not be taxed at any different rate than other "moneyed capital." A full consideration of the whole subject will, however, suggest a doubt whether Congress possesses the power to grant any such authorization, inasmuch as to have done so would have been equivalent to authorizing the States to do an act which in itself is unconstitutional—a thing which it is self-evident that Congress can not do. Thus "*the power to tax,*" says Chief-Justice Marshall, in giving the opinion of the Supreme Court denying the right of Maryland to tax the Bank of the United States, "*involves the power to destroy*"; and in the case of Weston *vs.* The City of Charleston, the same court, by the same eminent authority, held further, as before shown, "*that if the right to impose a tax exists, it is a right which in its nature acknowledges no limits.*" For Congress, therefore, to have authorized the States to tax "national agencies" would have been equivalent to authorizing the exercise of a right to destroy; which right, the Supreme Court has held, can not, from its nature, when once existing, be limited.

ALIENATION OF THE TAXING POWER.—The application of the decision by the United States Supreme Court in the celebrated Dartmouth College case, has resulted in the general acceptance of the legal principle that a charter of incorporation by a State is a contract between the State and the incorporators; and if such charter contains a clause exempting the incorporators entirely from taxation, or for a definite period, a subsequent Legislature can not repeal the clause of exemption. Within a recent period the interest involved in this question has become so great, and the power of wealthy corporations who claim the benefit of this principle is so extensive, that it is desirable to briefly call attention to views of dissenting legal authorities and dissenting State courts.

"It is claimed that the power of taxation is one of the sovereign powers of the State necessary to its continued existence, and that it was never contemplated, when the people through their Constitutions delegated to their representatives in Legislature assembled the power to make laws for the good of the people of the State, that this grant of legislative power carried with it the right to barter away with private corporations one of the essential prerogatives of the Government, the very life-blood of the State." *

How one of the States of the Union—Connecticut—has recently thrown away valuable public franchises is thus graphically described by one of the leading and authoritative newspapers of New England—i. e., the Springfield Republican. We have here the astonishing fact that over seventy per cent of the stock capital of twenty-six monopoly electric or "trolley" companies operated in that State has been issued for something other than money, (cash) paid in, and hence may be said to represent nothing but what is popularly characterized as "water." The bonded debt of these roads amounts to $8,690,100, or over three times the amount of their cash stock—i. e., $2,671,240. This bonded debt, standing in comparison with a total stock issue, strikingly illustrates what has taken place: *first,* a gratuitous grant or franchise; *second,* an issue of bonds thereon to build the roads; *third,* a share capital, the product of the printing press, and representing no value whatever except as an instrumentality for obtaining extra profits and exceptional legislation through its distribution.

"This watered capitalization will in time, of course, pass into innocent hands, and the 'rights' of the monopolies in the matter of charges will all be gauged by the yearly revenue in its relation to this totality of nominal capital. The stock waterers will have sold their water at handsome figures and made off, and the purchasers of the water must henceforward, of course, be considered legitimate investors whose holdings are entitled to full consideration; and only until monopoly charges suffice to pay eight and ten per cent on all capital, watered or otherwise, will it be safe for any community to demand a reduction of charges without bringing upon itself the charge of being favorable to anarchy and confiscation.

"The people of Connecticut are preparing the way to pay handsomely for their electric transportation. The penalty of present neglect to guard and restrict closely the capitalization of these monopolies will fall in ugly force upon this and future generations; and when the time is ripe for municipal or State assumption of the monopolies, as may some time happen, the people

* Burroughs On Taxation, from which authority the writer is mainly indebted in his presentation of this important subject.

will have the pleasure, no doubt, of paying more than face value for the water now so freely allowed to issue."

On this subject the late Chief-Justice Taney expressed his views as follows, in a case that came up before the United States Supreme Court in 1853: "The powers of sovereignty confided to the legislative body of a State are undoubtedly a trust committed to them to be executed to the best of their judgment for the public good; and no one Legislature can by its own act disarm its successors of any of its powers or rights of sovereignty confided by the people to the legislative body, unless they are authorized to do so by the Constitution under which they are elected. They can not, therefore, by contract, deprive a future Legislature of the power of imposing any tax it may deem necessary for the public service, or of exercising any other act of sovereignty confided to the legislative body, unless the power to make such contract is conferred upon them by the Constitution of the State. And in every controversy on this subject the question must depend on the Constitution of the State, and the extent of the power thereby conferred on the legislative body."

The subject again came up before the United States Supreme Court in 1869, 1871, and 1872, when the question at each time was treated as *res adjudicata* (definitely settled). In the first of these instances Justice Miller thus expressed his views: "We do not believe that any legislative body, sitting under a State Constitution of the usual character, has a right to sell, to give, or bargain away forever the taxing power of the State. This is a power which, in modern political societies, is absolutely necessary to the continued existence of every such society. While under such forms of government the ancient chiefs or heads of the Government might carry it on by revenues owned by them personally and by the exaction of personal service from their subjects, no civilized Government has ever existed that did not rely upon taxation in some form for the continuance of that existence. To hold, then, that any one of the annual Legislatures can, by contract, deprive the State forever of the power of taxation is to hold that they can destroy the Government they are appointed to serve, and that their action in that regard is strictly lawful. The result of such a principle, under the growing tendency to special and partial legislation, would be to exempt the rich from taxation and cast all the burden of the support of government on those who are too poor or too honest to purchase such immunity."

Like dissenting views have also found expression in various State courts. Chief-Justice Beasley, of New Jersey, for example, in commenting on the proposition that a charter of incorporation is a contract, says: "The entire contract on the part of a State, implied in such cases, is the supposed legislative agreement not to alter or recall the privilege granted. No other stipulation on the part of the State was ever suggested to exist, and it was the imagined existence of such stipulation alone which converted what else, in all its essential qualities as well as in its form, was an act of legislation, into a contract on the part of the community with the corporators. Without such stipulation, having an obligatory force, I am wholly unable to conceive the ground of difference between the charter of a corporation and any other act of legislation. If a statute lay no obligation on the State to do or refrain from doing a particular thing or one or more particular things, such an enactment seems to me to be a pure act of legislation, and in no sense a contract." "A law which seeks to deprive the Legislature of the power to tax must be so clear, explicit, and determinative that there can be neither doubt nor controversy about its terms, or the consideration which rendes it binding. Every presumption will be made against its surrender, as the power was committed by the people to the Government to be exercised, and not to be alienated." (47 Missouri, 158.)

And Justice Cooley (one of the justices of the Supreme Court of Michigan), in reviewing the action of the United States Supreme Court, says: "It is not very clear that this court has ever at any time expressly declared the right of a State to grant away the sovereign power of taxation." A court in Pennsylvania has also said: "Revenue is as essential to government as food to individuals; to sell it is to commit suicide." (30 Pennsylvania Statutes, 9.)

Turning to English jurisprudence, we have an opinion of Edmund Burke that the charter of the East India Company, in virtue of which great authority was exercised, "was a charter to establish monopoly and create power," and not entitled to the protection of the various charters of English liberty.

So long, however, as the decision of the United States Supreme Court in the Dartmouth College case is not reversed by the same court, the above and many other like expressions of opinion on the part of judges and men learned in the law and in constitutional history have nothing of practical significance.

THE study of the customs and religious views of the Kekchi Indians of Guatemala, by Dr. C. Sapper, has uncovered a curious mixture of pagan and Christian ideas. The people are nominally attached to the Roman Catholic Church, yet they will not worship in a church out of their own district because they believe the god of that church can not understand them. So, when they go away from home, they give up all religious exercises. On first crossing a mountain pass the Indians put a stone at the foot of the cross which is usually erected there, often offering flowers and incense, and sometimes dancing before it besides; but if there be no cross at the pass, the Kekchi Indian prays and brings offerings to the heathen god.

INDIAN WAMPUM RECORDS.

By HORATIO HALE.

IT is a notable fact that the Indian tribes of northeastern America, belonging to the Iroquoian and Algonquian families, who at the first coming of the white colonists occupied the eastern portions of what are now the United States and Canada, and who are often styled savages, had two inventions or usages which are ordinarily deemed the special concomitants of an advanced civilization. These were a monetary currency and the use of a form of script for conveying intelligence and recording facts. These customs or inventions were connected with one medium, but it is probable that the inventions themselves belong to widely different periods.

In a paper which was read before the British Association for the Advancement of Science at Montreal in August, 1884, and was published in the Popular Science Monthly for January, 1886, I produced the evidence which seemed to me to show that the shell money of North America was derived from the ancient tortoise-shell money of China. This shell money preceded the metallic coins, commonly known as *cash*, which are circular disks of copper perforated in the center, and usually strung on a string. These came into use more than two thousand years before the Christian era. The shell money which preceded the copper *cash* has been traced eastwardly, through the Pelew Islands and the Micronesian groups of the North Pacific, to the coasts of California and Oregon, where it is in use among the Indians to this day, and whence it has apparently made its way across the continent to the eastern coast. As was then remarked, "The fact that the Indians of the west coast of America received their monetary system from eastern Asia or from the Pacific islands could not in itself be regarded as affording evidence that America was first peopled from that direction, just as the fact that the coinage of Bactria was derived from Greece would not indicate that the Bactrian population was of Grecian origin. All that we could infer would be some early intercourse, such as recent experience warrants us in supposing. A Chinese junk or a large Micronesian *prao*, drifting to the Californian coast some three or four thousand years ago, would sufficiently explain the introduction of an art so easily learned as that of making and using perforated shell disks for money."

There is good evidence, from the disclosures of the ancient mounds, to show that shell beads were largely used by the Indians of former ages as ornaments, and perhaps as valued treasures. But there seems no clear proof that they were employed for mnemonic purposes until a comparatively recent date. My late distinguished friend Sir Daniel Wilson had indeed inferred this use of them in former times. In his Prehistoric Man (page 77 of the third edition) he tells us that "in the Grave Creek Mound, shell beads, such as constitute the wampum of forest tribes, amounted to between three and four thousand; and it seems singularly consistent with the partial civilization of the ancient mound builders to assume that in such deposits we have the relics of sepulchral records which constituted the scroll of fame of the illustrious dead, or copies of the national archives deposited with the great sachem to whose wisdom or prowess the safety of his people had been due." This inference seemed to me natural and reasonable; but more recent studies have induced me to question it. Many fragments of ancient cloth have been found in the mounds. The wampum belt was a woven structure of peculiar firmness, having a strong warp, with a duplicate woof, on which the beads were strongly attached. That no fragment of such a record has been found in our ancient mounds is surprising, if such numbers of them were buried as this presumption would lead us to suppose. Moreover, it is doubtful if the true wampum bead of the modern belt was in general use in prehistoric times. The shell beads of those times, if small, are of oval or ovoid shape, and, if large, are thick circular disks, resembling modern button molds, or still larger. The beads in modern belts are, as is well known, oblong tubes, about the fourth of an inch in length, shaped like pieces of a tobacco pipe cut off square at the ends. They are well suited to be woven together in a belt, but are otherwise not adapted either for ornament or for use as money. Mr. Holmes, in his valuable paper on Art in Shell of the Ancient Americans, published in the Second Annual Report of the Bureau of Ethnology, remarks that "it is not known positively that beads of this particular shape were employed in pre-Columbian times; but it is certainly one of the earliest historical forms, and one which has been manufactured extensively by the Indians as well as by the whites. They may be found both in very old and in very recent graves, and have always formed an important part of the stock of the Indian trader."

The conclusion to which I have been led by these and other evidences is that the use of wampum for conveying messages and preserving records was one of the improvements which accompanied the formation of the Iroquois confederation, and was most probably due to the genius of Hiawatha. Like all his other reforms, it merely brought into clear and useful shape a tendency toward which his people had been advancing. We can not doubt that in dealings between different native tribes there would have been frequent interchange of presents; and no presents would be more likely or more acceptable than strings of the valued wampum. To weave a number of these strings together in a belt, inscribed with a mark indicative of its purpose, would be a natural idea. But the custom resulting from this idea had in it, as Mr. Holmes well observes, "a germ of great promise, one which must in time have become a powerful agent in the evolution of art and learning. It was a nucleus about which all the elements of culture could arrange themselves." Unfortunately, the advent of the white settlers, bringing with them the seeds of inevitable war and disease, blighted these prospects. It is interesting to consider what might have been the fruits of the principles of peace and progress planted by the Iroquois reformer and his coadjutors if time had been allowed for their display. There is no good reason for doubting that the figures on the wampum records, which had already, when the whites arrived, passed beyond the stage of mere picture writing, might have developed into a phonetic system, as we know had been the case with the Mexican script at the time of the conquest; and we have reason to believe that the Mayan script was undergoing the same evolution. The Mexican civilization, such as it was, had shocking features, which do not allow us to regret its destruction. The Mayan, however, was much less offensive; and as for the Kechuas, or Peruvians, the striking facts set forth by Sir Clement Markham in his recent history of Peru, showing that the oppressive exactions of the Spanish conquerors had in a little over three centuries reduced the native population from eleven millions to less than one million, would seem to establish the truth of the assertion which has been made by Carli, Draper, and other writers, that the Spanish conquest destroyed a superior civilization, to replace it by a form decidedly inferior.

It is a well-known fact that the tradition of the Iroquois people ascribes the invention, not of wampum itself, but of the wampum "belt" or record, to Hiawatha. His name, *Hayuñwatha*, means "The Maker of the Wampum Belt," being derived from *ayuñwa* (wampum belt) and an old verb, *katha*—now, according to Father Cuoq, rarely used—signifying "to make." When I first heard the tradition—being then of opinion that the wampum belt was an ancient Indian construction, dating back to the times of the mound builders—I formed and expressed the conclusion that the tradition had, like many such legends, grown out of the name. Later inquiries, however, have led me to believe that this conclusion was too hastily formed, and that the name, which may be briefly rendered "the wampum-belt maker," was one of those titles which were not infrequently given by the Iroquois to a member of the tribe to commemorate some notable achievement which he had effected. Its date would then, as has been said, be that of the formation of the Iroquois confederacy. This date was fixed by the estimates severally made at different times by my friend the Hon. L. H. Morgan and myself, in accordance with the testimony of the leading Iroquois chiefs, at about the middle of the fifteenth century, or, more precisely, about the year 1459. Other investigators, whose views are entitled to respectful consideration, including the Rev. Dr. Beauchamp and Mr. J. N. B. Hewitt, have been inclined to place the formation of the league at a later time. But their conclusions differ considerably, and fail to account for many important facts. I am therefore compelled to adhere to my original estimate. I fully accept Mr. Hewitt's identification of the "Trudamani" or "Toudamani," of whom Jacques Cartier heard from the Hurons in 1535, with the well-known "Tsonnontowanen" of later writers. These "great mountain people," or Senecas, were the most powerful of the Iroquois nations, and their name was commonly used by the Hurons or Wyandots from ancient times as the general name of all the Iroquois confederates. This we learn from the little book entitled Origin and Traditional History of the Wyandots, published at Toronto in 1870 by Peter Dooyentate Clarke, a half-breed Wyandot, and giving much important information concerning the traditions of his people. He speaks particularly of the war which occurred "in the first quarter of the sixteenth century," between the Hurons and the Senecas (or Iroquois), who had previously lived on friendly terms, though in separate villages, on the St. Lawrence River, near what is now Montreal, but was then the site of the Huron capital town of Hochelaga. The result was that the Hurons, later in the same century, broke up their villages near Montreal, and journeyed westward, and afterward northward, until they reached Lake Huron. Meanwhile the warfare between the two leading branches of the Huron-Iroquois stock continued through the sixteenth and seventeenth centuries. All this is simply historical, and accords in the main with the narratives of the French explorers, from Cartier to Champlain and Charlevoix, and with the traditions of both branches of the Huron-Iroquois family.

Between the year 1459 and that of Cartier's arrival at Hochelaga, in 1535, there was ample time for the Hurons to become familiar with the new art of making wampum belts. In fact, we learn from Cartier's narrative that they were then proficient in it. When he kidnapped Donnaconna, the chief of Stadaconé (now Quebec), to carry him to France, the terrified people, in the hope of redeeming him, presented to the captain no less than twenty-four "collars of porcelain," or wampum belts, which, the writer tells us, "is the greatest treasure they have in the world, for they prize it above gold and silver."

Another inquiry of interest relates to the time when wampum ceased to be made by the Indians. That the records are retained to this day among certain tribes is well known, though their use is slowly dying out. But the beads themselves are no longer made by the Indians. As regards the time when their manufacture ceased, very vague and some very erroneous ideas have prevailed. It is well known that for more than a century—in fact, for the greater part of two centuries—the wampum beads have been made by the whites for use in commerce with the Indians; and an opinion has grown up that this has been the case ever since the first arrival of the white colonists, and that most of the wampum records held by the Indian tribes have been woven from these modern machine-made beads. Mr. Holmes, however, gives the historical evidence which shows that this opinion has originated in error. He quotes Thomas Morton, of Massachusetts, who in 1630, writing of the New England Indians, tells us that "they have a kind of beads instead of money, to buy withal such things as they do want, which they call *wampumpeak*; and it is of two sorts; the one is white and the other is a violet color. These are made with the shells of fish. The white with them is as silver is with us, the other as our gold; and for these they buy and sell, not only among themselves, but even with us. These beads are current in all parts of New England, from one end of the coast to the other; and although some have endeavored by example to have the like made of the same kind of shells, yet none has ever as yet attained to any perfection in the composure of them, but the salvages have found a great difference to be in the one and the other, and have known the counterfeit beads from those of their own making, and do slight them." Nearly a century later the Carolina surveyor, Lawson, writing in 1714 of the same money, speaks of it as "all made of shells which are found on the coast of Carolina, which are very large and hard, so that they are very difficult to cut. Some English smiths," he adds, "have tried to drill this sort of shell money, and thereby thought to get an advantage, but it proved so hard that nothing could be gained." The introduction of the machine drill could not, in fact, have made much difference in this respect, as each bead must still be fashioned separately by a white workman, whose time was much more valuable than that of an Indian. That which finally gave the English beads an advantage was not the superiority or the cheapness of their workmanship, but the destruction of the Indian workmen. The quarter of a century which followed the publication of Lawson's book, from 1714 to 1740, saw the extermination of most of the Carolina tribes, and a great decline in the numbers of the Northern Indians from the effects of war and pestilence. It was during this period that the wampum-making industry seems to have ceased among them, and the use of machine-made beads to have become universal. The wampum belts continued for a century longer to be made from these beads by the Indian women, but the difference between the belts of the two periods is apparent at a glance. The hand-made beads in the earlier belts are of various sizes, some being twice as large as others, while the machine-made beads, of which the more recent belts are composed, are all of uniform size. Such belts can still be procured from the civilized and mostly half-breed Iroquois of the province of Quebec, with any devices that may be desired. They differ from the genuine Indian belts precisely as a counterfeit *denarius* differs from a genuine Roman coin.

SOME PRIMITIVE CALIFORNIANS.

By MARY SHELDON BARNES.

IN the Santa Clara Valley, near the southern end of San Francisco Bay, some five miles south of Stanford University, there stands a fine old deserted abode, formerly a well-known station on the road from the Santa Clara Mission to San Francisco. Its owner, Don Secundini Robles, was of the pure old Castilian stock, and he and his wife, Donna Maria, were lord and lady for all the region round, and their house the center for all the gay *rodeos* and *fandangos* of the valley. Now the house is a ruin, Don Secundini dead, and Donna Maria, in poverty and alone, lives in the village of Mountain View. But their name passes on to fame among the Stanford students in connection with the Robles Rancheria, a large, low-lying mound of earth some quarter of a mile away from the old house, with that mysterious reputation attaching to it that always hovers around an Indian mound. It has indeed an artificial look, rising in the midst of the otherwise level valley; and the boys of the vicinity assured us that there were plenty of skeletons in it. The man who owned it said that when he first began to plow in that field he turned up human bones, and added, "You may guess I was scared." Indian mortars and pestles from this same heap were found in the possession of various neighbors, and the site altogether seemed promising for exploration. So, with the permission of the owner, and with such direction as could be given by a historian with an amateur interest in archæology, some Stanford students began to explore the site.

The survey of one of our civil engineers gave us the plot of the mound shown in Fig. 1: a length of four hundred and seventy feet, a width of three hundred and twenty feet, an area of some two acres, and a height of about ten feet in the highest parts. Its size was notable, and at once made us suspect that this mound had not been built up purposely, but had rather accumulated through the *débris* and the burials of some generations of Indian life and death. All our excavations bore out this idea, thus taking the structure rather out of the category of mounds into that of middens.

The excavations made from time to time resulted in the discovery of some thirty skeletons of both sexes and of all ages,

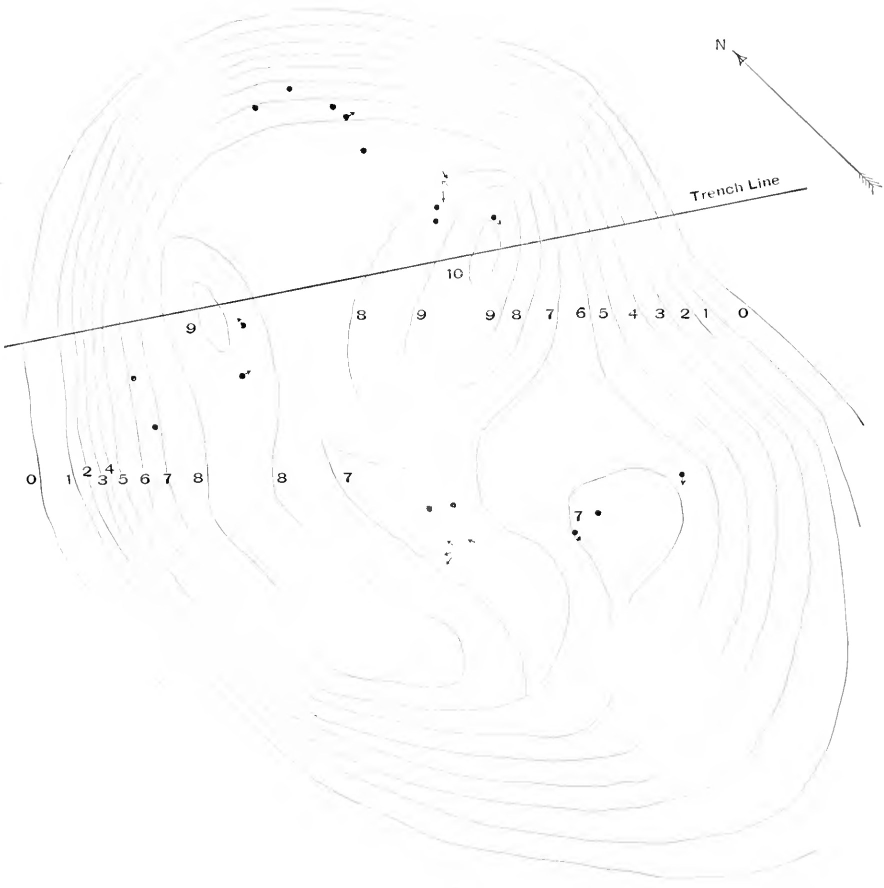

Fig. 1.

many of them undisturbed and often accompanied by various objects of use or ornament. Each cross on Fig. 1 shows the spot from which a skeleton was taken; the arrows indicate the point of the compass toward which the face was turned. The variations in this latter respect furnish negative evidence that the inhabitants of Robles Rancheria had no fixed superstition in connection with the heavenly bodies. It will be seen that there is hardly any trace of regularity in the interments further than this: the bodies were buried singly and, roughly speaking, in an irregular double circle about the center of the rancheria; they were also buried without previous mutilation or separation, each skeleton being complete. This is again a piece of negative evidence going to prove that cannibalism was not practiced within the tribe; nor in our excavations were any human bones found broken for marrow, or in any situation indicating that they formed a part of the food supply for the Robles Rancheria. Layers of ashes and bits of charcoal were found irregularly throughout every excavation made for a skeleton, but since they were also found throughout the length of a trench run toward the center of the mound, we concluded that they had no special connection with the burial, although it must be added that a few skeletons showed traces of partial burning.

Fig. 2.

The posture of the buried Indians is shown by Fig. 2, from a photograph taken before the skeleton was removed. This posture is common among our North American Indians, and results apparently from the attempt to compress the body into the smallest possible space for burial. Each skeleton excavated showed traces of this posture, except the irregular group to the southwest of the mound, where the bones were found in a very confused state, and where one large and complete skeleton was found interred at full length on its back. No traces of any covering for the body were discovered. Among the skeletons removed one of exceptional interest was very carefully taken out by Mr. Edward Hughes. It was the skeleton of a very old Indian, whose vertebræ had grown together so as to cause a terrible deformity. Fig. 3, from a photograph of this skeleton mounted, shows the attitude in which its owner was compelled to live for many years. This ossification had also partially extended to other parts of the body: he could not move his ribs in breathing, he could not lift his head. Another interesting discovery noted by Mr. Hughes was the fact that one of his arms had been broken and most skillfully reset. As Mr. Hughes remarked, the finding of this skeleton, interred, as it had been, carefully, with a fine mortar, two or three bone implements, and an abalone shell, tells us that the former inhabitants of the Robles Rancheria had advanced far enough in civilization to care for the old and decrepit members of their little society. This one at least must have been practically helpless long before his death.

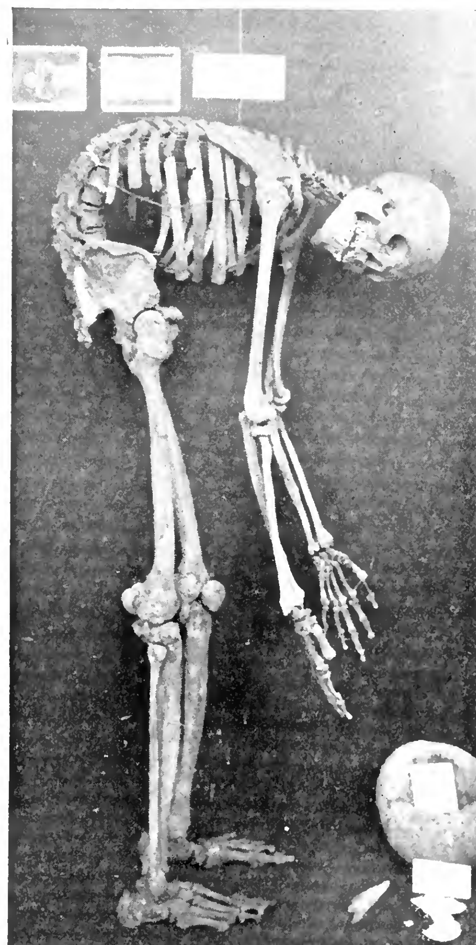

Fig. 3.

The objects interred with the skeletons are made of stone, shell, and bone; of stone implements the mortar and pestle are the most common; in fact, they are surprisingly common, indicating the possession of a great number within the same tribe. They are of the stone found in the immediate neighborhood, with one exception, and are of all grades of finish, as seen in Fig. 4, which shows us all varieties, from the rude bowlder, in which two or more slight concavities have begun to be worn, to the finished mortar, smooth within and without. The most finished mortar of all found was a small one used for grinding paint, shown in Fig. 5. The series of this implement taken from this rancheria furnishes a beautiful illustration of the evolution of what is perhaps the most primitive of human utensils, the mill. In Fig. 5, *i*, the three pestles show a similar evolution, from the longish pebble to the right, to the purposely shaped large and symmetrical one to the left.

The absence among the stone implements of arrow and spear heads puzzled us greatly, since these objects are very generally

Fig. 4.

found up and down the coast. Only two decided flint arrow points were found in all our work, and these were two broken points of the black obsidian of Napa County, some distance north of the bay, evidently an imported product (Fig. 5, *b*). But on stating our difficulty to Mr. Horatio Rust, of Pasadena, who has made a lifelong study of archæology, especially in California, he informed us that the Indians of this part of the country used wooden points, hardened by fire, for their arrows and spears; these, of course, have perished, and certain it is that in all our valley we do not find these characteristic stone implements. We found, however, in the course of our excavation, many sharp-edged bits of rough flint which may have been used in very primitive work as knives or scrapers; and we did not fail to find those mysterious objects known as "charm stones," since Mr. Yates's careful study has revealed their nature. According to Mr. Yates, who relies on the testimony of old Indians, these stones were a part of the "medicine" of the California tribes, and used in various combinations to bring rain, success in hunting, or in war.* We found no other objects of superstition, unless the

* Charm Stones, the So-called "Plummets" or "Sinkers" of California. By Dr. Lorenzo Gordin Yates. Santa Barbara, California, 1890. Bulletin No. 2 of Santa Barbara Society of Natural History.

ornament seen in the upper right-hand corner of *d′* in Fig. 5 be such. This was a bit of human breastbone, pierced in the center, and suggested at once the idea that it might have been worn as a fetich, or possibly was merely a war trophy—the breastbone of mine enemy.

Bone and shell seem to have furnished the chief material for the tools and ornaments of the inhabitants of this old village. The most common bone implements found were those shown in Fig. 5, *g*, finely pointed and polished from the ulna of a deer's leg. Here, again, as in the mortar and pestle, we find a very early and a very valuable artificial form reached by easy transition from a natural object which was somewhat adapted to the uses aimed at, and which was probably first employed without any endeavor to adapt it artificially. We judged, as a matter of course, that these sharp bone points were used for tipping spears, as they are well adapted to such a purpose; but all the traditions of the neighborhood insist that they were used for ornaments, and that with bunches of bright feathers, attached by strings of sinew, they were stuck into the hair. One bone needle was found, but the small size of this implement and its easy destructibility make it

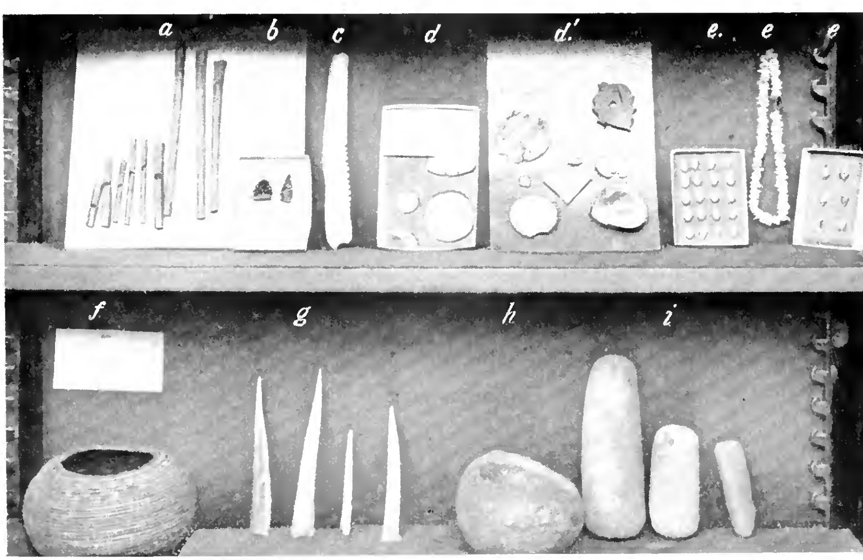

Fig. 5.

surprising that even one was discovered. One of our most unique finds was a set of bone whistles shown at *a*, Fig. 5. They were made from the long leg bones of some waterfowl, and are evidently intended to furnish a variety of sounds, if we may judge from their varied length and the different positions of their holes.

A passage from Frank Marryatt is interesting in this connection. He says of the Santa Cruz Indians:

"Of an evening they made a great disturbance by indulging in what they intended for a dance; this consisted in crowding together in uncouth attitudes, and stamping on the ground to the accompaniment of primitive whistles, of which each man held one in his mouth, while the women howled and shrieked in chorus." *

With the same skeleton in whose possession were found these primitive pipes of Pan, the saw-toothed bone shown at *c*, Fig. 5, was found. It suggests a saw, but may have been a tally bone, on which count could be kept of years or moons; this use is perhaps indicated by the fact that the notches are only part way along the edge of the bone, and that notched shell, which they also knew how to make, would have been more effective as a saw. A sort of romantic atmosphere seems to surround this especial skeleton, who may have been some sort of primitive historian and musician, furnishing music and keeping the records of the tribe, singing the story of each year as each notch recalled it.

The articles in shell taken from this mound are all of two sorts—shell ornaments or shell money; both are shown at *d*, *d'*, and *e*, in Fig. 5. The shell ornaments are made from the brilliant abalone shell, which is still used to adorn the dooryards of good Californians. The ornaments are either round or oblong disks, pierced at one side for stringing, and all notched very exactly and evenly around the edge—perhaps, as Mr. Hughes suggested, in imitation of the heart shell, of which we found one specimen, shown in *d'*, Fig. 5, next to one of the disk ornaments. The money is like the shell money found all over California, and consists of perforated squares of shell or of small whole shells pierced from end to end, shown at *e*. In this case property and ornament seem to have had a close connection, as perhaps they always have. Aside from the skeletons and the artificial objects found in the Robles Rancheria, we came across many food remains which also tell their story. Bones of deer, elk, raccoon, bones of salmon, and several sorts of waterfowl, countless crabs' claws, mussel, oyster, periwinkle shells in abundance, grouped specially with little beds of ashes, told of good hunting and fireside feasts to follow, in which meat was not lacking to go with the rude bread made from the acorns and seeds ground in the mortars.

Before concluding our work on the Robles Rancheria, we paid a visit to Donna Maria Secundini Robles, and asked her what she knew of this old heap. She is nearly eighty, but remembers well,

* Frank Marryatt. Mountains and Mole-hills, or Recollections of a Burnt Diary, chap. v, p. 83. New York, 1855.

and almost seems to live in, the happy days before the Gringos came. This was her story: When she came as a girl to live on the Robles Ranch, there were three Indian rancherias within a mile of her home, one marked by the mound, and two others not far from the present station of Castro; but the Indians who lived on the mound had already deserted it, for when the Mission Fathers came to Santa Clara, the allegiance of the Indians was soon divided: some welcomed the new life and the new faith, and learned to pray and to hoe corn, to string rosaries, and to weave tule sombreros; while others still chose "the winds of freedom," and thought that acorns, clams, and fetiches would do very well for them. Among those who chose to be wild heathen still were the Indians of the Robles Rancheria; so they left their immemorial village site and went off down the San Joaquin Valley to Tulare, and were never seen again.

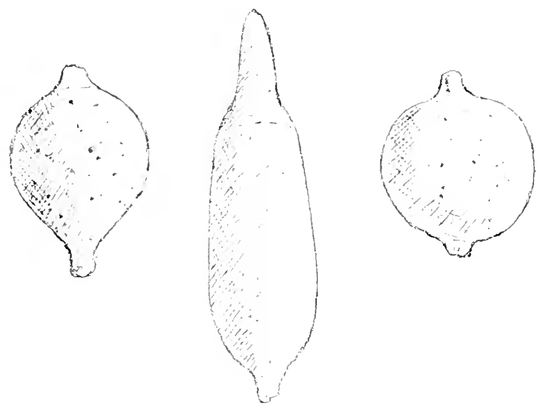

FIG. 6.

This story is confirmed by the fact that in our excavations we found no trace of any trade with whites—no glass beads, no bit of iron; this is noteworthy, since nearly all the known sites of old rancherias in California yield European beads in greater or less plenty. We had, therefore, by great good luck, been excavating a really prehistoric rancheria untouched by any foreign influence. On showing the various objects we had found to Donna Maria, she recognized their use at a glance, with the exception of the charm stones, which puzzled her; she confirmed, however, the statements which we had heard before as to the use of the sharp-pointed bones as hair ornaments. The manners and customs of these Indians were probably much the same as of those who went on living at the two neighboring rancherias, and with the latter Donna Maria was well acquainted, for, as she said, she had "danced with them often when a girl."

Piecing together our finds and the story of Donna Maria, the life of the Robles Rancheria reconstructs itself as follows: A little Indian village lies half hidden in great oak groves near San Francisco Bay, close by a spring oozing up under shady willows; an irregular circle of huts made of poles covered with rushes and branches shelters its population rather from sun than cold. In the middle of each tepee smolders a little fire, kindled by twirling a stick quickly about in a piece of rotten wood. The inhabitants eat bread made from white-oak acorns, from buckeye and laurel nuts, and, best of all, from manzanita berries. From these same nuts and berries they make *pinole*, a veritable mush, of which the early Spanish explorers constantly speak. They take the bitterness out of the acorns and nuts by soaking them long in water and then allowing them to dry in the sun, spread out on tule mats; then they grind them in their big stone mortars. To the mush and bread they add clams, fish, ducks, deer, and small game; they season their food with salt made from a certain root, and sweeten it by the addition of little sugar cakes, which they buy from the tribes of the mountains, who make them from the sap of some tree. Then there are thimbleberries, chokeweed berries, and in their season the madrona berry; and the tarweed grain made a pleasant variety in their mush and bread. After a feast of clams, tarweed mush, and thimbleberries, they lie about their fires and smoke coyote tobacco from wooden pipes, or dance to the music of their rude bone whistles.

Their dress is a simple apron or short skirt of buckskin, tule, or rabbit skin, with fringes and feathers for adornment, and longer for women; but their ornaments are their chief glory—bracelets, earrings, and necklaces of abalone shells, long, bone bodkins in their thick hair, to which were attached brilliant feathers; and Donna Maria's vivid pantomime shows us how their feathers dance above them as they dance, while their abalone pendants shake about their wrists and necks.

Their weapons are bows, arrows, and spears made of wood, and pointed with bone or flint, bound to a wooden shaft by rawhide, or the tough, sinewy fibers of a shrub which grows up in the mountains.

They made no pottery, but all their grinding, cooking, and carrying was done in stone or basketry; of the latter Donna Maria gave us for the museum a beautiful ancient specimen from one of these very rancherias. It is made of split roots woven so close as to be water-tight, and ornamented by a simple and even classic pattern. Often these baskets were patterned with lines and groups of little feathers, and then they were precious indeed.

When an Indian died, he was wrapped up in a blanket obtained from the missions, and buried in the rancheria itself, but not under the tepee. Before he was buried, the other Indians came and gave gifts and mourned.

A kindly, inoffensive tribe, they lived by hunting, fishing, and the natural nuts and grains of their environment. They ground their food and cooked it, loved music and personal adornment, held together in their village as a social unit, with a limited commerce. The range of trade indicated by the excavations and confirmed by Donna Maria reveals a narrow world, with a diameter of not much more than twenty miles. The two broken arrowheads from Napa and one broken basaltic lava mortar, whose material must have come from far to the northward, are unique importations to be explained by accident rather than by regular trade, since the other mortars are all made of bowlders easily found in the vicinity, and since, as I have said, the broken arrow points are unique. The hill tribes eastward essentially bounded their world. Tradition and evidence alike show them to be a spur of population entering the valley from the south-

Fig. 7.

ward. Contact with the more warlike and better equipped northern tribes would either have destroyed them or developed their own culture to a higher status of defense.

This low status of defense, the fact that their implements are so similar to the natural objects which suggest them, the low type of skull (Fig. 7), all go to show that the Indian of the Santa Clara Valley was one of the most primitive types known to ethnology within the historic era. The early fathers and voyagers have left a good deal of observation in regard to him, but all this observation is more or less vitiated by the fact that it was made after the contact of Spaniard and Indian had already begun its work. For this reason the evidence of the Robles Rancheria is especially valuable, since it apparently antedates this influence entirely and shows us primitive man in one of his most primitive seats. Nothing possessed or made by the men of the Robles Rancheria indicates that they had ever lived in any other vicinity, or knew any other materials than the bones and stones and shells of their own valley and its encircling hills. Shut off from communication almost as completely as if they had lived on an island, they seem to have lived and died undisturbed from some great antiquity, if we may judge from the height of the mound, which, as a *débris* heap, could only have accumulated slowly. Who knows but that here in the Santa Clara Valley is one of the seats where man first invented a stone mill, first loved the glitter and shine of a lovely shell, first raised his eyes and felt that he was different!

HOW PLANTS AND ANIMALS SPEND THE WINTER.

By W. S. BLATCHLEY,
STATE GEOLOGIST OF INDIANA.

ONE of the greatest problems which each of the living forms about us has had to solve during the years of its existence on earth is how best to perpetuate its kind during that cold season which once each year, in our temperate zone, is bound to come. Many are the solutions to this problem. Each form of life has, as it were, solved it best to suit its own peculiar case, and to the earnest student of Nature there is nothing more interesting than to pry into these solutions and note how varied, strange, and wonderful they are.

To fully appreciate some of the facts mentioned below it must be borne in mind that there is no such thing as "spontaneous generation" of life. Every cell is the offspring of a pre-existing cell. Nothing but a living thing can produce a living thing. Hence every weed that next season will spring up and provoke the farmer's ire, and every insect which will then make life almost intolerable for man or beast, exists throughout the winter in some form.

If we begin with some of the lowly plants, such as the fresh-water algæ, or so-called "frog-spittle" of the ponds, and many of the rusts and fungi which are so injurious to crops, we find that they form in autumn "resting spores." These are very small and globular, one-celled bodies, having a much thicker coat and denser protoplasm or contents than are found in the spores often produced in summer by the same plants, and which are destined for immediate growth. The power of life within these winter resting spores is proof against the severest attacks of frost, and they lie snugly ensconced in the mud at the bottom of pond or stream, or buried beneath the leaves in some sheltered nook, until the south winds of March or April furnish the key to unlock the castle of the ice king. Then the spirit of growth within each spore begins to assert itself once more, and, bursting the walls, the contents soon produce the parent or summer form of the plant with which we are most familiar. Thus the spores which next season will produce the grape mildew and the red rust of wheat are now in existence, the former within the substance of the fallen grape leaf, the latter within the stubble or about the roots of last season's wheat plants.

If the grape leaves should be carefully gathered and burned, and the stubble destroyed in like manner, not only would the next season's crop of these two parasitic plant pests be wonderfully lessened, but many injurious insects would at the same time be destroyed.

Higher in the scale of plant life we find the flowering annuals bending all their energies during the summer to produce that peculiar form, the "seed," which is only a little plant boxed up to successfully withstand the rigors of winter. The great sunflower, that grows into a giant in a single season and defies the summer sun and storm, falls an easy victim to the frosts of autumn. It, however, prepares the way for many successors in the ripened seeds, each one of which, under favorable conditions, will germinate, grow, reproduce its kind, and thus complete another cycle in the realm of vegetable life. The prospective life and activity of a whole field of next summer's waving corn may be considered as stored up in a few pecks of comparatively lifeless seed corn safely housed in the granary. Within its two protective coats and surrounded by a large store of food, in the form of seed leaf or nucleus, to be used when growth begins again, each little plantlet lives and survives the coldest blasts of King Boreas and his cohorts.

Note, too, the buds and underground stems which will furnish the beginning of next season's growth of our biennial and perennial plants. See how they are protected by heavy overcoats in the form of bud scales. Oftentimes, too, as in the hickory and "balm of Gilead" trees, these scales have a coat of resin or gum on the outside to render them waterproof; and some, as those of the pawpaw, are even fur-lined, or rather fur-covered, with a coating of soft black hairs. Were these protective scales not present, the tender shoots within them, which will furnish the nucleus of next season's foliage, would be seared and withered by the first frost as quickly as though touched with a red-hot iron.

The above are some of the many ways in which our plants, in the course of ages and many changes of environment, have solved the problem of surviving the cold of winter. Moreover, they always prepare for this cold in time, the resting spores and seeds being ripened and the bud scales formed over the tender tips of the branches long before the first severe frost appears.

Let us now glance at those higher forms of life called animals —"higher," because they are absolutely dependent upon plants for their food—and see how they pass away their time while their food-producers, the plants, are resting.

Beginning with the earthworms and their kindred, we find that at the approach of winter they burrow deep down where the icy breath of the frost never reaches, and there they live during the cold season a life of comparative quiet. That they are exceedingly sensitive to warmth, however, may be proved by the fact that when a warm rain comes some night in February or March, thawing out the crust of the earth, the next morning reveals the mouths of hundreds of the pits or burrows of these primitive tillers of the soil in our dooryard, each surrounded by a little pile of pellets, the castings of the active artisans of the pit during the night before.

If we will get up before dawn on such a morning we can find the worms crawling actively about over the surface of the ground, but when the first signs of day appear they seek once more their protective burrows, and only an occasional belated individual serves as a breakfast for the early birds.

The eyes of these lowly creatures are not visible, and consist of single special cells scattered among the epidermal cells of the skin, and connected by means of a sensory nerve fiber with a little bunch of nervous matter in the body. Such a simple visual apparatus serves them only in distinguishing light from darkness, but this to them is most important knowledge, as it enables them to avoid the surface of the earth by day, when their worst enemies, the birds, are in active search for them.

The fresh-water mussels and snails and the crayfish burrow deep into the mud and silt at the bottom of ponds and streams where they lie motionless during the winter. The land snails, in late autumn, crawl beneath logs, and, burrowing deep into the soft mold, they withdraw far into their shells. Then each one forms with a mucous secretion two thin, transparent membranes, one across the opening of the shell and one a little farther within, thus making the interior of the shell perfectly air-tight. There for five or six months he sleeps free from the pangs of hunger and the blasts of winter, and when the balmy breezes of spring blow up from the south he breaks down and devours the protecting membranes and goes forth with his home on his back to seek fresh leaves for food and to find for himself a mate.

Next in the scale come the insects, which comprise four fifths of all existing animals, and each one of the mighty horde seen in summer has passed the winter in some form. One must look for them in strange places and under many disguises, for they can not migrate, as do the majority of the birds, nor can they live an active life while the source of their food supply, the plants, are inactive.

The majority of those insects which next May or June will be found feeding on the buds or leaves of our trees, or crawling wormlike over the grass of our lawns, or burrowing beneath the roots of our garden plants, are represented in the winter by the eggs alone. These eggs are deposited in autumn by the mother insect, on or near the object destined to furnish the young, or larvæ, their food. Each egg corresponds to a seed of one of our annual plants, being, like it, but a form of life so fashioned and fitted as to withstand for a long period intense cold; the mother insect, like the summer form of the plant, succumbing to the first severe frost.

Thus myriads of the eggs of grasshoppers are in the early autumn deposited in the ground, in compact masses of forty to sixty each. About mid-April they begin to hatch, and the sprightly little insects, devoid of wings, but otherwise like their parents, are seen on every hand.

A comparatively small number of insects pass the winter in the larval or active stage of the young. Of these, perhaps the best known is the brown "woolly worm" or "hedgehog caterpillar," as it is familiarly called. It is thickly covered with stiff black hairs on each end, and with reddish hairs on the middle of the body. These hairs appear to be evenly and closely shorn, so as to give the animal a velvety look; and as they have a certain degree of elasticity, and the caterpillar curls up at the slightest touch, it generally manages to slip away when taken into the hand. Beneath loose bark, boards, rails, and stones, this caterpillar may be found in midwinter, coiled up and apparently lifeless. On the first bright, sunny days of spring it may be seen crawling rapidly over the ground, seeking the earliest vegetation which will furnish it a literal "breakfast." In April or May the chrysalis, surrounded by a loose cocoon formed of the hairs of the body interwoven with coarse silk, may be found in situations similar to those in which the larva passed the winter. From this, the perfect insect, the Isabella tiger moth, emerges about the last of June. It is a medium-sized moth, dull orange in color, with three rows of small black spots on the body, and some scattered spots of the same color on the wings.

By breaking open rotten logs one can find in midwinter the grubs or larvæ of many of the wood-boring beetles, and, beneath logs and stones near the margins of ponds and brooks, hordes of the maggots or larvæ of certain kinds of flies may often be found huddled together in great masses. The larvæ of a few butterflies also live over winter beneath chips or bunches of leaves near the roots of their food plant, or in webs of their own construction, which are woven on the stems close to the buds whose expanding leaves will furnish them their first meal in spring.

Many insects pass the winter in the quiescent or pupal stage; a state exceedingly well fitted for hibernating, requiring, as it does, no food, and giving plenty of time for the marvelous changes which are then undergone. Some of these pupæ are inclosed in dense silken cocoons, which are bound to the twigs of the plants upon which the larvæ feed, and thus they swing securely in their silken hammock through all the storms of winter. Perhaps the most common of these is that of the brown Cecropian moth, the large oval cocoon of which is a conspicuous object in winter on the twigs of our common shade and fruit trees. Many other pupæ may be found beneath logs or on the under side of bark, and usually have the chrysalis surrounded by a thin covering of hairs, which are rather loosely arranged. A number pass the cold season in the earth with no protective covering whatever. Among these is a large brown chrysalis with a long tongue-case bent over so as to resemble the handle of a jug. Every farm boy has plowed or spaded it up in the spring, and it is but the pupa of a large moth, the larva of which is the great green worm with a "horn on its tail," so common on tomato plants in the late summer.

Each of the winter forms of insects above mentioned can withstand long and severe cold weather—in fact, may be frozen solid for weeks and retain life and vigor, both of which are shown when warm weather and food appear again. Indeed, it is not an unusually cold winter, but one of successive thawings and freezings, which is most destructive to insect life. A mild winter encourages the growth of mold which attacks the hibernating larvæ and pupæ as soon as, from excess of rain or humidity, they become sickly; and it also permits the continued activity of insectivorous mammals and birds. Thus, moles, shrews, and field mice, instead of burying themselves deeply in the ground, run about freely during an open winter, and destroy enormous numbers of pupæ; while such birds as the woodpeckers, titmice, and chickadees are constantly on the alert, and searching in every crevice and cranny of fence and bark of tree for the hibernating larvæ.

Of the creeping, wingless creatures which can ever be found beneath rocks, rails, chunks, and especially beneath those old decaying logs which are half buried in the rich vegetable mold, the myriapods, or "thousand-legs," deserve more than passing notice. They are typical examples of that great branch of the animal kingdom known as *arthropods*, which comprises all insects and crustaceans. Each arthropod has the body composed of rings placed end to end and bearing jointed appendages, and in the myriapods each ring and its appendages can be plainly seen, whereas in the higher forms of the branch many of the rings are so combined as to be very difficult to make out.

Full forty kinds of myriapods occur in any area comprising one hundred square miles in the eastern United States. About twenty-five of them go by the general name of "thousand-legs," as each has from forty to fifty-five cylindrical rings in the body, and two pairs of legs to each ring. The other fifteen belong to the "centiped" group, the body consisting of about sixteen flattened segments, or rings, each bearing a single pair of legs. When disturbed, the "thousand-legs" always coils up and remains motionless, shamming death, or "playing 'possum," as it is popularly put, as a means of defense; while the centiped scampers hurriedly away and endeavors to hide beneath leaf, chip, or other protecting object. All those found in the Northern States are perfectly harmless, the true centiped, whose bite is reputed much more venomous than it really is, only being found in the South. True, some of the centiped group can pinch rather sharply with their beetle-like jaws, and one, our largest and most common species, a brownish-red fellow about three inches long and without eyes, can even draw blood if its jaws happen to strike a tender place. When handled, it always tries to bite, perhaps out of revenge for the abominably long Latin name given it by its describer. In fact, the name is longer than the animal itself—*Sco-lo-po-cryp-tops sex-spi-no-sa* being its cognomen in full. With such a handle attached to it, who can blame it for attempting to bite? Yet to the scientist up on his Latin each part of the above name bears a definite and tangible meaning. All the myriapods found in the woods and fields feed upon decaying vegetation, such as leaves, stems of weeds, and rotten wood, and in winter three or four species can usually be found within or beneath every decaying log or stump. One species with very long legs is often found in damp houses or in cellars. It is sometimes called the "wall-sweeper," on account of its rapid, ungainly gait, and is even reputed to prey upon cockroaches and other household pests.

Spiders, which do not undergo such changes as do most of the common, six-footed insects, winter either as eggs or in the mature form. The members of the "sedentary" or web-spinning group, as a rule, form nests in late autumn, in each of which are deposited from fifty to eighty eggs, which survive the winter and hatch in the spring, as soon as the food supply of gnats, flies, and mosquitoes appears. The different forms of spiders' nests are very interesting objects of study. Some are those close-spun, flat, button-shaped objects, about half an inch in diameter, which are so common in winter on the under side of bark, chunks, and flat rocks. Others are balloon-shaped and attached to weeds. Within the latter the young spiders often hatch in early winter, make their first meal off their empty egg cases, and then live together in hunger and harmony until the south winds blow again, when they emerge and scatter far and wide in search of sustenance.

The "wandering" spiders never spin webs, but run actively about and pounce upon their prey with a tiger-like spring. Six or eight of the larger species of this group winter in the mature form beneath logs and chunks, being often frozen solid during cold weather, but thawing out as healthy as ever when the temperature rises. Retiring beneath the loose-fitting bark of hickory or maple trees, a number of the smaller tube-weaving spiders construct about themselves a protecting web of many layers of the finest silk. Within this snug retreat they lie from November until April—a handsome, small, black fellow, with green jaws and two orange spots on his abdomen, being the most common species found motionless within this seeming shroud of silk on a day in midwinter.

In any Northern State as many as four hundred different kinds of the six-footed or true insects, in the winged or adult stage, may be taken in winter by any one who is so disposed, and knows where to search for them. Among the *Orthoptera* there are a half dozen or more grasshoppers which, when full grown, are less than half an inch in length, gray or blackish in color, and with the hard upper crust of the thorax extending the full length of the body and covering the wings. They are called "grouse grasshoppers," and during cold weather they hide beneath the loose bark of logs, or beneath the bottom rails of the old Virginia worm fences. From these retreats every warm, sunny day tempts them forth in numbers. On such occasions the earth seems to swarm with them, as they leap before the intruder, their hard bodies striking the dead leaves with a sound similar to that produced by falling hail. The common field cricket belongs also to the *Orthoptera*, and the young of various sizes winter under rails and logs, bidding defiance to Jack Frost from within a little burrow or pit beneath the protecting shelter.

The true bugs, or *Hemiptera*, hibernate in similar places; squash bugs, chinch bugs, "stink" bugs, and others being easily found in numbers beneath loose bark or hidden between the root leaves of mullein and other plants.

Nearly three hundred species of *Coleoptera*, or beetles, occupy similar positions. Almost any rotten log or stump when broken open discloses a half dozen or more "horn" or "bess beetles"—great, shining, clumsy, black fellows with a curved horn on the head. They are often utilized as horses by country children, the horn furnishing an inviting projection to which may be fastened, by a thread or cord, chips and pieces of bark to be dragged about by the strong and never lagging beast of burden. When tired of "playing horse" they can make of the insect an instrument of music, for, when held by the body, it emits a creaking, hissing noise, produced by rubbing the abdomen up and down against the inside of the hard, horny wing covers. This beetle passes its entire life in cavities in the rotten wood on which it feeds, and when it wishes a larger or more commodious home it has only to eat the more.

The handsome and beneficial lady beetles winter beneath fallen leaves or between and beneath the root leaves of the mullein and the thistle. Our most common species, the thirteen-spotted lady beetle, is gregarious, collecting together by thousands on the approach of cold weather, and lying huddled up like sheep until a "breath of spring" gives them the signal to disperse. Snout beetles galore can be found beneath piles of weeds near streams and the borders of ponds or beneath chunks and logs in sandy places. All are injurious, and the farmer by burning their hibernating places in winter can cause their destruction in numbers. Rove beetles, ground beetles, and many others live deep down in the vegetable mold beneath old logs, where they are, no doubt, as secure from the breath of the ice king as if they had followed the swallow to the tropics.

Of the *Diptera*, or flies, but few forms winter in the perfect state, yet the myriads of house flies and their kin, which next summer will distract the busy housewife, are represented in winter by a few isolated individuals which creep forth occasionally from crevice or cranny and greet us with a friendly buzz.

In midwinter one may also often see in the air swarms of small, gnatlike insects. They belong to this order, and live beneath the bark of freshly fallen beech and other logs. On warm, sunny days they go forth in numbers for a sort of rhythmical courtship; their movements while in the air being peculiar in that they usually rise and fall in the same vertical line—flitting up and down in a dreamy, dancing sort of motion.

Among the dozen or more butterflies and moths which winter in the perfect state the most common and the most handsome is the "Camberwell Beauty" or "Mourning Cloak," a large butterfly whose wings are a rich purplish brown above, duller beneath, and broadly margined with a yellowish band. It is often found in winter beneath chunks which are raised a short distance above the ground or in the crevices of old snags and fence rails. It is then apparently lifeless, with the antennæ resting close along the back, above which the wings are folded. But one or two warm days are necessary to restore it to activity, and I have seen it on the wing as early as the 2d of March, hovering over the open flowers of the little snow trillium.

All the species of ants survive the winter as mature forms, either in their nests in the ground or in huddled groups in half-rotten logs and stumps, while here and there beneath logs a solitary queen bumblebee, bald hornet, or yellow jacket is found—the sole representatives of their races.

Thus insects survive the winter in many ways and in many places, some as eggs, others as larvæ, still others as pupæ, and a large number as adults—all being able to withstand severe cold and yet retain vitality sufficient to recover, live, grow, and replenish the earth with their progeny when the halcyon days of spring appear once more.

In the scale of animal life the vertebrates or backboned animals succeed the insects. Beginning with the fishes, we find that in late autumn they mostly seek some deep pool in pond or stream at the bottom of which the water does not freeze. Here the herbivorous forms eke out a precarious existence by feeding upon the innumerable diatoms and other small plants which are always to be found in water, while the carnivorous prey upon the herbivorous, and so maintain the struggle for existence. The moving to these deeper channels and pools in autumn and the scattering in the spring of the assembly which has gathered there constitute the so-called migration of fishes, which is far from being so extensive and methodical as that practiced by the migratory birds.

Many of the smaller species of fishes, upon leaving these winter resorts, ascend small, clear brooks in large numbers for the purpose of depositing their eggs, as, when hatched in such a place, the young will be comparatively free from the attacks of the larger carnivorous forms. Among the lowest vertebrates often found in numbers in early spring in these meadow rills and brooks is the lamprey, or "lamper eel," as it is sometimes called. It has a slender, eel-like body, of a uniform leaden or blackish color, and with seven purse-shaped gill openings on each side. The mouth is fitted for sucking rather than biting, and with it they attach themselves to the bodies of fishes and feed on their flesh, which they scrape off with their rasplike teeth. Later in the season they disappear from these smaller streams, probably returning in midsummer to deeper water. Thoreau, who studied their habits closely, says of them: "They are rarely seen on their way down stream, and it is thought by fishermen that they never return, but waste away and die, clinging to rocks and stumps of trees for an indefinite period; a tragic feature to the scenery of the river bottoms worthy to be remembered with Shakespeare's description of the sea floor."

A few of the fishes, as the mud minnow and smaller catfishes, together with most frogs, turtles, and salamanders, on the approach of winter, burrow into the mud at the bottom of the streams and ponds, or beneath logs near their margins. There they live without moving about and with all the vital processes in a partially dormant condition, thus needing little if any food.

The box tortoise or "dry-land terrapin," the common toad, and some salamanders burrow into the dry earth, usually going deep enough to escape the frost, while snakes seek some crevice in the rocks or hole in the ground where they coil themselves together, oftentimes in vast numbers, and prepare for their winter's sleep. If the winter be an "open" one this hibernation is sometimes interrupted, and the animal issues forth from its retreat on a warm, sunny day, thinking, no doubt, that spring has come again.

Thus the writer has, on one occasion, seen a soft-shelled turtle moving gracefully over the bottom of a stream on a day in late December, and has in mid-January captured snakes and salamanders from beneath a pile of driftwood where they had taken temporary refuge.

With frogs especially this hibernation is not a perfect one, and there is a doubt if in a mild winter some species hibernate at all. For example, the little cricket frog or "peeper" has been seen many times in midwinter alongside the banks of flowing streams, and during the open winter of 1888–'89 numerous specimens of leopard and green frogs were seen on different occasions in December and January, while on February 18th they, together with the peepers, were in full chorus.

Of our mammals, a few of the rodents or gnawers, as the ground-hogs, gophers, and chipmunks, hibernate in burrows deep enough to escape the cold, and either feed on a stored supply of food, or, like the snakes and crayfish, do not feed at all.

Others, as the rabbits, field mice, and squirrels, are more or less active and forage freely on whatever they can find, eating many things which in summer they would spurn with scorn. To this class belongs that intelligent but injurious animal the musquash or muskrat. Those which inhabit the rivers and larger streams live in burrows dug deep beneath the banks, but those inhabiting sluggish streams and ponds usually construct a conical winter house about three feet in diameter and from two to three feet in height. These houses are made of coarse grasses, rushes, branches of shrubs, and small pieces of driftwood, closely cemented together with stiff, clayey mud. The top of the house usually projects two feet or more above the water, and when sun-dried is so strong as to easily sustain the weight of a man. The walls are generally about six inches in thickness and are very difficult to pull to pieces. Within is a single circular chamber with a shelf or floor of mud, sticks, leaves, and grass, ingeniously supported on coarse sticks stuck endwise into the mud after the manner of piles. In the center of this floor is an opening, from which six or eight diverging paths lead to the open water without, so that the little artisan has many avenues of escape in case of danger. These houses are often repaired and used for several winters in succession, but are vacated on the approach of spring. During the summer the muskrat is, in the main, a herbivorous animal, but in the winter necessity develops its carnivorous propensities and it feeds then mainly upon the mussels and crayfish which it can dig from the bottom of the pond or stream in which its house is built.

The bats pass the winter in caves, the attics of houses and barns, or in hollow trees, hanging downward by their hind claws, eating nothing and moving not. All the carnivora, or flesh-eaters, as the mink, skunk, opossum, fox, and wolf, are in winter active and voracious, needing much food to supply the necessary animal heat of the body. Hence they are then much more bold than in summer, and the hen yard or sheep pen of the farmer is too frequently called upon to supply this extra demand.

But of all our animals it seems to us the birds have solved the winter problem best. Possessing an enduring power of flight and a knowledge of a southern sunny sky, beneath which food is plentiful, they alone of the living forms about us have little fear of the coming of the frost. True, forty or more species remain in each of the Northern States during the cold season, but they are hardy birds which feed mainly on seeds, as the snow bird and song sparrow; on flesh, as the hawks and crows; or on burrowing insects, as the nuthatches and woodpeckers. And no winter day is too dull and dreary, no sky too leaden and cheerless, no north wind too harsh and biting for them to be on the lookout for food.

Such are some of the solutions to the problem of life in winter which the plants and animals about us have worked out; such some of the forms which they undergo, the places which they inhabit.

To the thinking mind a knowledge of these solutions but begets other and greater problems, such as how can a living thing be frozen solid for weeks and yet retain vitality enough to fully recover? How can a warm-blooded animal sleep for months without partaking of food or drink? And, greater than either, What is that which we call life?

I hold in my hand two objects, similar in size, color, organs, everything—twins from the same mother in all outward respects. One pulsates and throbs with that which we call "life." It possesses heat, bodily motion, animal power. The other is cold, motionless, pulseless, throbless—a thing of clay. What is that "life" which the one possesses and the other lacks? Ah, there's the rub! With the wisest of men we can only answer, "*Quien sabe?*" (Who knows?)

THE INTERPRETATIONS OF AUTOMATISM.

By Prof. WILLIAM ROMAINE NEWBOLD.

THROUGHOUT this series of papers I have confined myself closely to one theory of interpretation, and I have done so because the theory which I adopted stands nearest to those of current science. To leave the subject in this shape, however, would be an injustice both to my readers and myself. The phenomena the reality of which I have acknowledged constitute but a part of those which are regarded by competent observers as actually entering into the question; and the solution which I have proposed is not only with difficulty capable of reconciliation with these other phenomena, but is itself based upon a metaphysical theory which is far from demonstration. It seems, therefore, no more than fair that I should, before concluding my series, give my readers a somewhat broader outlook upon the various aspects of the problem than I have yet done. A complete survey of all theories that have been proposed to account for the whole or a part of the facts can not, of course, be given in a magazine article, even if I were competent to the task, which I do not profess to be. But some account of the manner in which the phenomena of suggestibility and automatism are related to the broader field of the supernormal, and of the possible points of view from which the whole field may be surveyed, seems to me essential.

There is no need of my again recounting the salient features of suggestibility, automatism, and secondary states. Let me turn at once to the material which I have hitherto excluded—the realm of the supernormal.

It is with some hesitation that I have resolved to introduce any discussion of these topics in the pages of the Popular Science Monthly. The inquiry into the supernormal is as yet in its infancy: its methods are still crude, and its results are under discussion. None of these results have as yet won the right to a place among the scientific truths which may be regarded as *known*. They are still the personal opinions of a small group of students, and although I account myself one of the group, I do not make the mistake of identifying my personal opinions with ascertained fact. Still, the relation between these phenomena and those of automatism in particular is so close that no student of the one group can ignore the other.

Alleged supernormal phenomena may be regarded as belonging to two classes—psychical and physical. The latter class embraces all alleged interferences with the known laws of the physical world. They may be dismissed from consideration here, not merely because they are not relevant, but because nearly every case so far reported has dissolved into fraud or malobservation upon closer examination, and the few which remain intact can not, in consequence, be regarded as proving anything.

By psychical phenomena I mean mental occurrences which either give true indications of events unknown to the percipient, or seem in some way to coincide with and suggest such events, or, in the case of impulses, seem to betray a knowledge of fact which was not possessed by the subject of the experience. These, again, may be subdivided into several groups. In the telepathic group the circumstances are such as to suggest a species of mental induction, one mind reflecting the thoughts of another. Thus a friend of mine was walking down a country road near Germantown, Pa., on a hot summer's day. Suddenly he found himself thinking, "Where can I find a doctor, where can I find a doctor?" He laughed at the absurdity—as if he wanted one—but, to be sure, if he did, where could one be found? Dr. Y—— was dead, and the only other he knew of was Dr. Z——, at Jenkintown. A few moments later he reached a crossroad, along which a man and boy were driving rapidly. As they met my friend, the man reined in the horse, leaned out, and said, "Can you tell me, sir, where I can find the nearest doctor?"

Nine times in the course of my own life I have had what is called a "presentiment." Eight times I wrote it down at once before learning whether it was true or false, and the ninth time I spoke of it. Three of these were false, one was partly true and partly false, one was not verified, but probably false. All these related to subjects much in my thoughts, and were probably suggested by circumstances. Four were true, of which one might have been suggested by circumstances. The other three were not only true and not apparently suggested by circumstances, but were among the most agitating experiences of my life. One drove me, in spite of the resistance of my reason, to take a journey which seemed the act of a lunatic, and proved the wisest thing I could do. Another impelled me to write a letter to a person three hundred and fifty miles away, to whom I had written a few hours before, but who happened to be in great trouble at the moment I felt the impulse. The third gave me absolute assurance that the very thing was about to happen which I believed to be of all things most impossible. I do not, of course, quote these few experiences as proving the existence of telepathy, but merely as illustrating what I mean by "apparently telepathic phenomena."

The vast majority of apparently supernormal phenomena are susceptible of a telepathic explanation, but in a few cases one is driven to other conceptions. Sometimes knowledge is shown of events not known to any one, and at other times a percipient will seem to "see" things at a distance, or to become aware of events remote in time.

These phenomena are ascribed to "clairvoyance," "precognition," and "retrocognition." They are much less common than those of the telepathic type, and the evidence for them is by no means as good.

Occasionally the information thus got professes to come from the spirit of some person deceased, and sometimes the claim seems plausible. Thus I once got from an automatic writer in Boston what purported to be messages from several of my deceased relatives, one of them being an aunt who died in my childhood, twenty-one years ago. Among the messages was an allusion to "Carson the Dr." This meant nothing to me at the time, but upon making inquiries I learned that an old doctor named *Corson* had attended my aunt during her last illness for about two weeks while she was at our house, although he was not her regular physician. She was afterward removed to a hospital in New York, and died there. The doctor has long been dead. I do not quote this to prove that the spirit of my aunt was really there, which I think very questionable, but to show how plausible these automatic utterances sometimes are. Probably my parents were the only persons living who knew that Dr. Corson attended my aunt for two weeks in 1875, and they have never seen the automatist.

Now, psychic phenomena nearly always occur in automatic form. Ungrounded emotions, inner or outer voices, apparitions, automatic writing and speech, irrational impulses—all these provide the garb for the appearance of knowledge for which we can not account. Hence it is impossible to study automatism without taking these alleged phenomena into consideration at some stage of the inquiry, even if they are considered only to be rejected.

There are three practicable methods of viewing the facts of suggestibility, automatism, and secondary states. In the first place, we may adopt the conception which underlies most of our modern thought, and regard mind as essentially a function of matter—that is, of the brain. We will then naturally look to physiology only for our explanation of these facts. Or we may hold to the purely psychological point of view, and endeavor to explain the phenomena by reference to psychological principles only. Or, finally, we may adopt the time-honored doctrine which regards mind and brain as two distinct entities, between which constant interaction is going on. We may then invoke both principles in our theories.

The first of these doctrines is commonly known as materialism, but as that word has been so much abused I shall use the phrase "theory of dependence." It has its root in the obvious fact that sensations and emotions are caused by physical and physiological processes. Recent physiological research has tended to establish this doctrine more firmly, to extend its scope and to determine the character of the relation. There is much evidence to show that thought, reason, and will are also dependent upon the brain for their very existence; that all mental states are especially connected with the cortex of the brain; that even some very complicated movements, to the performance of which we usually suppose consciousness to be essential, can be performed by lower, presumably unconscious, centers. All this tends to exalt our idea of the brain's capacities and to diminish the importance ascribed to mind. Moreover, careful psychological work has shown that many of what are termed mental laws are most easily explained as representing physical processes, and the sharp antithesis which we draw between the laws of mind and those of matter is in part at least illusory. The law of association is believed to be capable of interpretation in terms of the transmission of nervous impulses through the cortex, the laws of volition in their simpler forms point to a direct discharge of energy developed in connection with some substantive mental state into the subcortical mechanism and thence to the muscles, the law of attention suggests some species of coalescence of all the activities going on at one time in the cortex into a definite system. Even telepathy, which is regarded with so much suspicion by orthodox psychologists, is parallel to the phenomena of induction.

The more special lines of work, therefore, both in physiology and psychology, tend to converge upon the same conclusion to which we are already predisposed by the general drift of the intellectual movement initiated by Gassendi, Hobbes, Descartes, Galileo, and Newton—that it is to matter we must look for our knowledge of Nature, that material processes are independent and self-sufficient, that mind is merely a brain product, which waxes and wanes with the flow and ebb of physical activities within the cortex.

The attempts that have been made to explain some or all of the phenomena of suggestibility and automatism by reference to physical changes are almost innumerable, and scarcely any conceivable attribute of the brain or its functions has not been seized upon by somebody. One refers hypnotic states to excessive blood supply, another to diminished blood supply, another to accumulation of waste products in the blood, another to inhibition of the association paths, another to inhibition of the frontal region, another to inhibition of one hemisphere, another to inhibition of the entire cortex, and so on. There may be an element of truth in some of these theories, but it is certain that no one is sufficient to account for all the facts, even if the alleged supernormal facts be excluded as non-proved.

In fact, we know very little indeed about the brain processes which are immediately related to consciousness, and consequently many psychologists are reluctant to resort to them for explanations of what goes on in consciousness. They prefer to limit the inquiry to the facts and laws of mind and to formulate the phenomena of suggestibility and automatism in mental terms alone. It is not possible for me to analyze these theories here, as each presupposes a knowledge of the particular psychological point of view from which it is conceived. The ideas of inhibition of attention, interference with association, inhibition of will, influence of imagination and expectation, figure largely in all these theories. That which I have been developing in these pages belongs to this type, but is distinguished by its free use of conceptions derived from the theory of dependence. Assuming that consciousness depends upon and indicates the existence of physical processes, that these physical processes have the attributes of other physical forces, that they in some way coalesce and interact in the brain cortex, I borrowed these physical conceptions and applied them directly to those mental phenomena which we regard as dependent upon the physical. Thus, if the simultaneous grasping of several mental facts indicates a coalescence of their physical bases, and *vice versa*, then inability to become conscious of any mental fact the physical basis of which we have reason to believe exists would indicate that its physical basis had failed to coalesce with the others. In such cases I described the mental fact as itself "cut off from" or "dissociated from" the other mental states, although, manifestly, mental states, which do not themselves occupy space, can not be spatially cut off from or separated from anything whatever. The phenomena of suggestibility I ascribed to the removal through this dissociation of the checks and counterchecks exerted by mental states upon one another, thus allowing suggested sensations and ideas to work out their results more freely than usual.

Analogous conceptions have been worked out by other writers without explicit reference to the physical basis of consciousness. Thus, Dr. Hans Schmidkunz, in a bulky and learned but badly written book (*Psychologie der Suggestion*, Munich, 1892), makes free use of the conception of consciousness as a co-ordination of forces capable of occasional disruption, although he seems to have been led to that notion by the Herbartian psychology. Professors Janet and Binet also teach analogous doctrines without reference to the brain processes, and Prof. William James seems at times to hold a similar position.

In sharp antithesis to the theory of dependence stands the theory of independence. According to this doctrine, mind and matter are essentially distinct in nature, and are capable of independent existence, although in fact sometimes closely related. Many mental states, as sensations, are caused by physical processes, and, *vice versa*, many physical processes, as some bodily movements, are caused by mental states; but this relation of action and interaction is purely accidental, and can be dissolved without the destruction of either mind or matter. This theory has been stated in many forms, and is involved more or less implicitly in many philosophies. In one form or another it has been the dominant theory in every epoch of human thought, it lies at the foundation of most religions, and is to-day accepted by the mass of men; yet in the scientific world it has fallen into such disfavor that in many circles it is almost as disgraceful to avow belief in it as in witchcraft or ghosts.

The chief argument usually alleged in justification of this attitude is that the theory of independence violates the law of conservation of energy, which is justly regarded as one of the greatest scientific generalizations of this century. That law requires that in all the manifold flux of physical phenomena certain definite and quantitative relations should exist between the amount of work done and the amount of energy expended, thus binding all physical processes into a closed series. To admit mental phenomena into that series as a mode into which physical energy might be transformed would, it is claimed, break the law—first, because the new elements are non-physical, and it is inconceivable that the non-physical should affect the physical; and, second, because mental states can not be measured, and therefore can not constitute an equivalent of anything,

This *a priori* objection does not seem to me to possess much force. The argument from inconceivability has been urged against every new conception introduced into science; it was never more weighty then when hurled against the bold speculators who claimed that the earth was round and that the antipodes nevertheless did not fall off. That a thought should cause the disintegration of a molecule is intrinsically neither more nor less inconceivable than that a disturbance in an imponderable entity like ether should shatter an oak tree. What is inconceivable to one generation becomes the commonplace of the next.

What the objectors really mean is that such a relation is *incomprehensible*, which it certainly is, but so also are all natural phenomena when reduced to their lowest terms.

The argument from equivalence is of greater weight, but is not conclusive. Mental states, it is true, have never yet been measured, nor are they likely to be; but we have no right to assume that quantitative relations are the only relations of which the law of conservation of energy can take cognizance. As quantity is an essential attribute of matter, so is quality an essential attribute of mind, and we may discover that, *mutatis mutandis*, the law of equivalence holds—that every given quantity and kind of energy expended in the cortex has its fixed equivalent in a given *quality* of consciousness, that is, in some definite kind of sensation, thought, or emotion, and *vice versa*.

It should be observed that the argument from the law of conservation of energy overthrows both the theory of independence and that of dependence, and we are reduced to the contemplation of the relation of mind and matter as an inscrutable mystery—a mystery which some philosophers try thinly to veil, by invoking the good offices of a third unknown substance of which both matter and mind are supposed to be attributes. This is the so-called doctrine of monism.

I have thought it necessary to go into this argument to some degree because without some such explanation my readers may wonder why I regard the theory of independence as entitled to any hearing whatever. Yet I think that the disrepute into which it has fallen is not due to any imaginary conflict with the law of conservation of energy. It is in part due to the general drift of our age, which for nearly four hundred years has set away from the supranaturalistic conceptions of the middle ages toward naturalism, and has consequently left the doctrine of independence, which was universal throughout the middle ages, high and dry on the sands. It is for the most part, however, due to the direct evidence, of which I have above spoken, for the dependence of mind upon the body.

It is not my purpose to attempt to prove or to disprove either of these theories, but before proceeding to interpretations of automatism which may be based upon the latter, I may point out that the evidence is not so wholly one-sided as is commonly supposed. The clinical facts by no means warrant the assumption that mental degeneration necessarily keeps pace with brain destruction. Cases are frequently reported in which patients survive severe and permanent injuries to the brain with relatively slight mental impairment. Some of the phenomena of normal psychology, as the consciousness of self, attention, and will, are as easily interpreted from the one as from the other point of view; and in the supernormal field the facts already reported, should they be substantiated by further inquiry, would go far toward showing that consciousness is an entity governed by laws and possessed of powers incapable of expression in material conceptions.

I do not myself regard the theory of independence as proved, but I think we have enough evidence for it to destroy in any candid mind that considers it that absolute incredulity as to its possibility which at present characterizes the average man of science.

Now, if it were proved true, what explanations can it provide for the phenomena of suggestibility and automatism?

The simplest way of looking at the facts is to ascribe them to a *partial separation* of mind and body. This notion is based upon the fact that the memory of the secondary state is so often lost. The mind may be supposed to be asleep while another person plays upon the sensitive machine which it has just been using. When memory is retained, we may suppose that consciousness, upon being reunited to its body, reads off, as it were, the traces left in the brain by what was going on in its absence. This is the notion which the very word automatism connotes, and it has been held more or less clearly by many writers. It accounts very well for most of the facts of hypnotic states, for the simpler forms of post-hypnotic suggestion, and is especially suggested by hysterical losses of sensation and movement, and by successive personalities. The same fundamental conception may be interpreted in accordance with the theory of dependence by ascribing all these phenomena to brain processes of *too low a degree of intensity* to awaken consciousness.

But this notion breaks down when applied to the more advanced stages of motor automatism, as fully developed automatic writing, to simultaneous personalities, to the more advanced forms of post-hypnotic suggestion, to trance and ecstasy. In all these cases we have as good evidence for the existence of consciousness as we ever have, save that the consciousness which we infer does not become a part of some recognized person's memories. Consequently we must admit either that organized matter, or some *tertium quid* which is neither mind nor matter, is capable of producing the effects which we ascribe to consciousness, or else that there sometimes exists in connection with a given body a consciousness distinct from that known to us.

The first of these alternatives would practically bring us back to the theory of dependence. The second, the doctrine of a *tertium quid*, is found in many writers, although there is no agreement as to the characteristics of the third entity. This notion is indeed descended from the ancient distinction between body, soul, and spirit. The *tertium quid* is usually conceived as a semimaterial entity, akin in its nature to the physical substratum of light and electricity. The doctrine of the "astral body" belongs to this type. Or, the third entity may be conceived as akin to consciousness in its essential nature, although capable of separation from it. It may, for example, be identified with the life of sensation and sensuous desires which common sense discriminates from the "more spiritual" elements of thought, reason, and will.

If the third alternative be adopted, we must regard the principle which lies at the foundation of such phenomena as purely mental. The oldest form of this theory is the doctrine of possession, which ascribes all automatism to the agency of some adventitious mind, as that of a demon or spirit, entering into the body of the patient and assuming control, to the total or partial exclusion of its rightful owner.

In modern times the doctrine has assumed the form of "duplex personality." This theory maintains that in every man there are two minds, one known to us and one usually unknown.* To the latter are ascribed all the phenomena of suggestibility and automatism, sometimes also telepathy, clairvoyance, and the like, and even the power of moving furniture, of objectifying and "materializing" its ideas, and of performing the other tricks which "mediums" ascribe to spirits.

A similar theory has been developed by Mr. F. W. H. Myers in a series of papers in the Proceedings of the Society for Psychical Research. Mr. Myers avoids the words soul, spirit, and the like in stating his theory, on account of their crude associations, but I shall in this popular sketch make use of these familiar words, even at the risk of misrepresenting him a little.

Mr. Myers agrees with the other representatives of the soul theory in acknowledging the existence of a spiritual entity of some sort, although he does not define it or attempt to fix its relation to matter. Its essence is consciousness; but—and this is the point characteristic of the theory—the consciousness of which my soul consists is not identical with what I call my consciousness. Every soul is the basis or ground of existence of many wholly distinct consciousnesses of which the consciousness I call mine is but one. It is not even the most important of them, although it also is not the least important. It has been evolved by a process of selection out of an infinity of possible elements solely on the ground of utility. Its function is the preservation of the body; those mental elements which were found most directly to

* Some writers who hold to the doctrine of dependence have embraced a similar view, and regard the two minds as produced by the right and the left hemispheres of the brain respectively, and other duplex theories have been stated from the purely psychological point of view.

subserve that end have been discriminated from the others under the stress of natural selection and organized into a conscious system. The others have either been forced out, as their places were needed by more important elements, or have never got in, because they could not compete with the others in point of utility.

Among those which have been forced out, their functions being relegated to the nervous mechanism, are the powers of voluntarily controlling the involuntary muscles, the processes of secretion, absorption, assimilation, excretion. In many persons all vivid imagery has in like manner been lost. Among those which have never been received into the normal consciousness are those which we vaguely term genius, and also telepathy, clairvoyance, and probably an infinity of other modes of cognizing reality.

For all this infinite wealth of thought and experience which Mr. Myers believes to exist outside the narrow bounds of the upper consciousness he proposes the term "subliminal states." They embrace every type of consciousness known to us, from the most filmy and incoherent of dreams to the most sublime flights of genius, and many more of which we have never framed a conception. Sometimes they flow along in distinct streams, each with its own memory and desires; at others they blend into more complex wholes.

In the curious phenomena which I have been studying, and in many more which I have not taken into consideration, Mr. Myers believes we have manifestations of one or more of these hidden streams. In all forms of automatism the subliminal material is forced into the upper consciousness much as a stream of lava is forced through the earth's crust. The material itself may be nonsense or a revelation, but the mechanism is in all cases the same. In sleep, dream, hypnosis, trance, and ecstasy we see a temporary subsidence of the upper consciousness and the upheaval of a subliminal stratum.

We need not suppose that our selves are always to consist of this conglomerate of disorganized material. We may believe that in some future life harmony will succeed discord; all the scattered portions of our psychical selves will be reunited into a new and higher synthesis—a self more rich in memories, more alive to its environment, more strong in action than any we can now imagine.

Of all the theories developed from the point of view of the doctrine of independence, Mr. Myers's is the most comprehensive in its scope, is kept in most constant touch with what the author regards as the facts, and displays the greatest philosophic insight; but its very comprehensiveness may well make us hesitate. We must make theories—they are the very eyes of the student—but we must be slow in adopting them. The inquiry into the supernormal has but just begun, the support of the great body of scholars has not by any means been won, and the fundamental facts are still in question. The first need is more observation and more experiment. The theories framed by Mr. Myers and others will serve as guides in the inquiry, and in future, as facts accumulate, what there is in them of value will become manifest.

TENDENCIES IN ATHLETICS FOR WOMEN IN COLLEGES AND UNIVERSITIES.*

By SOPHIA FOSTER RICHARDSON.

FROM correspondence with the leading colleges and universities which educate women, I find that they have very generally introduced, or are preparing to introduce as far as possible, physical training and athletic sports.

I find, too, from this correspondence that if I describe the conditions at Vassar, where I am most familiar with them, I shall describe the general tendencies in athletics for women.

From the beginning Vassar has required practice in the gymnasium and an hour of outdoor exercise daily from every student throughout her course. A riding school was provided and a bowling alley, and the lake furnished boating of a mild type. There was not sufficient interest in riding to maintain the school, and after a few years it was given up. The bowling alley atrophied and fell off as a member of the body academic. The hour of outdoor exercise has been very generally spent in walking. The result of this daily practice is that members of the upper classes can *walk*, so that when the Professor of English at one time introduced the delightful custom of annually inviting fifteen or twenty seniors to accompany him on an autumnal tramp of from ten to twenty miles through the highlands of the Hudson, the invitation was always accepted with enthusiasm and the walk greatly enjoyed.

About twenty years ago, when I was a freshman, seven or eight baseball clubs suddenly came into being, spontaneously as it seemed, but I think they owed their existence to a few quiet suggestions from a resident physician, wise beyond her generation. The public, so far as it knew of our playing, was shocked, but in our retired grounds, and protected from observation even in these grounds by sheltering trees, we continued to play in spite of a censorious public. One day a student, while running be-

* A paper presented to the Association of Collegiate Alumnæ, October 31, 1896.

tween the bases, fell, with an injured leg. We attended her to the infirmary, with the foreboding that this accident would end our play of baseball. Not so. Dr. Webster said that the public would doubtless condemn the game as too violent, but that if the student had hurt herself while dancing the public would not condemn dancing to extinction. Singular point was given to her remark a few days later, when a student did fall while dancing and broke her leg. After this we played with the feeling somewhat lightened that we were enjoying delightful but contraband pleasure. The interest in baseball did not increase; clubs were not formed by incoming classes. I think there was too much pressure against it from disapproving mothers. However, those of us who had learned the value of vigorous play succeeded in keeping alive enough interest in the game to support two clubs until our senior year. This year saw the advent of tennis at college.

Knowing as I do that I owe to the regularity of college life and to vigorous play an excellent health record since graduation, it is difficult for me to conceive the point of view of those, if there be such, who disapprove of athletics for girls.

Tennis, being more conventional than baseball, at once gained, and has steadily maintained, a hold upon the students. A tennis association was organized, many courts were prepared, and an annual tournament, in competition for the college championship, was instituted.

The primitive calisthenics of the gymnasium have long since given place to scientific physical training, and a modern gymnasium has been built.

About seven years ago, through the generosity of Mr. Rockefeller, facilities were provided for flooding the lake. The skating season was thereby extended from a precarious duration of a week or two, contingent on the snowfall, to a reasonably certain period of six or eight weeks. As soon as these conditions were established, large numbers of students learned to skate. I think probably two thirds of the college now enjoy this sport.

A few years ago athletic games were introduced in connection with the work of the gymnasium. The students were taught battle-ball and basket-ball in the gymnasium, golf links were prepared and golf clubs procured. Battle-ball was discarded, as it did not prove a good game for outdoors. Golf, I believe, was voted uninteresting, and accordingly neglected, and I learn that it has not yet found favor with any of the colleges. It is thought that as golf becomes better known throughout the country, and students learn it before coming to college, they will play more at college.

Basket-ball has been enthusiastically received with us, as with all the colleges. Each class has a team and substitutes, and interclass contests are held. An athletic association has been organized by the students, and an annual field day has been observed, when there have been contests in field and track athletics.

If there be those who assume that physical excellence is the attribute of the so-called "new woman," and therefore unwomanly, we can only reply that the idea that women should have the same physical training as men is no newer than Plato's Republic, wherein the Greek sage insists that the women should have the same physical training as the men, that the race might be continued in the highest perfection of mental and physical vigor. Little is told us of the education of girls in Greece; but this we know—that Spartan girls were subjected to a course of training differing from their brothers only in being less severe. They had their own exercise grounds, in which they learned to leap, run, cast the javelin, throw the discus, play ball, wrestle, dance, and sing. The result of this fine physical training was not only health and strength, but beauty; for it is a well-attested fact that the daughters of Sparta were handsomer and more attractive than the more delicately nurtured Athenians. In Aristophanes, Lampito, a Spartan woman, excites the jealous admiration of the Athenian women because of her beauty. When some one said to Gorgo, the wife of Leonidas, "You Spartans are the only women who rule men," she proudly replied, "Because we are the only women who bring forth men."

In behalf of the introduction of games as supplementary to the work of the gymnasium, I will quote Miss Hill, of the Wellesley Gymnasium: "Four years ago I began to give my services to the college in organized 'sports and pastimes' in connection with the department, feeling that we were giving in America too much attention to artificial exercises and too little to the development of the play instinct, which is the natural means of recreation. I believe in gymnastics for girls for their *corrective* value and as an antidote to the faulty postures we take so much, the effects of wrong clothing, etc., lack of knowledge how to breathe, run, walk, to climb and leap for practical purposes and self-preservation in accident. But I think we use them too much. We waste time and strength in not accomplishing the direct results of gymnastics, and fail to obtain the nerve stimulus that comes from natural play. If games and sports are organized and directed to a certain extent by the director of physical training, often, of course, the gymnastic and corrective value can be got out of a sport, and the fun, too."

Matthew Arnold, in his work on Higher Schools and Universities in Germany, says, in describing the exercise ground of a German school finely equipped for gymnastics, "Nothing, however, will make an ex-schoolboy of one of the great English schools regard the gymnastics of a foreign school without a slight feeling of wonder and compassion, so much more animating and interesting do the games of his remembrance seem to him."

Statistics regarding the benefits that students have derived from athletic games are frequently asked for. These are difficult to state in the form of records. Nevertheless, the advantages are very real and very evident. A graduate of the University of California writes me, "Athletics proper, as distinguished from physical culture, are enormously important for girls—more so than for boys, for it brings out a side of their nature cramped from childhood." She says that, from her own experience, she knows that "there is nothing like the hard-played game to bring out powers of the body that the routine work can not touch. Still more, the mental and moral effect is wonderful. There is a zest, a freedom, a whole-souled sincerity of effort, a flinging aside of every consideration of how she is looking, or whether she is doing the proper thing, that goes right to the root of some of the most inveterate evils of feminine adolescence. The effect on our basket-ball girls has been perceptible in a single year; all their attitudes toward life have taken on a healthier and heartier tone." She adds that this is heartily the belief of the director of the gymnasium of the University of California.

The tendency of athletic games to dispel morbid conditions is, I think, too well known to require comment. One can not watch a game of basket-ball without observing the will-power, nerve-control, and general self-government which the rules of the game to prevent all rough play, and the necessity of quick decision and instant decided action, cultivate.

The match games give outdoor entertainment to the whole body of students, thoroughly diverting, and of the most healthful kind, free from all the unwholesome influences which more or less attend dramatics.

As a less direct result of the growing interest in athletics we may notice the increased stature of women, and a corrected æsthetic judgment which now pronounces the normal form the most beautiful.

A dinner was recently given at Vassar by one of the students, at which the guest qualification was the habitual wearing of broad-soled shoes. The hostess is a disciple of Matthew Arnold, who can not enjoy "sweetness and light" without a disposition to "make them prevail."

Many students ride the bicycle in all the colleges. So many papers have appeared in current literature setting forth the advantages of bicycling that little remains to be said on the subject. A note appeared in a September journal to the effect that at the annual sanitary conference at Newcastle, England, Dr. Turner declared that cycling in England had raised the average health of women—and this of English women. It preaches more effectively the gospel of recreation, fun and fresh air, and of hygienic dressing, than could countless lectures of eminent physicians.

There is a problem which men have failed to solve and which confronts us—the problem of making general the habit and love of outdoor athletic sports. In spite of the interest awakened throughout the country in baseball, football, rowing, and track athletics, in spite of American successes in the international contests in Greece, it is yet true that American men are not, as a class, habitually athletic or physically vigorous.

So with our students: notwithstanding the interest that has been awakened in athletics among them, there are yet many whose outdoor exercise still consists in an hour's walk, which, allowing the mind to dwell on the last subject read, does but meager service as a form of physical recreation.

In this connection the question has arisen whether we shall endeavor to stimulate general interest in athletic games by intercollegiate contests. The Western colleges seem inclined to answer this question in the affirmative. Chicago has played with Northwestern; there has recently been a very interesting game between the University of California and Leland Stanford University, and other Western colleges are anticipating future competitions with neighboring institutions. On the other hand, the Eastern colleges unite in disapproving of intercollegiate contests. Among other reasons it is thought that the strain on the players would be too great; that the tendency would be to narrow rather than to increase the number of players by raising the standard of excellence of the play and discouraging the less expert players; also that the interclass contests afford all the advantages of intercollegiate games without the objectionable features of the latter.

In considering athletics for women we must reckon with the American's national characteristic of *immoderation* when fired by interest in any new thing. It will be necessary to restrain the enthusiastic few from excess while endeavoring to stimulate the indifferent many to active interest. The end to be desired is, of course, symmetrical development, not the training of athletes.

For the best solution of the problem to which I have referred I think we must look for help to the secondary schools, in the hope that physical training and instruction in hygiene may begin with them.

The freshman comes to college utterly ignorant of the fundamental laws of hygiene. It is exceptional when the physical examination does not reveal marked defects of the nature of weak backs, poor chests, round shoulders, and anæmia. She is unskilled and unpracticed in any athletic exercise, even in that of walking. After she has been in college a few weeks she will tell you, with great pride, that she has walked to town, a distance of two miles! Every claim upon her time at college, social as well as intellectual, outranks in importance the claims of exercise, and this duty yields to pressure from any other. If she were trained to rank study and play of the right kind as of equal importance to her mental development, the conscientiousness with which she devotes herself to study would secure her faithful attention to recreation.

It is encouraging to see that already some schools are setting the example of reform in this direction. One school at Indianapolis has introduced scientific physical training under a skilled director, and has placed this training on exactly the same footing as the intellectual exercises of the school. Besides gymnastics, daily outdoor exercise of two hours duration is required of each student.

In another school, in Connecticut, in the care of an English principal, there is no two-by-two daily promenade. Groups of not less than three girls are allowed, within certain bounds, to take a walk of from four to eight miles. In the hour and a half which they are required to spend in vigorous exercise out of doors, they play tennis, cricket, and basket-ball, occasionally having matches with other schools. In the winter physical training in the gymnasium is prescribed in connection with the winter sports of coasting and skating. A "high-stand" prize is offered, for which no girl is qualified to compete without a good athletic record for the year.

Of special importance to the student is the relation of athletics to the hygiene of the brain. Physicians say that if a muscle is once overtaxed or a nerve overstrained, they never regain their original tone and power; and yet I think that in America little care is taken to prevent such injury to the brain. We summarily dispose of its welfare with the classical platitude, "*Mens sana in sano corpore.*"

What is indicated by the fact that the college "valedictorian" of the past so many times sank into obscurity after his commencement oration, while his classmate, not overzealous in study and reasonably interested in athletics, subsequently rose to distinction at the bar or in the pulpit?—by the fact that the graduate student frequently fails to fulfill undergraduate promise and to go from strength to strength in mental achievement?—by the fact that the country youth with meager opportunities, fresh from simple rural life, so frequently outstrips classmates who have known all the advantages which our best schools can afford? What is indicated by these conditions but that the students of our schools and colleges work in ignorance of the needs of the brain for its steadily strengthening development?

I was much interested to see in the October issue of the Popular Science Monthly a paper by Prof. Kraepelin, of Heidelberg, bearing on this point. His paper reports the result of experiments in "measuring the mental capacity of individuals." The measure is afforded by determining the number of small similar problems resolved by the subject in a given time—such, for example, as the continuous addition of a column of numbers. "Other means of measuring the capacity of a subject are afforded by the ease with which he is diverted from his task, or his susceptibility to disturbing influences from without and within; his elasticity, or the readiness with which he recovers from the effects of fatigue or diversion; and the way he is affected by taking food, physical exercise, and the time he has for sleep."

The experiment in addition, as made upon young men, showed that their *facility in addition fell off at the beginning of the second hour.* Experiments made by Prof. Burgerstein, of Vienna, showed that a *quarter of an hour of simple work is enough to develop the first signs of fatigue in a twelve-year-old pupil.*

Prof. Kraepelin claims that when fatigue "has once gained the upper hand, a speedy and unintermitted decline of efficiency ensues. The time when this shall take place depends on the degree of capacity already reached, the personal peculiarity, and casual influences."

It appears from these experiments that the mental vigor of most men is usually maintained at a certain height for the longest time in the forenoon. The rapidity with which one of the persons experimented upon could perform his tasks in addition sank about a third after a night journey by railway with insufficient sleep. Another experimenter could detect the effects of keeping himself awake all night in a gradual decrease in vigor lasting through four days.

The paper concludes as follows:

"When, now, we look back at the conditions we have discovered that control mental vigor, we conclude that our children are exposed by the extent and arrangement of study work in the schools to great perils for their mental and physical development. The questions that press upon us in this matter are of such importance that we all have reason to give them our full, undivided attention. We are only at the beginning of a real hygiene of mental labor, but the results we have obtained in this research, fully indicating the nature and operation of the dangers, point with equal clearness to the character of the preventive and remedial measures which should be sought and applied."

The president of one of our great universities has been quoted as advising the following division of a student's day: Eight hours for sleep, ten for work, two for exercise, three for meals, and one for incidentals. Whether this is an authentic quotation or not, it describes with fair accuracy the practice of the average college girl, excepting that she rarely takes more than one hour of exercise. Her conscience is most approving when she spends all the time there is, apart from other definite engagements, with her books. Now, in the light of Prof. Kraepelin's experiments, if not in that of our own observation, what happens as the result of this protracted poring over books? Either injury is done to the brain through overexertion, or the brain protects itself by inattention and the student wastes precious time and depletes to no purpose her all too small store of vitality.

Prof. Kraepelin lays great stress on the importance of sleep as a compensation for all effects of mental fatigue, and all will agree with him in this. But he claims that "it is fundamentally false to regard physical effort as in any way a suitable preparation for mental labor. Protracted experiments pursued under my direction have given the result that a simple walk of from one to two hours diminishes the mental capacity in adults at least as much as about an hour's work in addition." How can we reconcile this with our own experience or with the testimony of students? Only a few days ago a student told me with enthusiasm of the ease and rapidity with which her evening tasks were accomplished after an afternoon during which she had walked two miles to town, had there taken a bicycle lesson of an hour, and then walked back to college, this being more than double her usual amount of exercise. Can there be any question as to which is the better preparation for a day of mental labor—nine hours of sleep and three hours of vigorous exercise in the open air, or twelve hours of sleep and no exercise? Of course, time should be allowed after vigorous physical exercise for the relaxation and rest of the muscles before using the brain, but the time required for this is not long.

It seems to me that the practice and experience of the English offer convincing testimony against Prof. Kraepelin's opinion on this point. An American student can not compete with the English student in respect to the amount of work done in a given time; nor, I am told, can the German student. The habits of Germans and Americans conform, and differ from the English in respect to long hours of work and short hours of exercise.

The English students have apparently learned that the brain does its best work when allowed long periods of leisure. They make strenuous efforts to reduce their hours of study to a minimum. They work on an average six hours a day. Students have taken honors at Cambridge with a smaller average of study hours. I was told that Darwin achieved the work of his life by devoting three hours a day to his science. The dons at Newnham constantly urge the students to reduce their hours of work, claiming that the best results have been attained at the university by those who spent the least time in study.

The English students' power of concentration is remarkable. They respect perfectly the study hours of their friends, and will tolerate no interruption of their own. The English excel when tried by two of Prof. Kraepelin's tests of mental capacity: amount of work done in a given time and power of concentration.

Wherein lies their advantage? They will tell us that their strong and necessary ally is vigorous outdoor sport.

The English girl has, of course, known from childhood the habit of outdoor life. At college she plays hockey or hand polo, cricket, fives, and the games with which we are more familiar, for *at least* two hours a day, and oftener for a longer time. Two hours is a minimum of time spent in exercise. At frequent intervals, usually at the end of each week, she seeks recreation from past and preparation for future effort by spending many hours in the open air, in boating on the river it may be, or in taking a tramp of thirty miles or so. During vacations she not infrequently makes walking tours of longer or shorter duration.

If an English girl finds that her mind is inactive and unreceptive, she recognizes this as an indication that it needs recreation. She drops her books and puts her brain in fit condition for study by some vigorous play. Under like conditions, the American student, not recognizing Nature's signal, mentally scourges herself for dullness, and urges her jaded mind on to overexertion. I once heard an English girl assert that she could *dawdle* all day, but could not *study* for more than two hours at a time.

A senior at Vassar, who had been honored by her classmates with several appointments entailing strenuous editorial and executive duties, once said to me that she was grateful to the extra work for showing her in how short a time her regular work could be done. Having learned this lesson, she observed with surprise the time spent by her classmates over their tasks.

Every American who studies at Cambridge adopts the methods of work of her English friends, and ever afterward looks with compassion on the mistakes of her countrywomen.

The power of concentration of mind can not be exercised at will by those unaccustomed to practice it, but it can certainly be cultivated through training, and the earlier the training is begun the better. One school is known to me which has worked effectively in this direction by restricting the time spent in preparation of tasks, and by requiring a sufficient amount of outdoor play to keep the brain fresh and active.

In conclusion, we claim that the average American college girl, in comparison with her English cousin, expends by her methods of study a maximum of effort with a minimum of result; that, by way of reform, she should limit the hours of daily mental labor, as the workmen's hours of daily manual labor are limited, in order that during some periods of each day she may know perfect relaxation and freedom from pressing duties; that athletic games, instead of being for her a foe to scholarship, as the faculties of men's colleges seem inclined to regard them, may, by the exercise of good judgment in their use, be made an effective agent to build up the physique, and thus to keep the brain in condition for vigorous effort.

THE SCIENTIFIC WORK OF W. D. GUNNING.

By W. H. LARRABEE.

WHILE the applause and lasting fame which those win who make great scientific discoveries, or embody their observations in monumental books, are worthily bestowed, those also serve mankind and deserve to be well remembered who labor to make knowledge accessible to the whole people, and to lift the average of intelligence by writing books in plain language, by giving instruction, and by investing their teaching with the charms of their personal magnetism and warm eloquence. Of this latter class William D. Gunning was a conspicuous example. Few in the United States have labored more earnestly, with stricter singleness of purpose, or more successfully than he to interest the general public and make them acquainted with the latest results of true science.

Mr. Gunning was born in Bloomingburg, Fayette County, Ohio, July 28, 1828, and died in Greeley, Col., March 8, 1888. His family was of Scotch-Irish origin, but his direct ancestry is traced no further back than to Armagh, Ireland, whence his grandfather, William Gunning, emigrated in 1793 to Oswego County, N. Y., his father, Andrew Gunning, being then a child. The family removed to Bloomingburg in 1815. All that is told of the boy's early education is that he was taught at the log schoolhouse of his district by a young woman of the neighborhood. He showed an inquiring disposition and a tendency to bookish ways; and busied himself, it is said, with the stones and shells from the brookside near the house, and would ask to be told stories of them. When about fourteen years old he was apprenticed to Robert McLaughlin, his sister's husband, and was taught a trade. He always had a book on the bench by his side.

He developed a taste for discussion very early. He used to relate that it was a great treat to him, when a boy, to listen on Monday mornings to the remarks of the people of the neighborhood concerning the sermons of the Presbyterian minister of Bloomingburg. This minister was the Rev. William Dickey, who christened him, and after whom his second name was given

William Dickey Gunning.

him. He had a great respect for him personally and as a preacher. But it is recorded of young Gunning that he refused to join the church, because he wished "to do his own thinking." He had a strong bent for theological studies, and would have dearly loved the office of pulpit teacher, but would not endure the restraints put upon thought by the theological schools, and would never give up the privilege of honestly expressing his opinion. He declined several invitations to deliver addresses at Oberlin College, because his views were opposed to the beliefs held in that institution. But he finally consented to deliver the alumni address in 1879. He was never controversial, but simply and earnestly sought the truth. He entered Oberlin College about 1850, and was graduated from the literary department in 1854. Very soon after entering college he became a student of mark, and one of the few who, Mr. W. G. M. Stone, of Denver, a fellow-student in his last year, says, were "head and shoulders above their fellows, and himself second to none." The College Record of Deceased Alumni says of him that "when in college he was an enthusiastic cultivator of oratory and of a fine literary style. He had a marvelous command of words, a most fertile imagination, and was a skillful artist with crayon and chalk, so that his lectures were often enchanting as a dream. In his scientific facts he was accurate, but these were always subordinated to his philosophizing. He was an ardent devotee of the evolution theory. In religion he was of the liberal school."

After graduation he went to Natchez, Miss., where he had two brothers in business; taught in an academy; and studied law a year. His social relations there were all pleasant; but the independent Oberlin man, who in his boyhood had systematically aided fugitive slaves in escaping, could not make himself at home in the very center of the slaveholding region. Returning to Ohio, he exerted himself in behalf of the election of Mr. Chase, the Free-Soil candidate for Governor; and afterward engaged in geological work in Illinois, of which he kept no personal record. He took a course of comparative anatomy in New York, some time previous to 1862, but in what school or college is unknown, though he often bore testimony to the value of the instruction he received there.

Prof. Gunning's continuous career as a scientific author and lecturer began in 1862, and his earliest known publication was a paper on the Age of the Human Race, based on the discovery of relics of man in the caves of France, which was published in the Nevada (California) Journal. In the same year he was married and removed to Massachusetts; and about this time he began lecturing in and around Boston. He spent the summers, between the lecture seasons of several years, in physical and biological studies at Falmouth, Gay Head, Nantucket, Portland Harbor, and Eastport, a part of the time under the direction of Agassiz. Geology was the principal subject of his lectures, but as they went on they expanded till they covered a variety of subjects relating to life, evolution, American antiquities, and social theories. His prime object in all his lectures was to elevate and enlarge the mental vision. He sought to present the truth as his studies had shown it to him in a manner to awaken the interest of his audience and make them informed upon the subject. He sunk himself in his theme, kept the question of money profit farthest from his thoughts, and was never known to relinquish a course because it did not pay. It would be impracticable to enumerate here the several subjects of these lectures or speak of the places in the East and West where they were delivered. The whole country knew him through them. They were given first chiefly in the Eastern States, then Chicago and the Northwest became the principal field, and in the later years of the author's life the Pacific and Southern States. They were delivered in public halls, before lyceums, in colleges, in the field, in churches, before Young Men's Christian Associations, and were nearly everywhere listened to with absorbed attention, and well received even by those whose views were very different from his, and were commended by the public, by scholars, and by men of science. Sometimes they met with opposition and hostile criticism, as at Brooklyn, N. Y., and at Keene, N. H., where the Young Men's Christian Association took pains to resolve that it would not be held responsible for his views. Darwinism had not yet ceased to be a novelty and a shock to theologians, and there were not wanting men who were ready to use any pretext for attacking him on this ground. He was never at a loss for a sufficient answer to these attacks, and simply relied on facts for the vindication of his position. The accounts given by the hearers of his lectures all speak of wonderful power in them—descriptive and persuasive.

He soon came into demand as a contributor to periodicals, and through the columns of such journals as The Congregationalist, Christian Union, Theodore Tilton's Golden Age, Lippincott's Magazine, etc., his articles reached tens of thousands of readers. While addressing common intelligence he would never trifle with his subject or "make a toy of science," and declined offers for papers on the "science-made-easy" plan. His purpose and the thought that animated him were well expressed in the preface to his Life History of our Planet—published in Chicago in 1876, with illustrations by Mrs. Mary Gunning, in the observation that teaching the facts of a science is not teaching the science; that "facts do not enlarge the mind unless they are fertilized by principles," and that he sought to conduct his reader "through method to results."

Visiting Europe in 1866, after the death of the first Mrs. Gunning, he made a pedestrian tour through Yorkshire; was a guest on geological excursions of Sir Thomas Crosley in Halifax; was entertained by Prof. Robert Harley; lectured at Huddersfield and Brighouse, in England; then passing to the Continent, studied the Alps and their glaciers.

Being invited by Prof. E. L. Youmans to contribute to the first volume of the Popular Science Monthly, he wrote for it, after a special study on the spot, the article on The Past and Future of Niagara. This was followed by two other papers—Have Plants a Pedigree? and Progression and Retrogression.

As side incidents of Prof. Gunning's career, we may mention an experiment at orange cultivation in Florida, which, proving unprofitable, lasted but a short time; and services he rendered as a mining expert in the Western Territories.

As his religious views developed they became more and more radical. The independence of thought which he showed in youth when the subject of joining the church was mentioned was never relaxed; neither did the fervor of his religious feeling diminish. He appears through his whole career as a devout believer in the Creator and the spiritual life. He was much interested in the phenomena of spiritualism and impressed by them, wrote much upon the subject, and corresponded sympathetically with spiritualists. He was a member of the Free Religious Association and a valued contributor to The Index when Mr. Abbott and Mr. Underwood were its editors, and afterward to The Open Court, and a paper written by him in 1889 is believed to embody the earliest scientific treatment of the phenomena of that category. In 1887 he delivered a course of Sunday lectures to the Unitarian Society of Keokuk, Iowa. The military body of the city made him their chaplain. An Ethical Society was organized there, of which he served as pastor till January, 1888, when he removed to Greeley, Colorado, hoping to find relief there from frequently recurring attacks of bronchitis. He made an engagement with a Unitarian Society in Greeley, but two addresses—A Study of the Book of Job, and The Whirling Flag, Dante's Inferno—were all he was able to make in fulfillment of it. His health had long been delicate. A friend had warned him, in connection with his lectures in Cincinnati, in the winter of 1886, that he was "mad" to continue his labors in the existing condition of his health and in such weather. Yet he stopped, on his way from Keokuk to Greeley—only two months before he succumbed to his disease—to deliver a course of lectures in Quincy, Ill., which proved as acceptable as any of the long series. Of Prof. Gunning's amiable personal qualities all his friends speak in terms of warm enthusiasm. He was conscious, self-reliant, and tranquil to the last.

THE ANIMATE WORLD A UNITY.

By M. ALBERT GAUDRY.

THE aspect of paleontology has greatly changed since the time of Cuvier, when species were supposed to be fixed, and the curious monsters whose remains were unearthed from time to time were believed to be unchangeable, isolated entities. Now it is shown that fossil species are not thus independent, but are simply phases of development of types which are carrying on their evolution through the immensity of the ages. A plan has ruled in the vast and magnificent history of this evolution, and I purpose to tell what I believe I have discovered of it. I can not conceal that in the present state of science such an essay will be very imperfect. When I was traveling in the East I found the horizons in the morning veiled by the bluish mist which the poets are so fond of, and tried to discover the silhouettes of the beautiful marble mountains through them. So, in the morning of our paleontological science, we look upon the distances of life vaguely sketched, and try to distinguish a few lines of the plan that rules it. We discern but little, but that little is enough to charm us, as a glimpse of sunshine charms in a dark landscape.

It seems to me, further, that besides its philosophical interest, the inquiry into the plan of creation is of importance in practical geology. Up to this time the determination of the age of the earth has been empirical. It will become rational as soon as we are in possession of the plan of creation. Geologists will recognize that one of the best means of fixing the age of a formation is to know the stage of development of the fossils it contains.

The world of life is a grand unity, of which we can follow the development as we do that of an individual. When we follow the course of the immensity of geological times, we meet successive changes, and our mind goes on from surprise to surprise. Each epoch has its own physiognomy, and each phase of each epoch offers some variation; the days of the world follow one another and are not alike. Yet manifest as are the differences, they are not radical. Paleontology has not discovered any new branching or any new class or subclass.

From the primary ages, animated nature has had general traits of resemblance with existing nature. Sponges and polyps were already forming colonies, echinoderms were divided into five parts, insects were provided with three pairs of legs, arachnids had four, and myriapods had a multitude. M. Bernard Renault found in a coal bed an ostracode, the body of which is entirely preserved. A study of it made by M. Charles Brongniart showed the same details of organization as in our days. Numerous brachiopods belonged to genera which exist in our seas—such as *Lingula, Rhynchonella,* and *Terebratula.* Besides fishes of special types, we find some with tendencies toward those of to-day. Prof. Vaillant, examining a Permian genus which I had described under the name of *Megopleuron,* thought it was so nearly like some living ceratodes of Australia that he proposed to describe it under the same generic name. The Primary reptiles, although very different from those of our epoch, have many characters of resemblance to them. For example, having occasion to study in detail the reptiles of the Permian, I was very much struck by seeing that their heads had the same bones, both above and below, as in the existing animals. MM. Marcellin, Boule, and Glangeaud, comparing the paws of a reptile of the same formation with those of a common *varanus,* remarked their extreme similitude.

When we come to the Secondary formations, we find many invertebrate animals related to living genera. Most of the vertebrate animals are easily distinguished from present genera, though usually not because they present any unknown special features, but because they combine characteristics that are now distributed among distinct classes. M. Seeley has recently described Triassic quadrupeds from Africa which diminish the distance between the reptiles and the mammals; the icthyosaurus, which is cited as one of the most extraordinary fossils, recalls the fish in its vertebræ, the massive mammals in its fore flippers, and the reptiles in its other characteristics. Although the pterodactyl certainly belongs to the class of reptiles, its manner of flying is like that of flying mammals. The iguanodon is a reptile with its hinder limbs forerunners of those of birds. On the other hand, the archæopteryx is a bird with reptilian recollections. The Secondary fossils, which have surprised paleontologists so much by their singular features, in reality establish connections among animated beings instead of disclosing gaps.

In the Tertiary epoch the existing genera—rhinoceros, tapir, boar, gazelle, elephant, hyena, cat, bear, etc.—appear each in its turn. We find species, as well as genera, so near living forms that it is difficult not to suppose their near relationship.

Finally, the species of Quaternary times are for the most part identical with those of to-day, or so little different that they may be considered simply as races. It is impossible to mark a boundary between beings that existed before us and those that live with us.

It must therefore be recognized that the fossil world is not distinct from the existing world; there is only a single world, which has continued from the most ancient ages till our days. It can be studied as if it were an individual; in the same way as we follow the development of an individual through its different ages, we follow the development of the animate world through the phases of its existence that we call the geological ages.

When an old man feels the weight of years, he realizes indeed that his youth has departed from him; but at what moment did he pass from infancy to youth, and then to maturity and old age? He does not know; the phases of his life have unfolded themselves gradually. Things have gone in the same way for all beings. The world has not to-day the physiognomy it once had, but no one can say in what instant it passed from its Primary condition to its Secondary, and from that to its Tertiary, and then to its Quaternary and present. The change of beings has been slow and gradual.

The development of man—that is, of the individual himself—in which the marvels of the animate world are summarized, presents the following phases: 1. Multiplication of constituent parts—that is, numerous points of ossification appear which will become separate bones. 2. Differentiation of parts. As the parts multiply, they differentiate themselves; thus points of ossification similar in the beginning take on differences as they proceed; one becomes the humerus, another the radius, another the orbital bone, etc. 3. Growth of parts. At the same time that they multiply and differentiate themselves they are growing. 4. Progress of activity. Besides material progress, there is progress of a higher order—from the passive existence within his mother's womb till the individual reaches active life and manifests an energy of his own. 5. Progress of sensibility. Sensibility increases at the same time with activity, and sometimes determines it. 6. Progress of intelligence. Finally, intelligence appears. Last come, it also goes away last with sensibility, and will console the old man in the enfeeblement of his other faculties.

The history of the animate world, considered in the aggregate of geological times, is very similar to the history of a man in his brief life. We may study in succession the multiplication of beings on the surface of the globe; their differentiation; their growth; the progress of activity; the progress of sensibility; and the progress of intelligence.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

THE report of the British Association's committee on seismological observations recommends that, since it has been proved that any important earthquake is felt all over the globe, arrangements should be made for the record and study of these movements. Such records might prove as important as those of, for instance, terrestrial magnetism; and just as we have magnetic observatories in all parts of the world, so should there be seismological observatories.

CONDEMNATION OF CRIMINALS NOT PUNISHMENT.*

By EDWARD F. BRUSH, M. D.

WHEN studying a subject closely, we often discover that a simple word influences for right or wrong the whole matter, just as change of a note makes a different tune, or alters entirely the tone of the song. As Roget says: "A misapplied or misapprehended term is sufficient to give rise to fierce and interminable disputes; a misnomer has turned the tide of popular opinion; a verbal sophism has decided a party question; an artful watchword thrown among combustible material has kindled a flame of deadly warfare and changed the destiny of an empire." The word "punishment," as commonly used and understood judicially, should be eliminated from the tribunals that have to deal with that part of society that is known as the criminal class. Some one has said that jurists recognize only two terms in criminal law, "offense" and "punishment." The simplest and earliest definition of punishment is "to afflict with pain," and whenever the word is used it carries with it the idea or notion of consequent suffering. "There is undoubtedly a moral element in words; words are not neutral in the great conflict between good and evil, nor are there wanting, I suppose, in any language words that are the mournful record of the strange wickednesses which the genius of man, so fertile in evil, has invented." To the student of history does not the word punishment bring before the mind the cruel atrocities and horrible inflictions of the middle ages, with their gibbets, chains, racks, hot pincers, thumbscrews, and other hellish devices? It is a strange perversity of the human mind that many, very many words have deteriorated in their meaning; the word retaliation nowadays is never used to express a return of benefits, but always the paying of wrongs by wrongs; animosity, which was originally a very harmless word, is now used only to denote enmity and hate. I can recall no word that has taken the opposite course in our language, and the word punishment has now come by downward evolution from its original use to denote a spirit of vengeance, with its hatred, malice, and retribution, in the degraded sense of that word. Trench truthfully says: "There are often in words, contemplated singly, stores of passion as well as of historic truth; they are living powers, and quite as often and effectually embody facts of history or conviction of the moral common sense as of the imagination or passion of man; even as, so far as that moral sense may

* Presidential address delivered before the Society of Medical Jurisprudence at its annual meeting, held January 13, 1896.

be perverted, they will bear witness and keep a record of that perversion." The Pilgrims fled from England to escape the punishment of persecution, and soon they were themselves persecuting with dire punishment those whom they called witches, and also those who disagreed with them. Is it any wonder, therefore, that the Constitution of the United States should be marred by conferring the right to punish? When the truth of the axiom laid down by M. Ferri, in 1889, that "all men are responsible before society, but society has no right to punish, it has only the right to protect itself," is recognized as it surely will be, the instrument on which our liberties are built will not confer this pain-inflicting power, and the distinction between judgment and punishment will be clearly understood. That wise, wrinkled, and homely face of our martyred President masked a soul whose appreciation of the unchristian and debasing effect of public anger and vengeance was expressed when he uttered the immortal words, "Malice toward none, charity for all." To realize how the old ideas of punishment with its remorseless vindictiveness still possess the people, we have only to consider poor, trembling, unfortunate, irresponsible Guiteau, shambling his weary way from the court to the jail, when a human fiend, saturated with the barbarous notions of penalty and the spirit of vengeance inherited from past ages, fired at the helpless, unconvicted prisoner, and the awful echo of public exultation which followed his outrageous attempt. But this whole painful episode simply indicated a bitter spirit that will continue to dominate the people as long as the notion prevails that our courts of justice are to mete out retribution. Abolish the notion that society has the right to inflict pain, then the voice of the people calling for execution will be hushed. Eliminate from our courts the spirit of vengeance, and from the dire and sad necessity of taking human life remove the idea of punishment, implore God's pity alike on the executor and the executed, and human society will be kinder, better, and safer. When the idea of punishment is abolished, then the emotional attitude toward the criminal will disappear. None of the other dreadful, morbid conditions exhibited in the human being appear to elicit the kind of feeling we see very often demonstrated toward the very lowest murderer. When our courts of justice recognize that their functions are not to avenge, but to cure society of its diseased members, and that the treatment must be scientific, effectual, and humane, then the sentiments exhibited toward the criminal will be the same that we display toward the person afflicted with smallpox, typhoid fever, and the like. As organized society we have the right to protect ourselves both against the unfortunate criminal and the unfortunate person afflicted with a contagious disease, but this right should not be deemed the right to punish; no matter how grievous the methods we may adopt to prevent crime or other evils, we ought not to regard them in that light. It is very difficult to eliminate from the injured individual a feeling of anger and a desire for revenge, but our organized courts of justice should not by any word even appear to entertain or to strengthen such motives.

In the amputation of any portion of the body on account of gangrene or other morbid condition, there is no idea of punishment. The surgeons who are assembled in consultation to decide upon the treatment of the diseased member do not consider whether the morbid state is the result of transgression, but the simple question for them to decide is, "Will the other parts of the body be better if the diseased portion is removed?" All men of a scientific turn of mind who have made a study of criminal anthropology are fast approaching the physician's position regarding such questions. Every criminal is more or less a diseased portion of the body politic: some can be saved, some must be removed, and some must be destroyed, but the notion of punishment should not complicate the judgment in deciding what disposition is to be made in either case. The insane were formerly regarded with feelings of hatred and vindictiveness, but to-day this is only a shameful recollection. With the advance in the study of criminology and the more merciful era of humanitarianism that must follow, the like sentiments toward the criminal will be eliminated from our courts of justice. Prof. Austin Flint, the distinguished President of the New York State Medical Association, in his annual address to the association said, "Scientific progress will lead us finally to abandon the ancient idea of punishment of crime and substitute for it treatment and correction." Quetelet writes, "Every society has the criminals that it deserves."

There are very few persons who are not possessed by an intense desire to kill when they are suddenly confronted by a snake. Most of us have a hereditary prejudice against snakes, and can hardly talk about them without a shudder. Somewhat the same spirit possesses us when we hear of a murder: we are at once seized with a vengeful desire to hear of the murderer's capture and execution; but, as when, like reasonable human beings, we study the snake family, we find that there are differences among them, and some have qualities in consideration of which they might be spared, so with murderers—they are not all the same. The Hannigan trial is fresh in our memories; the motive that caused this man to commit a crime was the result of the very conditions which constitute our normal society; it was the deep sense of injured chastity, violated vows, a ruined life, broken home ties; this was made plain; the public demanded his release. Under the intense feeling engendered in society as to whether this man was to be punished or not punished, the fact was lost to sight that he had disobeyed our social rules in not waiting for the courts to deal with the criminal whose life he took.

There are, roughly speaking, three elements in human society. The largest is always the standard, and is modified in character according to the conditions of the times. Of the two other elements that do not harmonize with this, the first is what is known as the criminal class. This is sometimes made up of a comparatively large number of individuals, and is in reality composed of members of the human race who are lagging behind in the advanced march of civilization. The other conflicting element is comparatively meager in numbers, and is characterized by its members being always in advance of the main body. They are variously called reformers, cranks, or heretics. Many of these two less numerous groups are often brought up to answer for their acts, and the ultimate aim of all judicial processes concerning them should be to make them members of the larger body. Where this is unattainable, the incorrigible should be either destroyed or removed permanently from the society with which they are in conflict. The whole history of criminology up to date indicates positively that punishment does not reclaim, and we must banish from criminal law all idea of vengeance as involved in the term. When we look at it as an isolated fact, the position of a judge trying to impose the exact punishment to fit the crime and weighing what he is pleased to call mitigating circumstances, in order to lessen the measure of wrath prescribed for some unfortunates who often as much need treatment as some of our insane, we must at once be conscious that there is something wrong in our judicial system. This idea has been deemed sufficiently ludicrous to form one of the telling points in a comic opera.

One of the principal elements impelling the criminal to crime is his desire to punish his enemy, for it can not be denied that a large number of murders are committed from this motive. Should the law that we term majestic proceed with the same motive toward the criminal? It will always appear to be so while we continue to speak of it in the language now used. If the spirit of anger and revenge could be entirely eliminated from the death penalty, and every idea of punishment meted out to an individual was removed from the judgment, only the absolute safety of society being made the reason for taking the human life judicially, executions would become exceedingly rare. It must be plain that the question for us to decide to-day is, Are we, who belong to the predominating class of society, bettered by our acts toward those who are not in harmony with the methods and motives that have made society what it is, and keep it in the position it now occupies; or are we debasing ourselves by our method of dealing out punishment, as such, and thus keeping alive the spirit of vengeance?

What a ghastly, ludicrous state of affairs it must be, to see the murderer condemned to die, and awaiting in his cell the arrival of the fatal day, assured by his spiritual advisers that he has been pardoned by his Maker, and that the gentle Saviour is waiting to receive him in eternity, and still not have a ray of hope that the measure of the penalty, judicially pronounced, will be diminished! It would seem reasonable that a man who has been pardoned by his Creator should be pardoned by his fellows, and he surely should be if punishment was the only design. If, however, competent men have decided that his life is a menace to human society, then the questions of punishment and forgiveness are not to be considered. Even the great physician, Galen, seventeen hundred years ago wrote, "The evildoer is one whom we must destroy, not punish," repeating very nearly the words of Aristotle that when a criminal is a criminal by nature he ought to be destroyed, not in revenge, but for the same reason that scorpions and vipers are destroyed. Seneca advocated the same axiom. Let us, therefore, eliminate from our laws, which are or ought to be of benefit to humanity, all idea or notion of punishment; for, while our codes continue to present it, the whole aim and object of our common law, as it relates to the criminal, can not but point to the single fact of an effort to inflict pain on a human being. We try a man in order to ascertain if he must be punished, and the other higher, broader, and more noble function of the court, namely, to protect the majority of law-abiding citizens, is lost sight of by the larger proportion of the human race. The simple term justice or condemnation will convey the idea that the good of society is the consideration of the court, while the term punishment conveys the idea that the individual alone is the factor, and we can not blame the criminal, as long as it remains on our statute-books. for imagining that the whole force of our courts is to cause him bodily pain.

WHILE studying the songs of birds, Mr. Charles A. Witchell soon found that young birds acquire first the call cries and alarm notes of their respective species; that in each species these notes are much less liable to vary than are the songs; and that in different species physically allied they are more alike than are the songs of those species. Another interesting feature was the prominent occurrence of a particular cry in the species; its repetition in a less marked form in one or two allied birds, in which another cry might be the most pronounced; and the utterance of this second cry by some other allied birds, which had not the first-mentioned note. These facts are commended by the author to naturalists as bearing on the question of a common ancestry of species.

PLURAL STATES OF BEING.*

By ALFRED BINET.

THE variations of personality found in diseased subjects take on a great number of forms, of which the phenomenon resembling the presence of two or more personalities in the same individual—or "multiple personality"—is the subject of our present special study. It is common in hysteria, and the hysterical cases are those which have been most adequately investigated. These cases are often described as cases of somnambulism. In popular usage somnambulism is the state of those who rise in the night and perform automatic and even intelligent acts without waking. They dress themselves, perhaps, resume their day's work, solve a problem to which they had vainly sought the solution before, then return to bed and to sleep again; the next morning they have no memory of having been up in the night. Indeed, they are often much surprised to see a piece of work now finished which had been unfinished the evening before. Or they walk on the roof or perform some other equally startling feat. Authors are not as yet entirely agreed upon the nature of this sleep-walking, but the general tendency of the day is to admit that it covers a mass of irregular phenomena which resemble one another in appearance only, being really quite distinct in nature. In these phenomena we may see an example of double personality. These noctambulists are two persons. The person who rises in the night is entirely distinct from the one who is awake during the day, since the latter has no knowledge or memory of anything that has happened during the night. But it is not possible to make an adequate analysis of this state; the elements are too obscure.

Another form of natural somnambulism is "daytime" somnambulism, or vigilambulism, and concerns hysterical patients who possess, besides their normal and regular life, another psychological existence or second state, so to speak, of which they retain no memory in their normal condition. The peculiar characteristic of this second state is that it constitutes a complete psychological existence; the subject lives the everyday life, his mind is alive to all ideas and perceptions, and he is not delirious. Uninformed persons would never know that the subject is in a state of somnambulism.

The best examples that can be cited of the somnambulism that

* From Alterations of Personality. By Alfred Binet. Translated by Helen Green Baldwin, with Notes and a Preface by J. Mark Baldwin. (International Scientific Series.) In press of D. Appleton & Co.

we have just defined are found in observations, now old, made by Azam, Dufay, and other physicians. These observations are to-day well known and trite. They have been published and analyzed in a number of medical journals, and even in some literary ones.

The state of somnambulism is artificially induced in hypnotism, which may be brought about in a large variety of ways, in all of which there are reasons for supposing the psychological causes play the larger part. When one now comes to define somnambulism from the psychological point of view he sees at once that it constitutes a new mode of mental existence. The old mesmerists were quite right when they described it as a second personality.

Two fundamental elements constitute personality—memory and character. In the latter respect, as to character, induced somnambulism is not perhaps always clearly distinguishable from the waking state. It frequently happens that the somnambulist does not relinquish the character that he had before he was put to sleep. The reasons are manifold. This does not, however, hold for the second element of personality—memory. It has long been said that memory supplies the chief sign by which the new state may be distinguished from the normal state. The somnambulist shows, in fact, a curious modification in the range of his memory; the same regular phenomena of amnesia may be produced in him as occur in the spontaneous variations of personality.

Two propositions sum up the principal modifications of memory which accompany induced hypnotic somnambulism; first, the subject recalls during his waking state none of the events which happened during somnambulism; and second, on the other hand, when put in the somnambulistic state he may remember not only the previous somnambulistic states, but also events belonging to his waking state. It follows that memory attains its maximum extent in somnambulism, since it then embraces two psychological existences at once, as the normal memory never does. It may even be remarked that the somnambulist, when he endeavors to recollect certain particulars, has better memory than the same person awake. Gurney has shown, moreover, from studies of hysterical patients, that somnambulistic states may persist in the waking life; that the somnambulistic ego, the second condition, is not always completely effaced when the waking state returns, but survives, coexists with normal thought, and gives rise to complex phenomena of division of consciousness.

A second form of the phenomenon of double personality is the coexistence of the two egos, which is presented in two cases. The first is hysterical insensibility. If a part of a person's body is insensible, he is not aware of what happens to it; and, on the other hand, the nervous centers in relation with this insensible region may continue to act, as is the case in hysteria. The result is that certain actions, more often simple, but sometimes very complicated, can be performed subconsciously by a hysterical patient; further, these actions may have a psychical nature, and show intellectual processes distinct from those of the subject, thus constituting a second ego, which coexists with the first.

A second condition that may occasion the division of consciousness is the concentration of attention on a single thing. The result of this state of concentration is that the mind is absorbed to the exclusion of other things, and to such a degree insensible that the way is opened for automatic actions; and these actions, becoming more complicated, as in the preceding case, may assume a psychical nature and establish intelligences of a parasitic kind, existing side by side with the normal personality, which is not aware of them.

The real nature of hysterical anæsthesia has long been misapprehended, and it has been compared to common anæsthesia from organic causes, as, for example, from the interruption of the afferent nerve tracts. This way of considering it should be completely abandoned, for we now know that hysterical anæsthesia is not a real local insensibility, but an insensibility due to unconsciousness, to mental disintegration; in short, it is psychical insensibility, arising simply because the personality of the patient is impaired, or even entirely divided.

The existence of unconscious phenomena in the case of hysterical patients need not astonish us, for each one of us may, if we watch ourselves with sufficient care, detect in ourselves a series of automatic actions, performed involuntarily and unconsciously. To walk, to sit down, to turn the page of a book—these are actions which we perform without thinking of them. But it is difficult to study unconscious activity in a normal man, for this activity shows itself chiefly in routine, in formed habits, kept going by repetition; in general, it does little new. Sometimes it seems to judge and reason, but these are old judgments and reasons which it repeats. At all events, it seldom acquires any considerable development, and almost never, one might say, amounts to the dignity of an independent personality. The conditions of study are much more favorable when we apply ourselves to hysterical subjects.

Among these unconscious phenomena are those known as movements of repetition, and these are often provoked by suggestion—as when an order or suggestion is given to a person awake or in a somnambulistic state to imitate all movements that are performed before him, or to continue indefinitely the regular movement that is imparted to a part of his body. It is supposed, for the explanation of this phenomenon, that the continuation of a movement may occur, either from obedience or merely because an image has been conjured up in the mind of the patient, this image being the source of the movements. An anæsthetic hand is made to write a letter; the movement of this hand stimulates somewhere in the mind of the unconscious subject the motor images; these images are not inhibited by anything; they spend themselves in action, and the movement is repeated. This involves no obedience; it is a much more simple and elementary psychological phenomenon. These explanations may possibly both hold good, each for different persons and for different conditions of experiments.

The same effects as in anæsthesia may be produced in the state of distraction. Attention—an effort of the mind and of the entire organism which increases the intensity of certain states of consciousness—if brought to bear on a perception, makes it more swift, more exact, more detailed. This adaptation of all the available force of the organism converging in a single event, which may be a sensation, an image, a sentiment, etc., produces a temporary state of monöideism. It is accompanied by distraction. One can not pay attention to certain things without being distracted from others. The likeness of distraction and anæsthesia has been mentioned. A hysterical patient whose arm is insensible finds himself in very nearly the same state of mind as if he never thought of his arm, or if he were indifferent to it, or as if he had concentrated the power of his attention on other things. So we may try experiment with it: we may concentrate this hysterical patient's attention on a certain point and examine the special effects of the division of consciousness produced by distraction. The ease with which the attention of these patients can be distracted is almost incredible. Profiting by the state produced, one has only to approach from behind and pronounce some words in a low voice to place himself in relation with the unconscious person. The sentence is not heard by the principal personality, whose mind is elsewhere, but the unconscious person hears it and acts upon it. The identity of the secondary ego constituted during anæsthesia or distraction with the somnambulistic ego has been established in experiments by M. Paul Janet.

While the two consciousnesses are separate from a certain point of view, they may be reunited from another point of view and may retain both relations. The phenomena are very complicated and very interesting for psychology. The relations of two consciousnesses may take two distinct forms—those of antagonism and those of united action. When they are in collaboration we have the two fundamental facts of the representation of the movement before it is performed and the perception of the movement as it is performed, or the model and the copy states of consciousness. These are illustrated in a remarkable way in automatic handwriting or the performance of graphic movements which are unknown to the principal consciousness and in a great variety of other movements which are brought about in the secondary consciousness by sensations, ideas, and states of all kinds which may occur in the principal consciousness. A curious manifestation of this reunion of consciousnesses is that of suggestions from unconscious indications, as when the infliction of a certain number of pricks on an unconscious member gives rise to a suggestion of the number, or when the pressure of a coin or other design suggests a rude reproduction of the design more exact in detail than is made when the organism is in the normal condition. The connections of these consciousnesses are in fact capable of producing hallucinations of all the senses, fixed ideas, and emotional effects.

Among experiments cited in which the person is induced to perform unconscious movements is that of the exploring pendulum described by Chevreul, the oscillations of which depend on psychological movements in the mind of the performer of the experiment, it registering the unconscious movements of the hand and making them perceptible by increasing them. Automatic handwriting is a psychological action of a similar nature, but a little more delicate and more complex.

What are called unconscious movements of healthy subjects and the various reactions of the secondary personalities of hysterical patients are really identical, but differ in extent, in external circumstance, or in degree of development; and healthy subjects may present special conditions of mind that tend to bring on mental disintegration, as when attention is divided among a great many subjects or when it is intensely concentrated on one thing and distracted as to all others; but the unconsciousness thus produced does not reach the degree of development attained in hysterical persons and is not as brilliant. It will not spontaneously write letters and confessions, but is still something positively existing.

Recent researches have thrown new light upon phenomena of spiritism, or so-called "spiritualism," by showing that these phenomena are due largely to mental disaggregation or division. There is no essential difference between the experiments described upon hysterical patients and the more spontaneous experiments that the spiritists practice upon themselves. The principal differences lie in the minor, or, one might almost say, anecdotal conditions—i. e., in the medium, the terms employed, or the imagined explanations.

SKETCH OF MARIA MITCHELL.

THE list of the great inscribed on the Boston Public Library bears the name of one American woman—Maria Mitchell. While other names of women equally worthy to be recorded there may easily occur to all of us, the validity of Miss Mitchell's title to be thus remembered will not be doubted.

Maria Mitchell was born on the island of Nantucket, August 1, 1818, and died in Lynn, Mass., June 28, 1889. Her parents belonged to the Society of Friends, of the colony who settled in Nantucket when that island belonged to New York; the father a school teacher and afterward cashier of a bank, indulgent to his children, fond of animals and kind to them, and cultivating a well-developed taste for experimental astronomy. He was also fond of beauty and of enjoyable things, and, as the rules of the society would not allow him to wear bright colors, he indulged his taste for them by buying red-covered copies of books, painting the framework of his telescope bright red, spreading a gay carpet on the floor, papering his sitting room with pink rose designs, and displaying the polarization of light. The mother was a woman of strong character, clear-headed and demonstrative. Books were abundant, in the house and at the library. Mr. Mitchell from his early youth was an enthusiastic student of astronomy. The evenings when pleasant, Mrs. Phœbe M. Kendall says in her biography, "were spent in observing the heavens, and to the children, accustomed to seeing such observations going on, the important study in the world seemed to be astronomy. One by one, as they became old enough, they were drafted into the service of counting seconds by the chronometer during the observations. Some of them took an interest in the thing itself, and others considered it rather stupid work; but they all took in so much of this atmosphere that, if any one had asked a little child of this family, 'Who was the greatest man that ever lived?' the answer would have come promptly, 'Herschel.'" Maria very early learned to use the sextant. On the occasion of the annular eclipse of the sun of 1831—central at Nantucket—when she was twelve years old, she held the chronometer, counting the seconds, while her father observed the eclipse. This event was called up in her diary, March 16, 1885, when she wrote, mentioning it, that now, "fifty-four years later, I counted seconds for a class of students at Vassar; it was the same eclipse, but the sun was only about half covered. Both days were perfectly clear and cold." At sixteen she became an assistant teacher in the school of Mr. Cyrus Peirce, where she had been a pupil; afterward opened a private school; and then became, for twenty years, librarian of the Nantucket Athenæum. In the library she found Dr. Bowditch's translation of La Place's *Mécanique céleste* and Gauss's *Theoria Motus,* in Latin, and read them. She also read voraciously on all subjects; and, as librarian, saw that the boys and girls got good books, while she skillfully kept the unwholesome ones out of their sight. While enjoying in her home all advantages for the cultivation of her scientific tastes, Miss Mitchell took her part in all the household work, knew how everything was to be done, and did what she did thoroughly. On one occasion, when the "help" had gone, she took charge, and made a record of how she spent the day. It was late in October. She arose at six, having been half asleep only for some hours, fearing she might not be up in time to get breakfast. "It was but half light, and I made a hasty toilet. I made a fire very quickly, prepared the coffee, baked the Graham bread, toasted white bread, trimmed the solar lamp, and made another fire in the dining room before seven o'clock. . . . I really found an hour too long for all this, and when I rang the bell at seven for breakfast, I had been waiting fifteen minutes for the clock to strike. I went to the Athenæum at 9.30, and, having decided that I would take the Newark and Cambridge places of the comet and work them up, did so, getting to the three equations before I went home to dinner at 12.30. I omitted the corrections for parallax and aberration, not intending to get more than a rough approximation. I find to my sorrow that they do not agree with those from my own observations. I shall look them over again next week. At noon I ran around and did several errands, dined, and was back again at my post by 1.30. Then I looked over my morning's work—I can find no mistake. I have worn myself thin trying to find out about this comet, and I know very little now in the matter. I saw, in looking over Cooper, elements of a comet of 1825 which resemble what I get out for this from my own observations, but I can not rely upon my own. I saw also to-day in Monthly Notices a plan for measuring the light of stars by degrees of illumination—an idea which occurred to me long ago, but which I have not practiced." The next day she got breakfast again, and varied her astronomical computation with tatting, reading in Humboldt's Cosmos for rest when she was tired; and in the evening, it being stormy and no observing, made a loaf of bread, worked at tatting and gave a lesson in it, and completed sixteen hours of steady work.

The discovery of a comet by Miss Mitchell, which first made her known to the world as an astronomer, is thus described in Mrs. Kendall's Life, Letters, and Journals: "Miss Mitchell spent every clear evening on the housetop 'sweeping' the heavens. No matter how many guests there might be in the parlor, Miss Mitchell would slip out, don her regimentals, as she called them, and, lantern in hand, mount to the roof. On the evening of October 1, 1847, there was a party of invited guests at the Mitchell home. As usual, Maria slipped out, ran up to the telescope, and soon returned and told her father that she thought she saw a comet. Mr. Mitchell hurried upstairs, stationed himself at the telescope, and, as soon as he looked at the object pointed out by his daughter, declared it to be a comet. Miss Mitchell, with her usual caution, advised him to say nothing about it until they had observed it long enough to be tolerably sure. But Mr. Mitchell immediately wrote to Prof. Bond, of Cambridge, announcing the discovery. On account of stormy weather, the mails did not leave Nantucket until October 3d." The comet was seen by Father de Vico at Rome, October 3d, and word of it was immediately sent to Prof. Schumacher at Altoona; by Mr. W. R. Dawes in Kent, England, October 7th; and by Madame Rümker at Hamburg, October 11th. The priority of Miss Mitchell's discovery was generally acknowledged. The King of Denmark had offered a gold medal to the first discoverer of a telescopic comet, but, dying, was succeeded by a king not so much interested in astronomy. Miss Mitchell, moreover, failed in securing priority of registry of the discovery, according to the terms laid down in the king's offer—a thing that was impossible in those days before the Atlantic telegraph. Her claim was taken up and pressed by Edward Everett, and referred by the king to Prof. Schumacher, who reported in favor of granting the medal to her. A few months after this, in 1848, Miss Mitchell was unanimously elected an honorary member of the American Academy of Arts and Sciences, being the first and only woman ever admitted to that society. She afterward became a member of the American Institute and of the American Association for the Advancement of Science. Of the meeting of this body in Boston in 1855, she wrote: "It is really amusing to find one's self lionized in a city where one has visited quietly for years. . . . For a few days science reigns supreme—we are fêted and complimented to the top of our heart, and although complimenters and complimented must feel that it is only a sort of theatrical performance for a few days and over, one does enjoy acting the part of greatness for a while!" In 1849 Miss Mitchell, on the invitation of the late Admiral Davis, undertook the computations, for the Nautical Almanac, of the tables of the planet Venus—a work which she carried on, in addition to other duties, for nineteen years. In the same year she was employed by Prof. Bache, of the United States Coast Survey, in the work of an astronomical party at Mount Independence, Maine.

In 1854 she records her "sweeping" of the heavens—a kind of work she really enjoyed, though her back soon became tired before the cold chilled her; in March, seeing two nebulæ in Leo with which she was not familiar and which repaid her for her time; and on September 18th, observing the two nebulæ in Ursa Major, which she had known "for many a year," but which to her surprise now appeared to be three. "The bright part of this object was clearly the old nebula, but what was the appendage? Had the nebula suddenly changed? Was it a comet, or was it merely a very fine night? Father decided at once for the comet; I hesitated, with my usual cowardice, and forbade his giving it a notice in the newspaper." Flying clouds prevented more satisfactory observations that evening and the next two, but "on the 21st came a circular, and behold Mr. Van Arsdale had seen it on the 13th, but had not been sure of it until the 15th on account of the clouds. I was too well pleased with having really made the discovery to care because I was not the first. Let the Dutchman have the reward of his sturdier frame and steadier nerves!" She consoled herself, further, by reflecting that the 13th was cloudy, and that she had evaded the task of making the computations, which she would have had to do to call the discovery hers. She seems, however, to have tried her hand at the computations, and was despondent because she had to renounce her own observations as too rough for use. "The best that can be said of my life so far is that it has been industrious, and the best that can be said of me is that I have not pretended to be what I was not."

The diary for 1857 tells of an extensive tour through the South, the many striking incidents of which are recorded with keen humor, and the first journey in Europe, in which Miss Mitchell took her almanac work with her.

On this her first visit to Europe, in 1857–'58, Miss Mitchell took letters from eminent scientific men in the United States to distinguished astronomers and mathematicians, and other persons, abroad. She was cordially received, and the astronomers opened their observatories to her and entertained her at their homes. To mention the names of all the notable persons whose acquaintance she thus made would be like making a list of the men of the time distinguished in science, literature, and art. Her observations, very freely given in her private journal but always kindly, contain much about the instruments and furnishings of the scientific establishments and the methods of carrying on the work. She found Mr. Airy, at Greenwich, not favorable to the multiplication of observatories; and to his remark that he would gladly destroy one half of the meridian instruments of the world by way of reform, she replied that her reform movement would be to bring together the astronomers who had no instruments and the instruments which had no astronomers. At Greenwich she met Herr Struve, the famous astronomer of Pulkova, visiting England on a scientific mission—"a magnificent-looking fellow, very large and well proportioned; his great head is covered with white hair, his features are regular and handsome. When he is introduced to any one he thrusts both hands into the pockets of his pantaloons, and bows"; and he told her that it was not necessary for her to present her letters—he knew her without.

With the Airys she went to Cambridge and visited Whewell, of whom—"An Englishman is proud, a Cambridge man is the proudest of Englishmen, and Dr. Whewell the proudest of Cambridge men." He was very severe, even to discourtesy, on Americans, and imperious in manner; and escorted Miss Mitchell to church wearing "a long gown reaching nearly to his feet, of rich scarlet, and adorned with flowing ribbons," which did not match the robe but were nearly crimson. At Cambridge she met Mr. Adams, the English calculator of the place of Neptune, and Prof. Sedgwick, then an old man of seventy-four. She was cordially entertained by Sir John and Lady Herschel; visited Le Verrier at his home in Paris; and at Rome was called upon by Father Secchi, and was admitted to the observatory where Mrs. Somerville and the daughter of Sir John Herschel had been refused; that observatory for which the Papal Government furnishes nice machinery to keep the telescope accurately up with the motion of the earth on its axis; "the same motion for declaring whose existence Galileo suffered; the two hundred years have done their work." At Florence she called on Mrs. Somerville, who, though seventy-seven years old, looked twenty years younger and came tripping into the room, speaking at once with all the vivacity of a young person, was interested in every new improvement, as much at home in the drawing room as in science, and asked many questions in regard to the progress of science in America. At Berlin she saw Humboldt, who was much obliged to her for calling to see him, talked intelligently to her about current affairs in the United States, told her the latest news from home, and showed her Clinton, N. Y., on the map when she did not know where it was.

A few months after the death of Mrs. Mitchell, in 1861, the family removed to Lynn, Mass., where Miss Mitchell had bought property, to which she transferred her observatory, and where she remained until she was called, in 1865, to be Professor of Astronomy and Director of the Observatory at Vassar College. This involved a change of occupation, and one that would, to a certain extent, divert her attention from what had been her life-work of observing. "But she was so much interested in the movement for the higher education of women, an interest which deepened as her work went on, that she gave up in a measure her scientific life, and threw herself heart and soul into this work." She further, in the course of time, gave up her work on the Nautical Almanac, in order to devote herself more exclusively to this. In October, 1888, we find this entry in her diary: "Resolved, in case of my outliving father and being in good health, to give my efforts to the intellectual culture of women, without regard to salary; if possible, connect myself with liberal Christian institutions—believing, as I do, that happiness and growth in this life are best promoted by them, and that what is good in this life is good in any life." She had her own views about the way teaching should be done, and did not hesitate to express them. Thus: "Our faculty meetings always try me in this respect; we do things that other colleges have done before. We wait and ask for precedent. If the earth had waited for a precedent, it would never have turned on its axis!" She thought teachers were inclined to talk too much; that to read a book, to think it over, and to write out notes, was a useful exercise; that "the greatest object in educating is to give the right habit of study; . . . not too much mechanical apparatus, let the imagination have some play; a cube may be shown by a model, but let the drawing upon the blackboard represent the cube, and, if possible, let Nature be the blackboard; spread your triangles upon land and sky; . . . a small apparatus well used does wonders. . . . I find a helping hand lifts the girl as crutches do; she learns to like the help which is not self-help." The relation between herself and her pupils is described as having been very cordial and intimate, and she remarked to one of her classes entering upon its study for the last year, "We are women studying together." According to her own description of her teaching, her beginning class used a small portable equatorial, which stood out of doors from seven o'clock in the morning till nine o'clock in the evening. They were expected to determine the rotation of the sun upon its axis by watching the spots; "the same for the planet Jupiter." They determined the revolution of Titan by watching its motions, the retrograde and direct motion of the planets among the stars, the position of the sun with reference to its setting in winter and summer, and the phases of Venus. "All their book learning in astronomy should be mathematical. The astronomy which is not mathematical, in what is so ludicrously called 'geography of the heavens,' is not astronomy at all." The senior girls in practical astronomy were taught separately: to obtain the time for the college by the meridian passage of stars; to find a planet at any hour of the day; to make drawings of what they see, and to determine positions of planets and satellites; to determine differences of right ascension; to know the satellites of Saturn by their physiognomy, as if they were persons; and they sometimes measured diameters. She held the marking system in contempt, would not drill, and could not drive.

Miss Mitchell began to observe the various colors of the stars in 1853, but nothing in her remarks concerning the phenomenon indicates that she had any anticipation of the explanations which later astronomers have offered for it. Her appreciation of it was largely æsthetic, but, as Mr. Bishop had found the blue stars generally small, she thought we might assume "that the blue stars are faint ones, and probably distant ones. But as not all faint stars or distant ones are blue, it shows that there is a real difference. . . . From age to age the colors of some of the prominent stars have certainly changed. This would seem more likely to be from change of place than of physical constitution. Nothing comes out more clearly in astronomical observations than the immense activity of the universe. 'All change, no loss, 'tis revolution all.'" Then she was led to remark that all observations of this kind are peculiarly adapted to women. "Indeed, all astronomical observing seems to be so fitted. The training of a girl fits her for delicate work. The touch of her fingers upon the delicate screws of an astronomical instrument might become wonderfully accurate in results; a woman's eyes are trained to nicety of color. . . . Then comes in the girl's habit of patient and quiet work, peculiarly fitted to routine observations. The girl who can stitch from morning to night would find two or three hours in the observatory a relief."

The chief scientific incident recorded of Miss Mitchell's second European tour (1873) is her visit to the observatory at Pulkova, where the second Struve—Otto—was director. Her Russian journal contains some keen comparative observations concerning civilization and education in Russia and the United States, not always to the advantage of the United States.

In 1859 Miss Mitchell was presented by the republic of San Marino with the bronze medal of merit, with the ribbon and letters patent signed by the two captains regent. In August, 1869, she went with several of her Vassar students to Burlington, Iowa, to observe the total eclipse of the sun, and published a popular article on the subject in the magazine Hours at Home. Her scientific record of the observation was published in Prof. Coffin's report. In 1878 she went to Denver to observe the eclipse. Her observing party of five ladies besides herself had their special places at the three telescopes as counters or as artists, and made the observations in silence. "Great," she says, "is the self-denial of those who follow science. Those who look through telescopes at the time of a total eclipse are martyrs; they severely deny themselves. The persons who can say that they have seen a total eclipse of the sun are those who rely upon their eyes. My aids, who touched no glasses, had a season of rare enjoyment."

In June, 1881, while going to Providence in a steamboat, she caught her first view of a new comet from the stateroom window. She at once hurried back to Poughkeepsie to make her observations. An apple tree was in the way, and she had it cut down. Then a mist arose, and the observation had to be postponed. On account of the incident of the tree, the girls called her George Washington.

During her later years at Vassar, Miss Mitchell endeavored to raise a fund to endow the chair of astronomy. The fund was completed after her death, amounting to fifty thousand dollars, and is known as the Maria Mitchell Endowment Fund. It was her custom every year, in the week before commencement, to give her students a "dome party"—a breakfast— in the observatory, and these were most enjoyable occasions to all.

Miss Mitchell was chairman of the Standing Committee on Woman's Work in Science of the American Association for the Advancement of Women, and was for several years president of the association. "Some of her students did their first work for women's organizations in gathering statistics and filling out blanks which she distributed among them." She believed in the woman suffrage movement, but took no prominent part in it. She was the first woman elected to membership in the American Academy of Arts and Sciences, Boston. She was chosen in 1859 a member of the American Philosophical Society; was for many years a member of the American Association for the Advancement of Science; was connected with the New England Women's Club and with Sorosis; and received degrees from Rutgers Female College, Hanover College, and Columbia College. She contributed a paper on Mary Somerville to the Atlantic Monthly in 1860; articles, mostly on observations of Jupiter and Saturn, to the American Journal of Science; a few popular science papers in Hours at Home; and an article on The Herschels was printed in The Century just after her death. She also read a few lectures to small societies and to one or two girls' schools, "but she never allowed such outside work to interfere with her duties at Vassar College." She resigned her position in Vassar College, on account of growing infirmity, in January, 1888, after having, as she boasted, earned a salary, without any intermission, for more than fifty years. The trustees made her professor emeritus, and offered her a home in the observatory, but she preferred to spend the few remaining months of her life with her family in Lynn.

It is partly a result of Miss Mitchell's work that woman astronomers are now no longer regarded as something remarkable.

Editor's Table.

POLITICS AND MORALS.

IN many States of the Union the school laws provide for compulsory education in what is called "temperance." How far the education supplied under this head sometimes is from being based on strict scientific principles was well shown some time ago by an able contributor to this magazine. It is a question, however, whether if even the instruction in "temperance" was all it ought to be from a scientific point of view, it is as much needed as other instruction for which no legal provision is made; we mean especially instruction in the everyday duties of citizenship.

According to prevalent ideas in this country, a people is free when it has adopted a popular form of government, and done away with everything having the appearance or savor of monarchy or aristocracy. Thus the Venezuelans are to be considered a free people because their government is, in form, republican; and the inhabitants of British Guiana not free, or at least not so free, because they are connected with the monarchy of Great Britain. In the early stages of the Venezuelan difficulty we heard not a little about the American system of government and American political ideas as opposed to the European system and European ideas. In the imagination of many, Venezuela stood for freedom and England for tyranny; and the interests of civilization were held to demand that the free power should be strengthened and the power representative of tyranny checked. To be sure, there was a country to the north of us, also connected with the British Empire, in which a reasonable degree of freedom seemed to exist. Still, that was not the right way of being free; the right way was to have your government republican in name as well as in essence, and above all to enjoy the vicissitudes of periodical elections for the chief magistracy. This Venezuela had done, and therefore Venezuela was a true home of orthodox freedom.

Happily, the Venezuelan difficulty is a difficulty no more as between the United States and England; but the underlying political ideas which tended to embitter feeling, and did so dangerously embitter it, on this side are deserving of study. Why has the overthrow of autocratic government provoked so much popular enthusiasm from the days of Harmodius and Aristogeiton down to our own times? Because the autocrat has been conceived of —and often rightly—as a man who used his power for his own selfish ends. The tyrant of popular imagination is a man who takes the taxes of the poor to spend upon his luxuries and vices; and the tyrant in history has not infrequently filled precisely this unworthy rôle. The advantage, then, to be gained from dethroning tyrants is that the power and resources of government then become available for the uses of the state. A virtuous tyrant would be one who used all his power in an unselfish manner for the benefit of his subjects; but when in the course of events even the virtuous tyrant becomes an impossibility, what is to be done with the power he formerly exercised? It passes over to the people; now what is going to be done with it? Here we come to the true *crux* and crisis of modern republican institutions. Strictly speaking, the power that has been wrested from the monarch ought to be applied, as a good monarch would apply it, to the benefit of the state as a whole ; but how is it really applied ?

Here it is, as we conceive, that there is room for a teaching, to speak plainly, of far greater value and importance than that which the law prescribes in the interest of "temperance" ; the teaching, to wit, that political power can be as much abused, and in multitudes of cases is as much abused, by the individual citizen as by any autocrat that ever lived. What can the autocrat do worse than use the power which he has grasped, or which has descended to him, for personal purposes instead of for public purposes ? It is true he uses *a great deal of power*, and thus is in the way of doing a great deal of harm ; but in essence he does no worse than the citizen who sells his vote or makes any use of it other than that which consideration of the public good would prescribe. The individual citizen wields but a fractional part of the power of the autocrat ; but the part he wields does not belong to him as his personal property ; and, if he uses it as such, he is simply a tyrant on a small scale, or, say, a fractional tyrant instead of an integral one. He is doing with his little bit of power just what the other man did with his vast and concentrated power. In fact, he is doing worse, because if he abuses his vote and influence he abuses *all* he possesses, whereas no autocrat was ever yet so bad that part of his power was not exercised for the public good. Tiberius and Nero were execrable men, but many of their public acts were directed to the good of the state. The idea, therefore, which it is important to get into the mind of the young is that *the irresponsible voter is a tyrant*: he is diverting to private purposes a measure of political power which only belongs to him for public purposes.

Then, just as in "temperance" education the evils of intemperance are vividly set forth—with many a lively *excursus* on the evils of even the most moderate use of stimulants —so it would be perfectly proper to exhibit in detail the baseness of a system of politics in which private interest takes the place of public duty. The case is more urgent by far, in our opinion, than the case for "temperance" instruction for this reason, that there is already a vast body of sentiment in the country favorable to temperance and even to total abstinence; whereas there can not be said to be any vast body of sentiment favorable to pure, honest, and disinterested politics. Every man occupying an important political position knows the kind of solicitations he receives for all sorts of things possible and impossible. He knows how often he is assured that unless certain offices, contracts, etc., are disposed of in a certain way there is no earthly chance of his party succeeding in the next contest in congressional district so-and-so. Every such man knows also that it is not only from the ignorant and socially inferior that such communications proceed—that, on the contrary, men of substance and reputation are their authors in perhaps the majority of cases. The assumption may be said to be almost universal that a man's vote is his own, and that in casting it he has nothing to consider but his own interest. That it is disgraceful to withdraw support from a party in which a man professes to have confidence and give it to one in which he professes to have no confidence, simply because some petty contract job or office is not disposed of to his liking, does not seem, broadly speaking, to be in anybody's thoughts. The politicians ignore it entirely in all their calculations. Side by side, therefore, with the pictures drawn in the "temperance" lesson of the reeling, brawling inebriate, it would be well, we think, to place a picture of the citizen who, boasting that he belongs to a free State, yet holds his vote in fee for some trumpery office, and openly threatens to betray causes on which at times he grows eloquent if his private demands are not met. It is not always for himself personally that the free and enlightened elector wants an office. It may be for his brother, his father-in-law, his nephew, or his business partner; but whatever it is that he wants, or for whomsoever he wants it, he makes no scruple about using his franchise and such political influence as he possesses in order to compass his ends. Often the demands that are made are flagrantly unjust; sometimes they involve wasteful expenditure of public money; but none the less are they pressed by men who exult, as we have said, in the freedom of our institutions, and look with mingled pity and contempt upon communities that are content to dwell under the baneful shadow of some monarchical form of government. A splendid text-book could be made for the instruction of American youth if some prominent statesman would make a selection from his correspondence with office-seekers and wire-pullers, with tariff-mongers and contract jobbers. We say this matter is more pressing—far more pressing—than instruction in temperance, for the reason that if the youth leaves school unwarned and unfortified against the abuses of politics, he will almost at once find himself in an atmosphere in which conscience in regard to such matters is wholly ignored; he will be caught in the wheelwork of the political machine and will become, while yet a youth, a political machinist himself.

The question as to how a low tone of political morality acts upon the general morals of the community is one on which we can not enter today. What we wish to insist on is that there is a crying need for explaining to the youth of the country not so much the technical details of our system of government—though every boy and girl leaving school should have correct general ideas on that subject—as the true principles which should govern political action here and everywhere, and the particular abuses, dangers, and diseases to which our own political system is exposed. Above all, the simple principle should be inculcated that political power can never be properly regarded as a private possession.

THE RACIAL GEOGRAPHY OF EUROPE.

It may savor of undue presumption to assert that the English language is the proper medium through which the anthropological history of Europe should first find expression. At first it would seem that the continental nations were most competent to unravel their own past history. This is indeed true, so far as each by itself is concerned. But when the task of combining them into a continental whole arises, the tables are turned. In no other department of science has political jealousy and hatred worked to greater harm than in anthropology; for Europe is divided into two armed camps—one led by the French, the other dominated by German influence. Their methods of work, their terminology, their conclusions, are all conflicting. Each claims priority, and each has a racial history of Europe which is suited to its own purpose. Hence the necessity that the delicate and judicial work of combining the truth which is revealed to each and of rejecting that which is false, should fall to those who lie beyond the reach of national prejudice. Writers in England—Beddoe and Isaac Taylor—have so far been most successful in this comprehensive work. It is now essayed for a third time in the series of papers upon the Racial Geography of Europe, which begins in this number. The Monroe doctrine forbids that we should intermeddle in European politics. The effect of this political neutrality should be to keep our hands free and our minds clear in science. In itself it furnishes a justification for our foreign intrusion into the European field.

During the civil war, while the first great investigation upon living men was being prosecuted upon nearly a million recruits in our armies, the United States held a proud place of leadership in that branch of the science of anthropology which deals with our own race in the life. This tremendous task exhausted all our energies at the outset; attention was directed to the American aborigines, and the white man was forgotten. This is one of several reasons competent to explain the popular ignorance and scientific neglect among us of a very live subject. To the average American reader, the word anthropology, if it conveys any meaning at all, conjures up visions of Indians, Hottentots, Fijians, and other savages, or perhaps of museums and curiosities, of Peruvian and Egyptian mummies, cave-dwellers, and the like—so far have primitive ethnology and archæology dominated the science.

Another reason why we in America have passed by this line of inquiry is because the conditions here have not invited research. Our own population is so recent, so artificial, such a hodge-podge of all civilized peoples, that science stands aghast at the problem of finding order in such chaos. In Europe all is, or was until recently, quite different; so that even now, after the railroad and the factory have disturbed the racial peace of the continent, the remnants of law and order still remain.

A special feature of this series of papers will consist of the maps and portraits with which the articles will be amply provided. Every portrait will be accompanied by precise data, obtained from measurements on the living subject. The leading experts all over Europe, among them Drs. Ammon in Baden, Beddoe in England, Collignon in France, Livi in Italy, Janko in Hungary, Kollmann in Switzerland, Ranke in Bavaria, and others, have kindly aided in this work; so that a large collection of racial portraits of permanent value will be presented. With these will be combined all the anthropological maps of value already published, as well as many entirely new ones. Each of these has been especially prepared for this purpose, indicating the exact distribution of each type of man or physical race trait, shown in portrait and described in text. By this means it is hoped that the interests of true science may be subserved; and that at the same time a necessarily technical subject may be rendered comprehensible and interesting to the general reader.

In the first paper of the series, printed in this number, the relation of language to race and nationality, with the changes it undergoes through the distribution of population and the influence of environment, are considered. The next paper will deal with the shape of the head as an ethnic characteristic; the third with the color of the hair and eyes—that is to say, with the distribution of blondes and brunettes; and the fourth the stature. Then the association of these into three race types—the Teutonic, the Alpine, and the Mediterranean—will follow. France, Germany, the British Isles may then be taken up, each by itself, with consideration of special topics, such as the Basques, the Etruscans, living representatives of the Cro-Magnon race, and the like. Thus the way will be prepared for the still broader questions concerning the ultimate origin of the three races above named, with their relation to the negro and the people of Asia. The intention of the whole series will be to give a living picture of the people of Europe, and to analyze it for the benefit of the student of history and sociology.

SCIENCE AND HUMANITY.

WE noticed last month the anxiety of a high ecclesiastical dignitary lest the world under the guidance of the modern scientific thought should be given over completely to cruelty and selfishness; and our attention has since been drawn to an article in a Toronto educational journal which seems to be in some measure inspired by a similar apprehension. We say "in some measure" only, for the writer is in evident sympathy with the work of science as a whole, and is chiefly concerned with the moral evils which he thinks will ensue from the scientific practice of vivisection.

The question as to the value of vivisection for the advancement of scientific theory is a large one, upon which we are not prepared to enter. Suffice it to say for the present that, while some diversity of opinion exists on the subject, the great majority of teachers and experimenters in biology and physiology believe that it affords most important aid in the prosecution and illustration of their studies. That the practice is liable to abuse in careless or indifferent hands may be readily admitted, but it must be said at the same time that the feeling of the scientific world in general is as strongly opposed to any needless infliction of suffering on the lower animals as that of the unscientific world can be. It is recognized that the practice should only be resorted to in a guarded manner, for definite ends, and should be accompanied by whatever alleviations of pain it is possible to introduce. No condemnation could be too strong for any purposeless cruelty at the expense of sentient creatures, or any profession of indifference to the pains which they are necessarily compelled to undergo. The great safeguard of the scientific world against such misuse of the power we possess over the dumb creation lies in the fact that the one professed and never-forgotten purpose of the practice now in question is the mitigation and prevention of human suffering. If the question were asked whether, on the whole, the animal creation had gained or lost by the advance of scientific thought, there could be little doubt about the answer. It is since science became a prominent occupation of men's minds that qualms of conscience have begun to be felt about some forms of sport in which animal life is sacrificed, and that measures have been taken to secure merciful treatment for animals in course of transportation, and for the prevention of various forms of cruelty and neglect through which animals suffered at the hands of man. That much remains to be done in these directions is undoubted, but we may be sure of this, that the more animals become the subject of scientific study and treatment, the better on the whole will be their lot. It may be that the need for vivisection will in time wholly pass away, the truths which it is adapted to teach having in the main been acquired. There will then remain as the result of temporary suffering a body of knowledge available for the prevention of suffering, not only in the human race, but among the lower animals as well. What may be called the metaphysics of the subject is difficult to deal with, and we can not follow our Toronto contemporary on that ground. In a practical matter like this we feel that it is safer and better to trust the instincts of humane men; and among those who have approved of a limited and careful use of vivisection are to be found many whose humanity and sensibility no one would doubt. Science and humanity go hand in hand for the simple reason that *science is human*. In matters of this kind we are therefore disposed to trust the scientific spirit as being essentially a spirit of mercy and benevolence, a minister of good to mankind, and not to mankind only, but to the lower tribes of life as well.

Scientific Literature.

SPECIAL BOOKS.

Early in 1895 the reading and thinking world was given something like a galvanic shock by the appearance of Nordau's book on Degeneration. It represented much of the genius of the later nineteenth century—genius that has produced many of the most widely admired works of art and literature—as being a variety of wholesale derangement that was developing in a considerable part of the race. Such a diagnosis could hardly pass unchallenged. The magazinists hastened to answer Nordau. An anonymous English writer put forth a volume controverting his position, and a fellow-countryman of Nordau, Dr. *William Hirsch*, has so modified a work that he had under way as to make it also a reply.* Dr. Hirsch's book is first an examination, in the light of the latest advances made in neurology, of the much debated question, How closely is genius related to insanity? After briefly defining the limits of insanity he examines the psychology of genius and then compares the diseased with the supernormal mind. He holds that—

> Genius in different departments is referable to the most diverse psychical conditions. Psychical faculties and characters which in one case constitute the essence of genius, in another case are inconsistent with the action of genius. In short, definite psychical characters common to all genius are not to be found. One would seek in vain any common psychological explanation of the greatness of a Paganini and a Bismarck, of a Mozart and a Napoleon.

While he refrains from fitting a definition to either genius or insanity, he does not hesitate to compare the two. He takes up the chief symptoms which other authors have found in both men of genius and the insane. Among these are hallucinations, melancholy, the lively fancy of

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* Genius and Degeneration. By Dr. William Hirsch. New York: D. Appleton & Co. Pp. 333, 8vo. Price, $3.50.

the *littérateur* and the lying of the imbecile, and the fact that some great men have actually had attacks of insanity. Yet he deems all these to be mere resemblances, not real affinities. Great men are not to be measured by the same standard as ordinary beings, and the reason why they are often deemed insane by those around them is because their superior powers are not understood. Taking up the subject of degeneration, he discusses the views of Morel, Krafft-Ebing, and Lombroso as to the characteristics of degenerates, and concludes that "in consequence of its common cause in all cases—namely, mental instability, discord of the mental faculties—the cases always have something to characterize them, and they give to the competent observer no occasion to confound them with great, fully developed, and harmonious minds." In his chapter on Secular Hysteria, Dr. Hirsch first comes in conflict with Nordau. He flatly contradicts the assertion of the latter that neurasthenia and hysteria are epidemic as they have never been in former centuries and are vitiating the literature, art, and culture of the time. He says:

Had Nordau in his sharp critique of existing conditions in the fields of society, literature, and art made no pretension to any other standpoint than that of the æsthetician and art critic, his work, in spite of its many eccentricities and falsities, would undeniably not have been without service, for he lays the scourge that is their due upon many a folly and absurdity of our time. But when he wraps himself in the solemn garb of science and, assuming the position of a psychiatrist, hurls the ban of degeneracy and hysteria upon everything that does not meet his approval, he can only be called a psychiatric *dilettante*.

He regards as Nordau's chief error the drawing of psychiatric conclusions from his purely subjective criticism of works of art, without regard to the purpose of the artist or author. In order to make his meaning clear he takes Richard Wagner as an example, and gives quite an extended analysis of his compositions, maintaining that they give no such evidence of degeneracy as Nordau alleges. In reading Dr. Hirsch's pages one can not help being impressed with his fairness. He never fails to admit what he can agree with in his opponent's position. At the same time he is a good fighter, and his blows fall thick and heavily upon those things that he undertakes to combat.

Although prepared chiefly for certain professional and business men, the little book on *Theater Fires*, recently published by Mr. *Gerhard*, deals with a matter which often becomes of wide and painful interest.* From the statistical pages, with which the author introduces his subject, we learn that before 1878 five hundred and sixteen theaters had been completely destroyed by fire. Theaters are in most danger from fire when they are new and their apparatus may not be in perfect working order, and again when forty to fifty years old and much of the apparatus has become worn out. The causes of theater fires are many and various, but most of them arise, naturally, on the stage or in the dressing rooms. Panics in theaters also have a number of causes besides the actual appearance of fire. One may be started by a false alarm, by an alarm of fire in the neighborhood, by the unannounced darkening of the house, by the plunging of a frightened horse on the stage, etc. As measures for preventing outbreaks of fire

* Theater Fires and Panics. By William Paul Gerhard. New York: John Wiley & Sons. Pp. 175, 12mo. Price, $1.50.

Mr. Gerhard recommends the isolation of the building so far as practicable, fireproof construction, using brick and terra cotta in preference to stone and avoiding exposed ironwork, the use of incandescent electric lights, proper storing of scenery, removal of rubbish, etc. If a fire does start, the building should be so divided as to localize it. The stage should be separated from the auditorium by a fire wall. The proscenium opening should be fitted with a fire-resisting curtain, closing as nearly as possible hermetically. There should be as few other openings in this wall as possible, and all of them kept closed by fire doors. The safety of the spectators and stage people can be best provided for by having adequate exits. All other devices Mr. Gerhard ranks as subordinate. The exits, he says, should be arranged so as to widen as they approach the outside of the building. There should be no stinting of exits for the occupants of the galleries, who have often been suffocated in large numbers by the rising smoke and hot gases of combustion. Many other measures for preventing or restricting the damage done by fires are named by Mr. Gerhard, and he describes with considerable detail what he deems the best appliances for putting out theater fires before they have gained much headway. The volume is made up of three papers prepared for different occasions, hence there are some repetitions in it. This not very serious fault doubtless could have been wholly or largely removed by a moderate amount of editing. A list of books and magazine articles on theater construction and protection is appended. Every theatergoer should read the volume, so that he may know when he is in a safe house, and should never again allow the most seductive bill to tempt him into a death-trap.

It is a strong presumptive recommendation of Mr. *Parry's Evolution of the Art of Music* * that it was nine years in preparation. The examination of the book reveals throughout evidences of the thorough study and careful work implied by that term of years, and of effort to go to the bottom of the subject. The author seems to have found a firm basis for his deductions, and expresses them clearly and distinctly, without any of the hazy uncertainty and vague indefiniteness that mark the majority of attempts to analyze music and make them far from satisfactory. The origin of music is found in natural or spontaneous vocal expressions of feeling and sensibility, such as are common to all sentient beings. Man has developed and extended them and formulated them according to his stage of culture, and the purpose in this book is to point out how and by what steps he has done this and brought musical expression to its present high condition. These utterances pass within the range of art when they take any definite form, just as speech begins when vague signals of sound give place to words. When these musical figures become definite enough to be remembered, scales are formed, or series of notes which stand in some recognizable relation to one another in respect of pitch. The connection of music, or vocal, with dancing or muscular expression of feeling gives rise to rhythm, and we have all the elements of the art. The scales, ancient and modern, and of various races, are described and analyzed. A step higher than the primitive fragments of tune and rhythm of savage music—the first stages of musical development—is folk music, in which an appearance of orderliness and

* The Evolution of the Art of Music. By C. Hubert Parry. New York : D. Appleton & Co. (International Scientific Series.) Pp. 342. Price, $1.75.

completeness is given; and we have the folk music of various tribes and nations, described and illustrated with specimens, in its different degrees of development. Next, the religious aspect of music is referred to, and the beginning of harmony is discussed in connection with the appearance of Christian church music. The era of pure choral music succeeding this is followed by the rise of secular music, with the history of opera swaying to and fro in the struggle between the musical and dramatic elements for predominance. Instrumental music is next studied in its early and middle stage; the sonata; and finally the modern developments, with all their varieties of style and form. In these discussions the typical works of each age, form, and style are described and analyzed, the work done by the composers who have made epochs in the progress of the art or established new forms is examined into, and each point is illustrated by the introduction of scores. Wagner is the latest master who has left a distinct mark in the growth of music, and the nature and effect of the most characteristic features of his compositions are inquired into in what seems to us a truly judicial spirit.

GENERAL NOTICES.

Chemistry in Daily Life * embodies the substance of a course of lectures delivered by Dr. *Lassar-Cohn*, Professor of Chemistry in the University of Königsberg, to a society in that town modeled after the celebrated Humboldt Academy of Berlin. The book is written in a popular style, and covers a very wide and important field. It is really a technological handbook of what is perhaps best described as household chemistry The subjects treated are necessarily extremely various, and, except from the side of their importance in the affairs of everyday life, are not in many instances very closely connected. The Physics and Chemistry of Breathing, Argon, Composition of Fats, Tetravalency of the Atom of Carbon, Vaseline, and Incandescent Gaslights are some few of the special headings in the first two chapters, and will perhaps serve to indicate the great variety of topics treated. Perhaps the most important chapters are the first five, which deal chiefly with the chemistry of physiology. Tanning and bleaching are given a chapter. Oil painting, modern explosives, glass manufacture, photography, and metallurgy are other subjects receiving special attention. The work is necessarily more or less superficial, but it contains much information of importance to the ordinary householder. The translation seems to have been very well done.

* Chemistry in Daily Life. By Dr. Lassar-Cohn. Translated by M. M. Pattison Muir. Philadelphia: J. B. Lippincott Co. Pp. 324, 12mo. Price, $1.75.

The importance which proper nursing is known to have in therapeutics has led of late years to systematic courses in this subject, both at general hospitals and in special schools. These courses have made special text-books a necessity. Dr. *Wise's* work * is the latest handbook of this sort to reach us. As the author says, the chief difficulty in a text-book of nursing is to strike a happy medium between a medical and a high-school text-book—to avoid extreme technicality on the one hand and a too superficial treatment on the other. Dr. Wise seems to have accomplished this. The first volume, with the exception of the last four chapters, which give some general instructions for the preparation and care of the sick-room, is devoted to a statement of the simpler facts of anatomy, physiology, hygiene, and sanitation which have a bearing on nursing. It is the second volume which is the real text-book. Methods of applying local remedies and bandaging are first taken up. The treatment of fractures, dislocations, inflammation, and hæmorrhage are next considered. Emergency work, artificial respiration, con-

* A Text-Book for Training Schools for Nurses. By P. M. Wise, M.D. 2 vols. New York: G. P. Putnam's Sons. Pp. 247 and 327, 12mo. Price, $1.25 each.

vulsions, coma, wounds, and burns are discussed in detail. Nervous diseases and insanity receive considerable attention. Bathing, massage, the administration of medicine and food, children's diseases, signs of death, and care of the dead bring us to the last four chapters, which treat of pregnancy, childbirth, and gynæcological nursing in general. The work is intended as a text book, for use in a school or hospital, and should be supplemented by clinical study.

In the preparation of his *Story of the Earth*, Dr. *Heilprin* * has sought to present briefly, forcibly, and in a more popular form than in most books of a similar nature, the general facts of geology. Avoiding the recapitulation of numberless details with which authors are easily tempted to burden a work on this science, and making his account narrative rather than adopting an analytical method, he has endeavored to make the book comprehensive enough to meet the needs of the average student, and enlist the attention of readers who would pass by a difficult technical work and would yet not be satisfied with an ordinary elementary one. He has made it a model of compactness, simplicity, lucidity, and readableness, touching upon all essential points, and dwelling on them long enough to make them understood, yet without tiring the reader. The illustrations are numerous, all photographs from the things themselves, largely American, and represent clearly what it is intended to show. First, the rocks are described as a whole; then "what a mountain teaches" is told; the operative forces in geology are presented—snow and glaciers, underground waters, the forces in the earth's interior, volcanoes and earthquakes, and corals and their island products; three chapters are given to the description of fossils; the physiognomy of the land surface is delineated; and the more useful metals and minerals, building stones, soils and fertilizers, and some of the commoner rock-forming minerals and minerals occurring in rocks are described.

The great interest which Prof. Weismann's theories regarding the problems of heredity have excited has led to the translation of a work by Dr. *Oscar Hertwig*, *The Biological Problem of To day*,* which was published last year in Germany. The book is practically a criticism of Weismannism, Dr. Weismann being the most prominent upholder of what is called the Præformation theory. The main question at issue is a purely biological and very technical one—namely, the process by which organic development is carried on. The Præformationists believe that the future organism exists in the germ, with its various parts differentiated, but of course so extremely minute as to render any physical appreciation of this fact quite impossible. The upholders of what is called Epigenesis, on the other hand, insist that in the beginning there is no such differentiation, but that the original germinating mass is practically homogeneous, and the subsequent specialization is "impressed" on different portions of similar material. Dr. Hertwig's book consists of a statement of his reasons for believing in epigenesis. Most of them are based on data gained during investigations of cell structure and growth, and by means of experiments on the lower forms of organized matter. Dr. Hertwig's name is associated with many of the most important advances in our knowledge of cells and embryology, and his views on the question in dispute are of the utmost value. In his introduction the translator has given a brief general statement of the early stages in the development of the vertebrate, which is intended as a help for readers not familiar with the subject of embryology.

We have just received a third edition of Dr. *Brinton's Myths of the New World.* The first edition, which appeared so long ago as 1868, has been somewhat superseded by later publications, and, while many of the recent contributions to the subject are not considered by Dr. Brinton to be as satisfactory as the work of the earlier writers, many of the opinions put forward in the original work as theories have now been accepted by most students of mythology, and require a restatement in more emphatic form. In its original edition the work was intended more for the thoughtful general

* The Earth and its Story. By Angelo Heilprin. Boston, New York, and Chicago: Silver, Burdett & Co. Pp. 267, with Sixty-four Plates.

* The Biological Problem of To-Day. By Prof. Dr. Oscar Hertwig. New York: The Macmillan Co. Pp. 148, 16mo. Price, $1.25.

reader than for the antiquary, and this idea has been kept in mind during the revision. There is a useful bibliography appended. (Philadelphia: David McKay, $2.)

The *Coming Ice Age*, by *C. A. M. Taber*, is an attempt to show the manner in which an ice age is being brought about, and is an extension, the author says, of a treatise published in 1894 on The Cause of Warm and Frigid Zones. The author's notion seems to be that ocean currents, in conjunction with winds and slight modifications in coast line, are sufficient to bring about the great changes in climate necessary to produce a glacial epoch in present temperate regions. The author sums up as follows: "Consequently, there seems to be no method yet devised through Nature's mode of action that can carry sufficient heat into the antarctic latitudes to melt the ice sheets from the southern continent, or even arrest their growth, while the Cape Horn channel maintains its present width and depth. Therefore the increase of glaciers and icebergs will slowly continue until a glacial epoch is perfected."

The *Transactions of the Kansas Academy of Science* for the years 1893-'94 has just come to hand. The volume begins with an article by the retiring president, entitled "Small Things," in which he calls attention to the great importance in scientific investigation of apparently trivial details. There are a number of mathematical papers, among which may be mentioned The Inverse of Conics and Conchoids from the Center, and Harmonic Forms. A long and well-illustrated account of Kansas Mosses is the most important paper in the botanical section. Mr. Robert Hay contributes a paper on the Economic Geology of the River Counties of Kansas, to which is appended an exhaustive bibliography.

Modern Optical Instruments, by *Henry Orford*, is intended apparently as an elementary text-book of practical optics. The construction and properties of the human eye are described in the earlier pages, as are also some of the commoner aberrations and defects to which our eyes are subject. The following chapters, which deal with the theory and practice of ophthalmoscopic examination, with the various forms of spectacles and the principles governing their use and selection, the stereoscope, the optical lantern, and the spectroscope, contain a very good elementary consideration of these various subjects. (Macmillan, 80 cents.)

Special Method in Natural Science is the title of No. 4 of a series of special methods in the common-school studies. It is intended to give the teacher "a general view of the problem of science-teaching." As in most books of this class, many of the suggestions seem trivial and unnecessary. Some of the hints, however, are good, and very possibly the others may be useful to that large class of teachers who are such through "circumstances," and not because of any special training or ability which they have for teaching. (Public School Publishing Company, Washington, Ill., 50 cents.)

An extended work on *Oceanic Ichthyology*, by the late Dr. *George Brown Goode* and Dr. *Tarleton H. Bean*, has been issued by the Smithsonian Institution. It consists of technical descriptions of all forms of fishes found in the seas of the world, accompanied by an atlas of 123 plates bearing 417 figures. The text forms a volume of 553 quarto pages and contains many new facts. This treatise appears at a time when no deep-sea explorations are in progress, and the final ichthyological results of all past expeditions have been published. The authors have aimed to assemble in it all existing scientific data concerning oceanic fishes, and it is not likely to be superseded as an authority for many years. Its preparation was carried on in great part amid the pressure of official duties. It was first ready for printing in 1885, was revised and rewritten in 1888 and in 1891, and again in 1894 as it was going through the press, these changes being made necessary by successive publications of new material. For the senior author, whose death occurred within the same month in which it was issued, this is a truly monumental work.

The *Tenth Annual Report of the Commissioner of Labor*, for 1894, makes a thick octavo volume and another about half as thick. It is devoted to strikes and lockouts, covering those occurring in the United States from January, 1887, to June, 1894, and forming a continuation of the Third Annual Report. For each disturbance there are given the occupation and number of the workers concerned, locality, cause or object, duration, whether successful or not, losses to employers and employees, etc. The main table of strikes is arranged by States, years, and industries, and occupies over 1200 pages of the first volume. The lockouts are presented in a table of 108 pages. The second volume contains summary tables in which the same information is presented from various aspects. From the commissioner's analysis of the tables, it appears that, of the 10,487 strikes occurring in the seven years and a half, 43·52 per cent were successful, 10·19 per cent partly successful, and 46·28 per cent failed. Of the lockouts—four or five hundred in all—48·87 per cent were successful, 10·15 per cent partly so, and 40·44 per cent failed. For the whole period of thirteen years and a half covered by the Third and Tenth Reports together, the loss to employees from strikes was, in round numbers, $164,000,000; from lockouts, $27,000,000. The losses to employers from the same causes were $83,000,000 and $12,000,000 respectively.

The Pedagogical Series of papers issued by the University of Pennsylvania has for its first number an account of *Three Typical Educational Systems*, by *Lewis R. Harley*, Ph. D. This consists of outlines of the public-school systems of Massachusetts, New York, and Michigan. While often referring to the origin of certain features, Dr. Harley has not undertaken to give a history of school administration in these three States, but rather to represent it as it exists.

The memoir on the discovery of *Argon* with which Lord *Rayleigh* and Prof. *William Ramsay* won the Hodgkins-Fund prize has been issued as one of the Smithsonian Contributions to Knowledge. This remarkable discovery has been widely described in both technical and popular journals, and a revised version of the memoir has been published in the Philosophical Transactions. The paper is here presented in the form in which it was submitted to the committee.

The Peabody Museum at Cambridge has begun a series of quarto publications with a memoir on *Prehistoric Ruins of Copan, Honduras*, being a preliminary report of the explorations made by the museum from 1891 to 1895. This report has been compiled by George B. Gordon from his field notes and those of Marshall H. Saville and John G. Owens, who at different times have carried on the explorations under the direction of the museum. It is intended to give only a general description of the ruins and a summary of the work of the several expeditions. It will be followed by special papers on the discoveries made. The museum has had the co-operation of Alfred P. Maudslay, the English explorer of Central America, and has adopted the names, letters, and numbers with which he has designated various portions of the ruins and some prominent sculptures, while for new features the letters and figures have been continued in sequence. The memoir is illustrated with a plan of the ruins and a considerable number of plates and figures representing stelæ, altars, and other pieces of sculpture. The explorations were made possible by the contributions of subscribers, whose names appear in the report.

It is a serious warning that is put into story form in *Cursed before Birth*, by *J. H. Tilden*, M. D. (the author, Denver)—a warning to women who shirk the cares of motherhood, to girls who think it is a benefit to be noticed by old and wealthy men, and to young men on whose shoulders rests the guardianship of a home. It is a warning also to those rapacious miscreants who imagine that they can prey upon the virtue of their communities without coming to a day of reckoning. Dr. Tilden writes with much earnestness, and there are many who should heed his admonition.

An elementary book under the title *Uncle Sam's Letters on Phrenology*, originally published in 1842, has been reprinted recently (Fowler & Wells Company, paper, 50 cents). The letters are written in a familiar style, with considerable pleasantry, and contain many illustrative anecdotes and allusions to public men and affairs of fifty years ago.

On account of the important position occupied by the alternating current transformer in systems of distribution for light and power, Prof. *Frederick Bedell*, of Cornell University, has been led to prepare a treatise on *The Principles of the Transformer*. "Ten years ago," the author remarks in his preface, "the transformer was born, and in one decade it has attained its maturity. During its development it has been the subject of much investigation and study and has been carefully considered from every standpoint, so that complete novelty of treatment is now scarcely looked for—in fact, would not be desirable. There is a demand, however, for a united and logical exposition of the principles involved. To this end the writer has turned his efforts and contributes the following pages." The subject has been kept within well-defined limits. Thus, while systems of distribution are briefly reviewed as bearing directly upon the principles of the apparatus, the subjects of fuel and boilers and of central-station operation have been excluded as irrelevant. The theory of the alternator is given in brief. The author has taken especial pains to make his book tend toward uniformity rather than diversity in notation. The C. G. S. system has been used for expressing magnetic quantities for the reason that international agreement as to names for magnetic units has not yet been secured. In elucidating the principles set forth, two hundred and fifty diagrams and other cuts are used, and the volume is adequately indexed.

The *School Algebra*, by *Emerson E. White* (American Book Company, $1), has among its distinctive features the early introduction of the equation, the application of arithmetical approaches to algebraic processes and principles, and the immediate application of facts and principles in simple exercises. Processes that do not appear generally in school algebras are the multiplication and division of polynomials by detached coefficients; a general method of factoring trinomials; the solution of quadratic equations by factoring; and in the closing chapters a simple treatment of undetermined coefficients, determinants, and curve tracing.

The Romance of Industry and Invention, consisting of articles selected by *Robert Cochrane* from the pages of Chambers's Journal, with additions, is a nice book for Scotch and English readers, but we fail to see why it should come to America (Lippincott, $1.25). One would suppose from reading it that the biography of the Englishman Wedgwood was the whole history of the pottery industry; that America has no cotton mills, but only serves with India and Egypt to furnish raw material to England; that only the gold fields in British possessions are worth more than a mere allusion, while Ericsson's Monitor with its revolving turret never existed. On the other hand, it does appear that the chief inventors of sewing machines were Americans; more credit is given to Morse for the telegraph and Field for the Atlantic cable than is usual in British popular writings; while Bell and Edison can not be hidden in any account of their inventions; and there is actually a distinct admission that "from the time of their last war with us down to within a quarter of a century ago our Yankee neighbors generally seemed to be a little ahead of this country in maritime matters."

A graphic lesson in *The Effects of Erosion*, due to forest destruction, is afforded in a chart recently issued by the United States Department of Agriculture. It bears three colored pictures showing respectively How the Farm is Lost, How the Farm is Regained, and How the Farm is Retained, each accompanied by a few lines of explanation and counsel.

In August, 1896, the first number of *The Hypnotic Magazine* appeared (Psychic Publishing Company, Chicago, $2.50 a year). It is edited by *Sydney Flower* and is devoted to "an investigation of the science of hypnotism, its uses and abuses, and its therapeutic possibilities." Among the articles in the first number is a report by Herbert A. Parkyn, M. D., of cases treated in the daily clinic conducted by him in Chicago. Other contributors are Charles G. Davis, M. D., W. L. Stevenson, M. D., and W. X. Sudduth, M. D. The contributors, although showing the confidence of enthusiasts, succeed in avoiding the extravagances that sometimes make hypnotism ridiculous, while the tone of the Introduction and other editorial expressions is modest and enlightened.

Visible Speech is a system of speech notation which uses symbols designed to suggest the proper positions of the vocal organs. It has been presented to the public by its author, Prof *Alexander Melville Bell*, in books adapted to a variety of needs. One now before us, *English Visible Speech in Twelve Lessons* (Volta Bureau, Washington, 50 cents), is intended as a first book for the use of children, foreigners, and the deaf in learning to read English. Each lesson is accompanied by cuts showing the positions of the vocal organs denoted by the new symbols introduced in that lesson, and by a page of directions for the teacher. There is also a table of vowels occurring in foreign languages. The first few reading exercises are adapted to children—most of the others to adults.

Under the title *Cheerful Philosophy for Thoughtful Invalids*, a little book of forty pages has been published by *William H. Clarke*, which is well calculated to aid those bodily afflicted in rendering their lives "less burdensome to themselves and more useful to others." While it is religious in tone it is not sanctimonious, and the practical application of its encouraging counsel is shown in several anecdotes (E. T. Clarke & Co., Reading, Mass., 50 cents).

According to the *Report of the United States Life-Saving Service*, the number of disasters within the scope of the service during the year 1894–'95 exceeded that of any previous year by seventy-nine. This large excess was in part due to the extension of the service, but chiefly to the conditions of weather which prevailed. The proportion of loss of life and likewise of property was smaller than in any year but one since the general extension of the service on the sea and lake coasts. The general superintendent still finds it necessary to urge upon Congress a more liberal and discriminating scale of payment for district superintendents and surfmen.

The somewhat ambiguous title of *The Nursery Book* denotes a guide to the multiplication of plants by Prof. *L. H. Bailey*, the third edition of which appears in The Gardencraft Series (Macmillan, $1). While there is a short chapter devoted to methods of sowing seeds, the book is mainly occupied with grafting, cutting, and similar processes. A special feature is the alphabetical Nursery List, telling how every plant generally known to gardeners is propagated. There are also a glossary and an index. The descriptions are illustrated with one hundred and fifty-two cuts. For this edition, the author says, "the entire volume has been thoroughly ransacked and renovated."

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Fragments of Science.

American Man in the Ice Age.—Very important evidence has been found during the past year of the existence of man in North America during the Ice age, or at least the latter part of it. The two chief items, coming from different parts of the country and established by the evidence of different observers working independently, are of sufficient force to make the conclusion exceedingly probable. First, we have the discovery by Mr. Volk, reported to the American Association by Prof. Wright and enlarged upon by Prof. Putnam, of argillite implements in the undisturbed glacial gravel near Trenton. The excavations, carried on during two years by Mr. Volk, in such a manner and through such formations that mistake was practically impossible, revealed a disturbed upper layer of sand and gravel, in which were implements of flint and argillite, and beneath this an undisturbed layer, compact and distinctly stratified, in which only implements of argillite were found. The opinion, reached by Prof. Wright and Prof. H. Carvill Lewis fifteen years ago, assigning this formation to "a period when the land stood one hundred and fifty feet below its present level, and when the cold waters from the melting glacier bore ice rafts which dropped their bowlders," is confirmed by Prof. Salisbury in his last New Jersey Geological Report, who holds that "it seems certain that the formation (Jamesburg) was produced during the submergence of the area which it covers," and that it has been only slightly eroded, contrary to the view of Prof. Chamberlin that the glacial deposit was an older one than this, and has suffered great erosions. The fact that only argillite implements were found in the lower stratum, while both flint and argillite are found in the layers above, contradicts the theory that they drifted down through cracks, root holes, etc., for in such drifting there could have been no selection of one kind of implements and exclusion of the other kind. The second piece of evidence was presented by Prof. E. W. Claypole, who described the finding of neolithic axes in digging a well in the blue till, twenty feet below the surface, at New London, Huron County, Ohio. The account of the workman who found the implements, given in full, describing the formations through which he passed in the digging, and confirmed by Prof. Claypole's personal inspection of the premises, is so distinct as apparently to leave no room for doubt. The circumstantial evidence sustaining his testimony is of the most convincing character. The passage from the yellow till into the blue till, and the occurrence of occasional strata of gravel, are characteristic of the glacial de posits of northern Ohio; and the axe had been subjected to oxidizing agencies characteristic of the deeply covered strata of that immediate vicinity. The Trenton discovery is interpreted as showing that there was a clearly marked succession of human occupancy in the Delaware Valley, in which, from the sole use of argillite implements, a transition occurred to the use of flint and jasper in later times; while in the Ohio discovery the conditions were such as apparently to exclude every supposition but that of the contemporaneous age of the implement with the formatiom in which it was found.

Nature Study in the Chicago Schools.—A plan for systematic outdoor or field work in connection with Nature study, to be carried on by the pupils of the public schools of Chicago, has been reported by a committee of sixty teachers which was appointed in May, 1896, by the Chicago Institute of Education. The features of the plan may perhaps be best understood by indicating the duties of the subcommittees which the general committee has instituted to care for its various special features. First is the executive committee, the purpose of which is to devise ways and means for carrying the whole into effect and to second the efforts and work of the other subcommittees. A committee on maps will prepare maps of the environs of Chicago to assist the pupils and teachers in a systematic study of the country at a convenient distance around the city; these maps to comprise large maps, each including only one of the most conspicuous geographo-geologic features, and smaller maps showing details—the location of the specific features of interest. The maps already made by Prof. T. C. Chamberlin, and kindly offered by him, will be used as the basis of this work. A committee on syllabi is to prepare printed outlines and suggestions which will intelligently and economically direct pupils and teachers in their consideration of the different areas and subjects chosen for study. The syllabus should not be compiled information, but should simply suggest the problems that are furnished for study by each area and indicate lines and methods of investigation. A fourth committee will look in the libraries after the books that may be useful to the pupils engaged in Nature study and available for their use. A committee on instruction and school exhibits will make themselves acquainted with the work of Nature study in the schools and with the teachers engaged in it, and make monthly reports to the committee of sixty of what is actually being accomplished, and will establish at some suitable place a permanent exhibit illustrating the character of the work. A committee of public information will see that all these things are made known and kept in mind. A committee on transportation will try to interest the railroads, etc., in the scheme, and to secure convenient facilities and privileges for the transportation of pupils and parties going out to fields of Nature study. Arrangements will be made for frequent trips of small numbers rather than for larger excursions at longer intervals, which might give the affair too much the air of a picnic. Hence it is suggested that only the pupils of one or two rooms be sent out at a time, under the immediate supervision of their teachers. A committee on finance and a conference committee are also instituted for the purpose indicated by their titles. It is anticipated by the committee of sixty that, when once under way, this plan will be expanded to include every department of school work.

Spitzbergen Explored.—The principal geographical work of the Conway expedition to Spitzbergen was the first crossing of the island, from Advent Bay to Agardh Bay. The country traversed was mapped, its geology was examined, and collections were made of its plants and animals. Afterward the whole expedition sailed northward to the Seven Islands, and through Kinlopen Strait and across Olga Strait to near King Charles Island. An attempt to complete the circumnavigation of Spitzbergen was blocked by ice. The highest peak in the island was ascended. The land animals observed were the bear, arctic fox, and reindeer, of which the last are abundant. Birds are individually numerous, but of few species. All the twenty-five recorded species were observed, except the snowy owl, and one unrecorded species was seen. The flora is remarkably uniform, and the influence of height has less effect upon it than situation and season. The species found on the mountain summits in the middle of the summer were the same as those observed on the coast at the beginning of spring. As the season advanced, the species first found in flower on the lowlands and in sheltered valleys were succeeded by another set; but at any time it was only necessary to seek exposed and barren positions, or to climb above the snow line, to find the first flora still in flower. Spitzbergen offered better opportunities for geological than for zoölogical or botanical research. One of the main temptations it offers the geologist is a magnificent opportunity for the study of glacial action; for there, says Mr. J. W. Gregory, of the expedition, we may see marine and land ice working side by side. The inland glaciers are very different from those of Switzerland, especially in having no *névé* fields. All the snow that falls on the collecting ground at the head of the glacier turns to ice on the spot. Cases of the formation of typical bowlder clay by land ice were easily found; so, likewise, were instances of the uplift of material through ice. The glaciation of Spitzbergen was solely due to a local ice action. No evidence was found of a great polar ice cap.

Care of the Lawn.—An interesting little article in Garden and Forest on lawn and grass infesting insects contains some valuable information for the suburban householder. Land cultivated in one kind of crop for many years successively tends to attract all the different kinds of insects that feed upon it. In some localities where onions were grown in times past with excellent results the onion maggots now make it impossible to raise a crop. In many parts of New York State wheat culture had to be abandoned for a time because of the ravages of the Hessian fly. Farmers have long known that after land has been in pasture for a few years, or has been mowed, the grass "runs out." They accept this fact, and act upon it without much questioning as to just what this running out consists of. In many cases it is simply because the land has become so thoroughly infested with grass-feeding insects that the roots are no longer able to support a growth. Insects are not confined to farms or farm lands; they occur wherever plants are grown in cities and villages, and are troublesome in the back yard, in the kitchen garden, to the shade trees, and even to the little patch of lawn in front of the house. The more extensive the lawn and, in a general way, the better kept it is, the more attractive it is to insects. Insects of almost all orders are found in grass lands, and, as there are few grass plots in which there is not also some clover, insects infesting this plant are also more or less abundant. It is always a matter of interest to determine what is causing the injury, but, after all, the important question is, What can we do to check it? On lawns, where the object is to keep the grass as long a time as possible, one of the simplest measures is frequent cutting and rolling. This has a tendency to drive off the *lepidopterous* insects that may be among the grass, and to prevent the laying of eggs. The grass should be always kept well fed; but no barnyard manure should be used: all insects do very much better in a soil containing much vegetable matter, and are least at home where mineral fertilizers are constantly used. Lawns should be fed almost entirely with mineral fertilizers, nitrate of soda being used to furnish the necessary nitrogen, and *kainit* or muriate to furnish the potash. The fertilizer should be applied just before a rain. Where land is badly infested and there is poultry about, it is a good plan to dig up the sod and turn the chickens in for a few days. They will, if the soil is turned over two or three times, pretty thoroughly dispose of the bugs. A kerosene emulsion is fatal to the insects and does not injure the plant roots.

The Advantage of Elective Courses.—The Hon. T. W. Higginson, referring in the recollections of his life which he is now publishing in the Atlantic Monthly to the time when he was secretary of the College Natural History Society at Harvard, observes that "in looking back on the various reports written by me for its meetings, it is interesting to see that this wholly voluntary work had a freshness and vigor beyond any which

I can now trace in any of the 'themes' of which Prof. Channing thought so well. There is no greater mark of the progress of the university than the expansion of the electives to include the natural sciences. My own omnivorousness in study was so great that I did not suffer much from our restricted curriculum; but there were young men in my time who would have graduated in these later days with highest honors in some department of physics or biology, but who were then at the very foot of the class, and lost for life the advantage of early training in the studies they loved. Akin to this modern gain and equally unquestionable is the advantage now enjoyed in the way of original research. Every year young men of my acquaintance come to me for consultation about some thesis they are preparing in history or literature, and they little know the envy with which they inspire their adviser; that they should be spared from the old routine to investigate anything for themselves seems such a happiness."

Forests and River Flow.—Mr. C. C. Vermeule observes, in a report of the State Geological Survey on Forestry in New Jersey, that in estimating the relation of forests to the flow of rivers we should not consider the points of extremely high and extremely low water, but should look for the beneficial effects in the stages which prevail during the months of an ordinary dry period. "The soil and subsoil of a watershed," he says, "hold a large amount of water, which is fed out as drainage, in the form of springs and seepage, to the stream during dry periods. It is a matter of common observation that at such times rivers continue to flow when the rainfall is much less than the evaporation, and indeed for long periods when there is no rainfall at all. Anything which tends to increase the amount of water which is held in the ground, and to regulate its discharge into the streams, tends to give a larger flow, and to shorten the periods of very low water in the streams during droughts, and with this increased capacity of the ground to absorb rain come also less frequent floods. Humus in the forest forms a great sponge, and of itself holds a large amount of water, while it and the inequalities caused by tree roots, etc., tend to prevent the water flowing over the surface, and the roots of the trees provide channels by which the water percolates into the subsoil readily. In this way the forest will easily absorb a larger amount of water than open lands. A high state of cultivation also has a tendency to increase the capacity of the ground to absorb water, because of constant loosening of the surface and the facilities provided for ready drainage. In this way cultivation, like forests, tends to render floods less frequent, but the effect of the drainage of the soil is that the ground water absorbed is fed out more rapidly to the streams during the early months of a dry period than is the case in forests; consequently the ground water is sooner exhausted and the duration of the low stages of the rivers during protracted droughts is thereby lengthened. Barren watersheds offer less capacity for absorption of rainfall. There is no humus or other matter on the surface to retain the rain, and the ground becomes hard and resists free percolation."

Long-lived Seeds.—M. Casimir de Candolle said, in an account in the British Association of experiments dealing with latent life in seeds, that seeds retain their germinating faculty for very long periods of time if kept dry and protected from all external influences which would produce changes in their physiological condition. The question as to what is their physiological condition during the period of rest is an interesting one. It is possible to conceive them as absorbing oxygen or as giving off carbonic dioxide. If the latter process takes place, the carbon must be supplied from the tissues of the seed itself. In that case would the seedlings produced from these seeds be normal? The author had raised perfect seedlings from seeds known to have been kept more than a hundred years. A remarkable instance of the length of time seeds may be preserved was afforded where, on clearing away heaps of rubbish which had been undisturbed for a long time in a silver mine in Greece, the ground over which the heap had lain became in a short time covered with a mass of plants, of which the seeds from which they sprang could not have been there less than fifteen hundred years. An Irish agriculturist in the audience said that certain fields in Ireland, which had long lain undisturbed, when plowed, produced an extraordinary crop of corn poppies. He thought that the physical texture of the soil would probably account for the long period during which the seed must have lain dormant. It seemed that in hard, closely packed soil seeds could remain in the resting state, but that they would assume their vital condition as soon as the soil was loosened. Another gentleman said that this power of seeds to germinate after a dormant period threw light on the glacial theory, since the seeds might possibly have remained buried in the quiescent state and then have germinated after the flow of ice had reached farther south.

Uses of Sawdust.—The most usual and extensive use of sawdust is probably as an absorbent on floors and in spit-boxes, but it has found many other economical applications. Compressed with pitch or with its own intrinsic resin if it be very resinous, it forms excellent kindling blocks; it may be burned as a fuel in specially prepared fireplaces. Fuel blocks are made by compressing it with various substances. An artificial hard wood is mentioned as formed in this way. At some factories it is distilled for purposes of lighting and the ammoniacal by-products. Oxalic acid is made from it by the process of Capitaine and Herlings. It forms a valuable litter for stables, and has fertilizing qualities of its own. Eggs are preserved by being carefully packed in it. With albumin, liquid paste, alum, bichromate of potash, or molasses it makes excellent briquettes; with cement, lime, or gypsum, a material for constructions; and with slaked lime, an excellent mortar. Mixed half and half with sand and clay, a material for partition walls and ceilings is formed. Sawdust is, therefore, a very useful material.

First Uses of Gunpowder.—The invention of gunpowder is shown by Mr. Oscar Guttmann, in his book on the Manufacture of Explosives, to have been most probably an evolution. The Greek fire of naphtha, mentioned by early European and Arabian writers, is believed to have been a composition containing niter, sulphur, and charcoal. Marcus Græcus, who wrote in the tenth century, gives a composition for charging rockets and crackers closely approaching that of modern blasting powder. This receipt is quoted by Albertus Magnus, and another one, not so clear, is given by Roger Bacon. None of these writers, however, speak of the use of such substances in any way like the firing of projectiles from guns; on the contrary, they all describe crackers and bombs or maroons, and say that these were discharged into towns from ballistæ or catapults or mangonels for the purpose of setting fire to them. Mr. Guttmann has found, however, in the Wardrobe Accounts of King Edward III of England, an entry between A. D. 1345 and 1349 giving credit to one Thomas of Roldeston for the king's work for his guns, for nine hundred and twelve pounds of saltpeter and eight hundred and eighty-six pounds of live sulphur. This seems to confirm the tradition that guns were used by the English at the battle of Crécy in 1346. Mr. Guttmann decides that Berthold Schwartz invented this use of gunpowder about 1313; if so, Schwartz must have been very young at the time, or else have lived to a very great age, for the date of his death is given as 1384.

French Mushrooms.—Mushroom-growing in France is a matter of ancient history, and the variety of mushrooms is infinite. The industry originated in a peculiar way. When the French began to make beds for their melons they noticed that large numbers of mushrooms would suddenly appear on the little mounds. They proved as profitable as the melons, but a crop could not be depended on. A number of investigators went to work to discover methods by which a fairly certain and regular crop could be obtained. They have partially succeeded, and the result is an industry very profitable to all concerned, and a consumption of mushrooms in France which is now something enormous. The mushroom loves a cool, damp place, and light has a decided effect upon its color, sunlight turning the surface to a reddish brown. It is for these reasons that it is usually cultivated in caves. In the department of the Seine there are over three thousand of these subterranean truck gardens, most of them deserted stone quarries. The people who cultivate them are said to practically live underground, and are called *champignonistes.* The beds are made as follows: A dry and clean place near the mouth of the cave is selected. The spot is covered with manure, which is allowed to lie undisturbed for several days. The manure is then thoroughly worked over, all foreign matter being removed, and then beaten and pressed down into shape. After about a week the process is repeated and the beds are watered. At the end of another week the surface will be brown and fermentation very active. At this stage the first turning must be repeated, when the mass is again allowed to rest three days. It should then be soft to the touch, but leave no moisture upon the hand. The temperature requires to be carefully watched, and the first heat of fermentation must be allowed to pass off before the *blanc* or spawn is sown. After the spawn is planted the beds are covered with a thin layer of prepared earth called *goptage*, kept well watered, and in about forty days the mushrooms will appear. A bed will with proper attention produce a continuous crop for three months. The seed, spawn, *semence*, or *blanc* (mycelium) is usually supplied by the market gardeners from old melon beds. It is sold in the shape of a brick or cake, which, if placed in a dry, airy place, preserves its vitality for several years. The annual crop of mushrooms in France is valued at about two million dollars.

Caviare in Russia.—In Russia fish plays a very important part in the economy of life. On fast days, of which there are so many, it is an indispensable article for the whole nation, and on other days many of the people, who are too poor to buy meat, depend on fish as their only animal food. Russia's numerous rivers and extensive coast line make fish a cheap and common food there. The most valuable products obtained from fish in Russia are cod-liver oil and caviare; the latter coming mainly from the sturgeon. The United States consul at St. Petersburg is given as authority for the following description of the preparation of caviare: The roe is taken out of the fish, and the egg bags in which it is inclosed are removed by rubbing the mass on a sieve; the eggs pass through the meshes, while the skin does not. When fish are in the first stage of decomposition, the egg skins get so soft that they can be readily separated from the roe, and from these the low grades of caviare are made. The caviare is next placed in brine. The difference between the so-called fresh caviare and the ordinary material put up for keeping or export consists in the longer or shorter time it is allowed to remain in the brine, and also on the strength of the latter. Immediately after the eggs have been rubbed through the sieve, they are put through the brine, and as soon as they are deprived of the superfluous salt, are placed in tin jars or cans and small wooden kegs, and the so-called fresh caviare, which is high priced, is ready for market. The cheaper kind is cured in the brine and then put into linen bags and pressed. This is called pressed caviare. During ten months of 1895 Russia exported 4,658,448 pounds of pressed and 613,904 pounds of fresh caviare.

Venomous Fishes.—In many seas, especially those of the tropics, are found fish provided with a poison apparatus, which consists usually of a spine or spines more or less erectile in character, and connected with a poison gland. Prof. James D. Brunton gives an interesting account of two of these fishes, the *Trachinis draco* and *Scorpæna scropha*. They are only poisonous as a serpent is poisonous —i. e., by wounding; their flesh is good and wholesome. Although the fish differ widely in appearance, yet the poison produces the same effect. The *Trachinis draco* is a handsome fish, not unlike a trout in general appearance. Upon each of its gill covers is situated the spine, connected with its poison gland through a duct formed by the combination of a groove in the spine and a very thin membrane, which covers the latter almost to its point. When the spine enters a resisting body, the membrane is pushed back, allowing the poisonous secretion free access to the wound. The gland is small, with nucleated colorless cells secreting a transparent fluid. The *Scorpæna*, on the other hand, is an unattractive-looking fish, squat of body and having a large, misshapen head. It may attain a large size, and is called by the French fishermen "*le diable.*" The special organ in this fish is connected with the first three rays of the dorsal fin, the duct being formed as in *Trachinis*. There is also a spine on each gill cover connected with a poison gland. The effect of a wound from either of these fish is quite a serious matter. At the moment of puncture only the sharp prick is felt. In a few minutes, however, the part commences to burn and itch, and then becomes acutely painful. These pains increase in violence and extent. Then a feeling of suffocation is felt, and pain over the heart. From this time commence those cries of anguish which can always be recognized as caused by the acutest torture and fear. The cries are continuous, and beads of sweat stand on the brow. Flashes of light pass before the eyes, and the pulse is found to beat intermittently. Finally, delirium and convulsions supervene, which may pass on to collapse and death, or may, after lasting for many hours, gradually subside, leaving a *malaise* which is very difficult to get rid of. The point of puncture soon shows the results of intense irritation, and may eventually become gangrenous and necessitate amputation. The treatment is practically the same as that for a snake bite. The poison approaches that of the serpent in character, being alkaloidal, very quickly decomposed, and intensely rapid in action. It is secreted in larger quantities at the spawning season, and is most active in the male fish. On coasts where these fish abound it frequently happens that bathers are poisoned by stepping on one of them, the *Trachinii* being especially fond of concealing themselves just under the sand in shallow water. It would be of interest to know whether Dr. Calmette's snake-bite antitoxin is also efficient against the venom of these fishes.

Baku.—A very interesting account of Baku, the great petroleum center in Russia on the Caspian Sea, is given by W. F. Hume. Its growth, it seems, has been almost Western in rapidity. What was an insignificant town of fourteen hundred inhabitants thirty years ago, is now a flourishing city of over one hundred thousand souls whose population is still rapidly increasing. Two causes have combined to bring about this rapid growth: First, its magnificent harbor, and, secondly and chiefly, its proximity to the main area of naphtha supply, which already rivals that of America in productiveness. Several attempts were made to start refineries in this district, the first by the brothers Doubinnin in 1823, but until 1859, when M. Kokareff founded the Baku Petroleum Company, none of them were successful. In 1865 the first refinery was established in Baku itself, and so rapidly did the industry develop, that in 1873 the town was in danger of becoming entirely absorbed by the distilleries that rose on every hand, while the black, dense, and acrid smoke from the naphtha-fed furnaces poisoned the atmosphere. The nuisance became such a serious one that the whole industry was moved outside the town (by an edict of the Government, which is Russian). How intolerable it had become, may be inferred from the fact that the sole firing material for the furnaces was the refuse oil, and no smoke-consuming appliances were employed; not only the buildings but the whole surface of the ground became coated with a thick layer of soot, while the roads were almost impassable, owing to pools and ponds of oil. The city received the name, *Tchornoia Gorod* (black town), which still clings to it. Through the use of a smoke-consuming device the present factory district is quite free from soot, and is hence called the white town. Baku is a commercial center, but most undesirable for residential purposes. It is subject to heavy dust storms, rainlessness, intense heat, and there is an almost entire absence of vegetation and fresh water. The only garden is the so-called Alexander II, maintained at great expense, the shrubs and trees being planted in imported soil. The spot of chief interest about the town is the plateau of Balachani-Sabountchi, situated about eight miles to the northeast of Baku. Here are located the great petroleum wells. Viewed from a distance the tall, closely set, truncated towers erected over the wells look almost like a pine forest. These pyramids consist of a wooden boarded framework, and are easily removable when the bore becomes exhausted. The Baku district is so saturated with naphtha oils that there is an ever-present danger of serious fires through the ignition of the hydrocarbon gases, which escape not only from the bores but through every fissure and cleft in the soil, and, although every possible precaution is taken, many disastrous fires have occurred.

A feature of considerable interest is the ancient temple of Zoroaster, which for twenty-five hundred years was the sacred resort for pilgrimage of the Guebers or fire-worshipers of Asia. Although, owing to its importance as a commercial center, Baku at present almost monopolizes the petroleum industry in southern Russia, it is but one of many important oil fields in this district.

Life in the Coldest Country.—The coldest region of the globe, that of Werkojank in Siberia, where the lowest temperature of −90° F. has been observed, and the mean of January is −48° F., is inhabited by about ten thousand five hundred persons of the Jakut and Lamut races. In a large part of the region, according to the representations of Mr. Sergius Kovalik in the Bulletin of the Geographical Society of Irkutsk, the air is so dry and winds are so rare that the intensity of the cold is not fully realized. Farther east there are sometimes terrible storms. In the summer time the temperature sometimes rises to 86° F. in the shade, while it freezes at night. The latter part of this season is often marked by copious rains and extensive inundations. Vegetation is scanty. There are no trees, only meadows. The people hunt fur-bearing animals, fish, and raise cattle and reindeers. It requires about eight cows to support a family, four being milked in the summer and two in the winter. The cattle are fed hay in the winter, and are allowed to go out occasionally when it is not too cold, their teats being carefully covered up with felt. Milk is the principal food, occasionally supplemented with hares, which are quite abundant. The houses are of wood, covered with clay, and consist of one room, in which the people and their animals live together. The wealthier classes are better provided with lodging and food. The people are very hospitable, but excessively punctilious concerning points of honor, such as the place at table.

MINOR PARAGRAPHS.

The great work described by M. P. Demoutzey in reforestation and the stemming of mountain torrents in France has been fittingly eulogized by M. Dehérain. Not more than a quarter of the work contemplated has been accomplished; but that which has been done proves what may be done, and that the solution of the difficult problem has substantially been reached. The needed work is not long or very expensive; it is only to assist Nature by easy and simple devices, and keep at it. When this is done, thirty or forty years will be long enough to produce great changes in the conditions and appearance of a devastated and torrent-rent region. M. Demoutzey's book is illustrated with plates and photographic views showing the character of the work accomplished.

Originally the area of natural gas in Indiana, according to the last report of W. S. Blatchley, State Geologist, embraced part or all of seventeen counties lying northeast of the center of the State, and comprised about five thousand square miles. On account of the encroachment of salt water and petroleum this area has become gradually reduced, until to-day the main gas field includes an approximate area of twenty-five hundred square miles. This, however, it is claimed, is larger than has ever been possessed by any other State in the Union. The average initial or rock pressure of the entire field in 1889 was three hundred and twenty-five pounds to the square inch. To-day, according to careful measurements, it is two hundred and thirty pounds to the square inch over the main field. Hence it is not doubted that the supply is diminishing, and that, as there can be no increase of it, the pressure will decrease more rapidly in the future than it has done in the past. The diminution in pressure is most noticeable in cities like Indianapolis and Richmond, which receive their supply through pipe lines, and less so in the cities that lie wholly within the field.

The library of the distinguished chemist August von Kekulé, of the University of Bonn, lately deceased, is in the hands of Gustav Fock, Magazingasse 4, Leipzig, for sale. Seldom has a collection of such value been put on the market. It was made with rare zeal and most intelligent judgment exercised through many years, and is so complete that hardly any work of scientific character and standing or scientific journal is missing from it. It contains about eighteen thousand volumes, dissertations, pamphlets, etc., most of which are bound. Among the treasures of the library are complete sets from the beginning up to 1895 or 1896 of twenty-five of the most important scientific (particularly chemical) periodicals—German, French, Italian, English, and American—and series of from fifteen to twenty-five years of six others; and a rich collection of alchemistic books published in former centuries. It seems to us very important that this collection should be kept in its integrity; indeed, it might be regarded as a scientific misfortune if it should be scattered; and it is to be hoped that some learned institution or library, or some benefactor of such, may find the way clear to buy it as a whole.

The researches of M. King concerning the retention of moisture in the soil, while they confirm the view that good cultivation offers an impediment to evaporation, show that bad harrowing and incomplete stirring of the soil have a different effect. A harrowing which simply scratches the ground without covering it with loose earth increases evaporation instead of diminishing it. So a dressing of the soil which extends to less than three centimetres in depth offers but a slight impediment to the escape of water. But a thin coating of dry earth (two centimetres) suffices to reduce the evaporation considerably, and a stirring of the soil from five to seven centimetres in depth will cause the moisture in arable land to be retained. The influence of manures was also studied. They isolate the surface, expose it to complete desiccation, and cause suffering to the crops, particularly in dry weather. The manure in another season becomes mixed with the soil, and the inverse effect is observed. The superficial layers gain moisture.

It appears from the studies of H. L. Russell and John Weinziel of the bacterial flora of American Cheddar cheese at the various phases of the ripening process, reported upon at the American Association, that for the first ten days the number of microbes diminishes from that contained in the milk. Soon an enormous development of organisms of the lactic-acid group begins, while the digesting and gas-producing bacteria gradually decrease. A period of decline succeeds this stage, and continues throughout the life of the cheese until, in the course of a year or two, it is almost sterile. The physical changes that mark the curing of the cheese begin to appear at the same time with the marked development of lactic-acid bacteria. The authors hold that these facts can not be reconciled with the theory that the digesting bacteria are the active agents in the curing.

One of the curious animal stories published in the London Spectator is of a dog belonging to an Oxford University man, which, being excluded from the college at night according to the rules, is kept at a house some distance off. Every morning it comes of its own accord to the owner's rooms, and is accompanied in its morning walk by a Cochin-China hen and a kitten belonging to the man with whom the dog is left during the night. The hen and kitten, not being permitted to enter, always leave the dog at the college (Balliol) gates. Another story in the same number of the Spectator relates to a canary bird whose seed trough was always found empty, though kept well supplied. One morning, observing that the bird appeared much excited and was singing lustily, its master looked and saw a mouse slowly climb down the cord, get through the bars of the cage, and, reaching the seed trough, eat the food with great relish, while the bird continued to sing. Finally, a cat caught the mouse, and the canary was never known to sing again.

An odd controversy has been going on between the Roman Catholic Journal, *Volkszeitung*, of Cologne, and the Abbé Künzle, of Feldberg, in Tyrol, concerning the authenticity of an alleged signature of the devil. The *Volkszeitung* denies the authenticity, and insists that it is not possible to procure an authentic signature of his Satanic Majesty. The abbé declares, on his side, that the devil Vitru appeared in October, 1883, in the lodge room of a Masonic lodge, where were several eminent men, including M. Crispi, and announced that a young woman named Sophia Sapho, who was present, would on the following September give birth to a daughter, who would be the grandmother of the Antichrist. He even condescended to sign a minute, which was drawn upon the spot, attaching to it the title *Sanctus Demon Primarius Præses*—which may mean "Holy Devil, First President"—with his signature, consisting of various symbolical signs, among which were a cock, a fork, etc. The *Volkszeitung* declares that it is superstition to believe in the authenticity of the signature, although it credits the possibility of compacts between the devil and the wicked. Père Künzle believes that it is consistent with sound doctrine to hold that the signature is that of the Prince of Evil. This is the point of controversy; and the scientific may look on, though not troubled about the matter.

NOTES.

M. Émile Rivière has discovered and explored for a length of one hundred and twenty-seven metres a prehistoric grotto in the department of Dordogne, France, the walls of which are covered with designs cut in the rock. As some of the figures pass under stalagmites, a great age is predicated for them.

M. Olszewski, having failed to liquefy helium, calculates that its boiling point is below $-264°$ C., or at least $20°$ below that of hydrogen. Were the temperature of ebullition calculated as a function of the density, it would be much higher, the density of helium being double that of hydrogen. Both helium and argon have boiling points much lower than was supposed—a fact which may be accounted for by the monatomic structure of the two substances.

A number of neolithic axes were described in the American Association by Prof. E. W. Claypole, which were found at New London, Huron County, Ohio, by an intelligent workman while digging a well in the blue clay at twenty feet below the surface. The features of the formation were those characteristic of the glacial deposits of northern Ohio. Heretofore, numerous flying reports of the discovery of implements in the glacial till have been made, but this, Prof. Wright says, is the first instance where the evidence has seemed in itself altogether convincing and satisfactory.

Bearing in mind that an estimated average length of pupilage is frequently made an important consideration in arranging some of the points of school management, Prof. C. M. Woodward undertook to deduce, from the comparison of the school statistics of several cities, the average age at which pupils withdraw from the public schools to engage in the active duties of life, or to enter private schools. He could get full statistics only from St. Louis, Chicago, and Boston. In these cities the average age of withdrawal is, severally, 13·3, 14·5, and 15·9 years.

M. Loewy, a fully trained astronomer who has made his reputation along many lines of research, and who has for many years belonged to the staff of that institution, has been selected by the French Government to succeed M. Tisserand as Director of the French Observatory.

Recent researches by Prof. J. A. Hennig indicate that pure metals have their electrical conductivity immensely increased by intense cold, while alloys experience in the same circumstances a comparatively small increase, not more than ten per cent. Prof. Hennig lays great stress on the value of these facts, as a means of testing the purity of a metal, almost rivaling the spectroscope in delicacy.

It is said that the German Government has recently sent Prof. Koch and Dr. Kohlenstock, both bacteriological experts, to the Cape to inquire into the plague of rinderpest, and to report what measures are best to prevent its spreading to the German Southwest African colonies.

At a meeting held at St George's Hospital (London) early in December, it was resolved "That the present year, being the centenary of the first successful vaccination, is an appropriate time to inaugurate a work of national utility in honor of Edward Jenner." A second resolution to the following effect was passed: "That a subscription be set on foot with the view of founding some institution of a nature to be hereafter determined in connection with the British Institute of Preventive Medicine, to be distinguished by Jenner's name."

The forest department in India is now paying its way handsomely and more, the profits having been going up steadily since 1875. While for the five years ending with that they stood at eleven lakhs, the profits for the five years ending in 1895 were fifty-three lakhs, or just short of five times as much.

Miss M. Peacock has published a paper in the magazine Folk Lore on executed criminals and folk medicine, in which are collected instances of belief in the medical effects of the touch of the body of an executed criminal.

An account of a number of remarkable cases of psychical or hypnotic phenomena which have fallen under his own observation, or have been investigated by the Society for Psychical Research, has been prepared by Dr. R. Osgood Mason, of this city, and is to be published by Henry Holt & Co., under the title of Telepathy and Subliminal Research. It will illustrate a theory held by the author and some other investigators of a principle pervading all the phenomena in question of a second self, to which the name subliminal (under the threshold) has been given, that acts and perceives in manners entirely unknown to our ordinary everyday consciousness.

The French colony of New Caledonia is troubled by the depredations of deer, which multiply with marvelous rapidity and invade the plantations, where they do great mischief, even climbing up into the granaries. A curious feature of the trouble is that the deer are not native, but are the offspring of a present made to the colony by the Queen of England. The *Revue Scientifique* draws from this fact a lesson that it is well to be cautious concerning the gifts of animals we may bestow upon other countries, and not make them without advice from experts concerning the conditions and contingencies. Rabbits in Australia, the mongoose in Jamaica, and the New Caledonian deer afford instances in which such gifts, made with the best intentions, have resulted disastrously. It is said that the farmers of the State of Maine have also suffered from the incursions of deer since restrictions were placed upon the hunting of them.

Women are gradually working their way into the German universities, where a few have been admitted, not as of right, but as of favor. Five ladies have up to this time taken the doctor's degree at Heidelberg. One of them, an American, made so brilliant a success that she was at once offered an appointment at the German zoölogical station near Naples.

The curious fact is noted by Mr. C. C. Vermeule, in his forest studies of New Jersey, that less disposition to destroy and waste the forests is shown by the native population than by the immigrants from countries where the control and management of the forests are, on the whole, superior to our modern methods.

The gypsies—those of Hungary, at least—are not all wanderers. Of 274,940 representatives of that race enumerated in 1893, 243,432 were described as sedentary, 20,406 as semi-sedentary, and only 8,938 as nomads, while 2,164 were soldiers or prisoners. All of them profess one of the various forms of Christianity of the people among whom they dwell, and only 82,405 are still able to talk gypsy dialects. Seventeen thousand of them are musicians.

Prof. Emil Du Bois-Reymond, of the University of Berlin, one of the most famous and many-sided German men of science, died, December 26th, aged seventy-eight, having been professor at Berlin since 1855. He had been suffering for several months from general debility, but his death, when it came, was sudden, though not unexpected. He was one of the earliest and most vigorous champions of the doctrine that biological phenomena are governed by physical and chemical laws, and ranked alongside of Tyndall and Huxley as a lecturer and popularizer of the natural sciences. Several of his ablest addresses have been published in the Monthly, including the Seven World Problems and The Limits of Our Knowledge of Nature—perhaps the two most famous of all. A sketch of his life and work to that time was published, with a portrait, in the Popular Science Monthly (vol. xiii) for July, 1878.

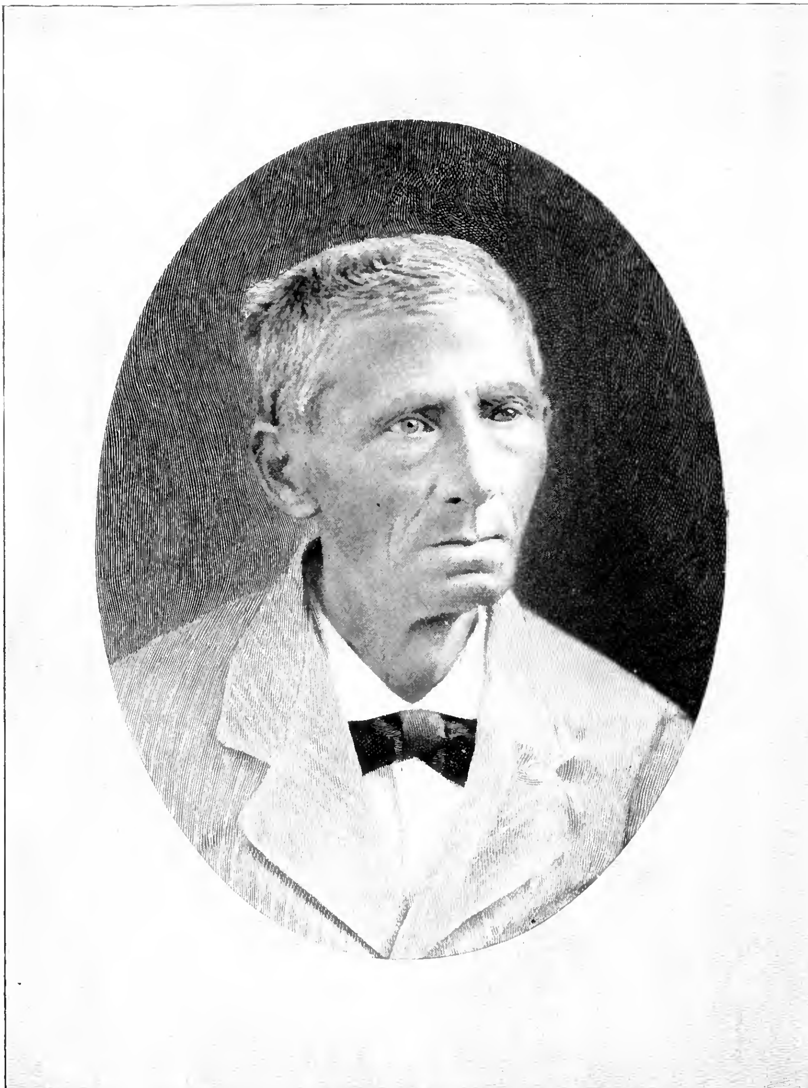
We have learned of the death of the Hon. Horatio Hale, of Clinton, Ontario, one of our most distinguished anthropologists, particularly in the study of aboriginal languages, but have received no details of the event. He was the author of several valuable articles in the Monthly.

Dr. Henry Tremen, formerly Director of the Botanic Garden at Peradenyia, Ceylon, who died October 10th, in his fifty-third year, was author of the Flora of the County of Middlesex, England, and, in conjunction with Prof. Bentley, of a standard work on Medical Botany; and had prepared a complete Flora of Ceylon, of which three parts have appeared.

August Trécul, who recently died in his seventy-sixth year, a distinguished plant anatomist and author of important technical studies in his specialty, spent three years in Texas, collecting material for the Paris Museum, and studying the textile plants used by the Indians.

Captain John Gregory Bourke, of the United States Cavalry, who died June 8th, besides being a gallant soldier, was an ethnologist of much repute. He had done much work in connection with the Bureau of Ethnology, and spent five years from 1886 in Washington compiling the ethnographic notes he had collected during his service in the West, and pursuing collateral studies. His most famous work was on the Snake Dance of the Moquis of Arizona, which attracted great attention all over the world and brought into prominence a branch of anthropology which had been relatively little studied. He was also author of works on the Medicine-men of the Apaches, and Scatalogic Rites of All Nations.

Hugo Gylden, Astronomer of the Royal Swedish Academy of Sciences and Director of the Observatory of Stockholm, who died November 9th, ranked with M. Tisserand as one of the most illustrious mathematical astronomers on the European continent. He was the son of Prof. Gylden, of the University of Helsingfors, where he was born in 1841. He was best known by the work which he had carried on since the death of Leverrier on the general theory of perturbations, and by his great treatise on the absolute orbits of the eight principal planets.



JOHN CHRISTOPHER GUNDLACH.

APPLETONS' POPULAR SCIENCE MONTHLY.

MARCH, 1897.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

By WILLIAM Z. RIPLEY, Ph. D.,

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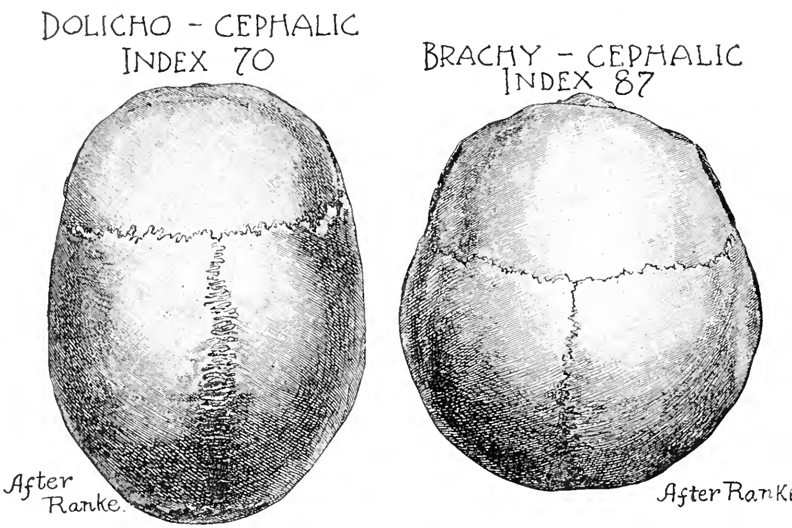
II.—THE SHAPE OF THE HEAD AS A RACIAL TRAIT.

THE shape of the human head—by which we mean the general proportions of length, breadth, and height, irrespective of the "bumps" of the phrenologist—is one of the best available tests of race known. Its value is, at the same time, but imperfectly appreciated beyond the inner circle of professional anthropology. Yet it is so simple a phenomenon, both in principle and in practical application, that it may readily be of use to the traveler and the not too superficial observer of men. To be sure, widespread and constant peculiarities of head form are less noticeable in America, because of the extreme variability of our population, compounded as it is of all the races of Europe; but in the Old World the observant traveler may with a little attention often detect the racial affinity of a people by this means.

The form of the head is for all racial purposes best measured by what is technically known as the cephalic index. This is simply the breadth of the head above the ears expressed in percentage of its length from forehead to back. Assuming that this length is 100, the width is expressed as a fraction of it. As the head becomes proportionately broader—that is, more fully rounded, viewed from the top down—this cephalic index increases. When it rises above 80, the head is called brachycephalic; when it falls below 75, the term dolichocephalic is applied to it. Indexes between 75 and 80 are characterized as mesocephalic. The two skulls in our illustrations, viewed from above, show how marked the differences in these proportions may be. In very rare instances the index may run in individuals as low as 62, and it has been observed as high as 103—that is to say, the head being broader than it is long. In our study, which is not of individuals, but of racial groups, the limits of variation are of course much



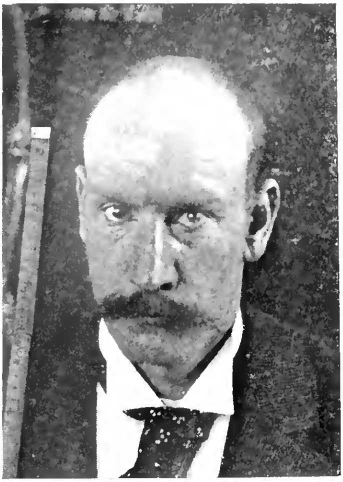
less. We shall seldom find heads in any considerable numbers exceeding the limits roughly indicated by the two crania in our illustrations.*

A factor which is of great assistance in the rapid identification of racial types is the correlation between the proportions of the head and the form of the face. In the majority of cases, particularly in Europe, a relatively broad head is accompanied by a rounded face, in which the breadth back of the cheek bones is

* Our data are drawn in the main not from the relative proportions of each type of head occurring within a given area, but from general averages made up by including all head forms alike. The more scientific method would be to give the relative proportions of each type of head; but that is impossible with the present data. It is a comforting circumstance, however, that the results drawn from the average approximate closely enough to those obtained in the other way for all general purposes. Oftentimes, for lack of data, it is impossible to employ the more scientific method for detailed analysis. Anthropologists distinguish between the relative proportions of the head measured over all the soft tissues, giving the cephalic index, and those taken from the skull divested of all its fleshy parts, in which latter case the relation of length to breadth is expressed by the so-called cranial index. Experience has shown that the cephalic generally exceeds the cranial index by two units, more or less. In other words, the living head is relatively broader than the cranium by about three per cent. This would fix our extreme indices on the living head at about 72 and 89 for averages.

considerable as compared with the height from forehead to chin. Anthropologists make use of this relation to measure the so-called facial index; but a lack of uniformity in the mode of taking measurements has so far prevented extended observations fit for exact comparison. It is sufficient for our purposes to adopt the rule, long head, oval face; short head and round face. Our six types on the next page, arranged in an ascending series of cephalic indices from 65 to 94, make clearly manifest this relation between the head and face. In proportion as the heads become broader back of the temples, the face appears relatively shorter. The correspondence is not exact, as, for example, in the case of the brachycephalic type from Piedmont in Italy, where the face is rather long for the breadth of the head. This is probably a case of individual variation, perhaps due to racial intermixture. Only a few examples of widespread disharmonism, as it is called, between head and face are known. The Greenland Eskimos resemble the Lapp shown in our portrait in squareness of face, notwithstanding the fact, illustrated in the world map on page 582, that they are almost the longest-headed race known. In Europe, where disharmonism is very infrequent among the living populations, its prevalence in the prehistoric Cro-Magnon race, will afford us a means of identification of this type wherever it persists to-day. At times disharmonism arises in mixed types the product of a cross between a broad and a long headed race, wherein the one element contributes the head form while the other persists rather in the facial proportions. Such combinations are apt to occur among the Swiss, lying as they do at the ethnic crossroads of the continent.

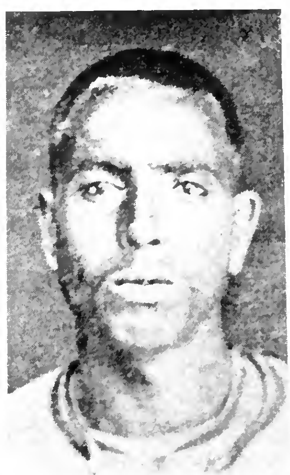
An important point to be noted in this connection is that this shape of the head seems to bear no direct relation to intellectual power or intelligence. Posterior development of the cranium does not imply a corresponding backwardness in culture. The broad-headed races of the earth may not as a whole be quite as deficient in civilization as some of the long heads, notably the Australians and Melanesians. On the other hand, the Chinese are conspicuously long-headed, surrounded by the barbarian brachycephalic Mongol hordes; and the Eskimos in many respects surpass the Indians in culture. Dozens of similar contrasts might be given. Europe offers the best refutation of the statement that the proportions of the head mean anything intellectually. The English, as our map of Europe will show, are distinctly long-headed. Measurements on the students at the Massachusetts Institute of Technology are fairly typical for the Anglo-Saxon peoples. Out of a total of 486 men, four were characterized at one extreme by an index below 70; the upper limit was marked by four men with an index of 87. The series of heads culminated at an index of 77,



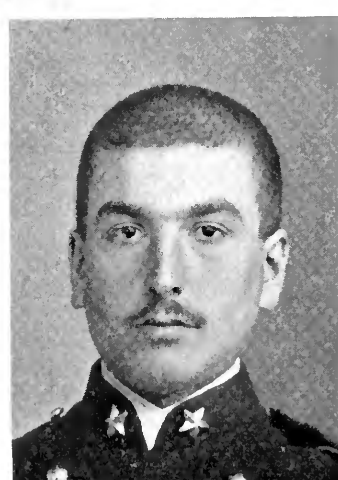
BASEL, TEUTONIC TYPE.
Cephalic Index, 64.

possessed by 72 students. This figure is near the average for the British Isles; and likewise, it should be added, for Hottentots and the wild men of Borneo, as our world map shows. Comparisons have been instituted in parts of Europe between the professional and uncultured classes in the same community. The differences in head form are as apt to fall one way as another, depending upon the degree of racial purity which exists in each class.* In our study of the proportions of the head, therefore, we are measuring merely race, and not intelligence in any sense. How fortunate this circumstance is for our purposes will appear in due time.

Equally unimportant to the anthropologist is the absolute size of the head. It is grievous to contemplate the waste of energy when, during our civil war, over one million soldiers had their heads measured in respect of this absolute size, in view of the fact that to-day anthropologists deny any considerable significance attaching to this characteristic. Popularly, a large head with beetling eyebrows suffices to establish a man's intellectual credit; but, like all other credit, it is entirely dependent upon what lies on deposit elsewhere. Neither size nor weight of the brain seems to be of importance. The long, narrow heads, as a rule, have a smaller



BERBER, TUNIS.
Cephalic Index, 72.



ISLAND OF ISCHIA, MIDDLE ITALY.

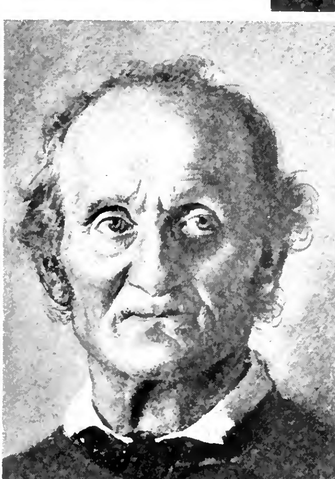
* Dr. Livi finds that in northern Italy the professional classes are longer-headed than the peasants; in the south the opposite rule prevails. The explanation is that in each case the upper classes are nearer a mean type for the country, as a result of greater mobility and ethnic intermixture. This topic is discussed by the author in Publications of the American Statistical Association, vol v, p. 38 *seq.*

capacity than those in which the breadth is considerable; but the exceptions are so common that they disprove the rule. Among the earliest men whose remains have been found in Europe, there was no appreciable difference from the present living populations. In many cases these prehistoric men even surpassed the present population in the size of the head. The peasant and the philosopher can not be distinguished in this respect. For the same reason the striking difference between the sexes, the head of the man being considerably larger than that of the woman, means nothing more than avoirdupois; or rather it seems merely to be correlated with the taller stature and more massive frame of the human male.

LAPP, SCANDINAVIA.
Cephalic Index, 94.

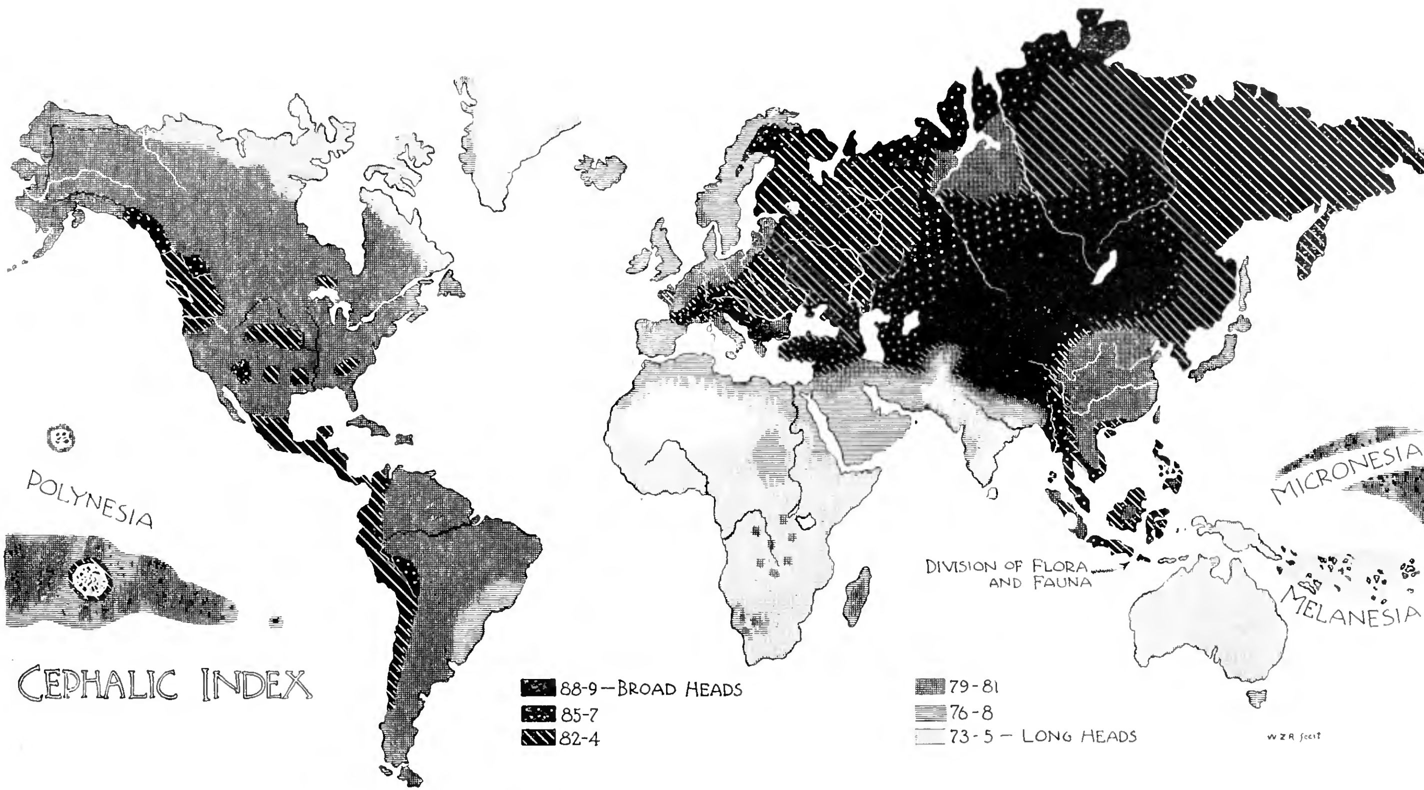
PIEDMONT, NORTHERN ITALY.
Cephalic Index, 91.

Turning to the world map* on the next page, showing the geographical distribution of the several types of head form which we have described, the first fact which impresses itself is of the violent contrasts in the eastern hemisphere between Europe-Asia, and the two southern continents Africa and Australia. Our two double portraits on pages 584 and 585 of the broad-headed, round-faced Asiatic and of the dolichocephalic, long-faced negro will serve as exam-



BAVARIAN TYROL

* This map is constructed primarily from data on living men, sufficient in amount to eliminate the effect of chance. Among a host of other authorities special mention should be made of Drs. Boas, on North America; Sören Hansen and Bessels, on the Eskimos; von den Steinen, Ten Kate, and Martin, on South America; Collignon, Berenger-Feraud, Deniker, and Laloy, on Africa; Sommier and Mantegazza, on northern, Chantre and Ujfalvy, on western Asia; Risley, on India; Lubbers, Ten Kate,


CEPHALIC INDEX
POLYNESIA
MICRONESIA
MELANESIA
DIVISION OF FLORA AND FAUNA
88-9—BROAD HEADS
85-7
82-4
79-81
76-8
73-5 — LONG HEADS
W Z R sculpt

ples of these extremes. In profile the posterior development of the negro skull should be compared with the bullet-shaped head of the Asiatic. It will appear that differences in length are as remarkable as in the breadth. The line of division of head forms passes east and west just south of the great continental backbone extending from the Alps to the Himalayas. Thus the primitive natives of India, the black men of the hill tribes, who are quite distinct from the Hindu invaders, form part of this southern long-headed group. The three southern centers of long-headedness may once have been part of a single continent which occupied the basin of the Indian Ocean. From the peculiar geographical localization about this latter center of the lemurs, a species allied to the monkeys, together with certain other mammals, some naturalists have advocated the theory that such a continent once united Africa and Australia.* To this hypothetical land mass they have assigned the name Lemuria. It would be idle to discuss the theory in this place. Whether such a continent ever existed or not, the present geographical distribution of long-headedness points to a common derivation of the African, the Melanesian, and the Dravidian peoples of India. The phenomena of skin color and of hair only serve to strengthen the hypothesis.

The extremes in head form here presented between the north and the south of the eastern hemisphere constitute the mainstay of the theory that in these places we find the two primary elements of the human species. Other racial traits only help to confirm the deduction. The most sudden anthropo-geographical transition in the world is afforded by the Himalaya mountain ranges. Happily, we possess pretty detailed information for parts of this region, especially the Pamir. This "roof of the world" is of peculiar interest to us as the land to which Max Müller sought to trace the Aryan invaders of Europe by a study of the languages of that continent. It is clearly proved that this greatest mountain system in the world is at the same time the dividing line between the extreme types of mankind. It is really the

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and Maurel, on Indonesia and the western Pacific. For special details *vide* Balz, on Japan; Man, on the Andamans; and others. For Africa and Australia the results are certain but scattered through a number of less extended investigations. Then there is the more general work of Weisbach, Broca, Pruner Bey, and others. All these have been checked or supplemented by the large collections of observations on the cranium. A complete bibliography, as detailed as the one provided for Europe, will be published in due time. It will never cease to be a matter of regret that observers like Paulitschke, Ehrenreich, Hartmann, Fritsch, Finsch, the Sarasin brothers, Stanley, and others, offer no material for work of this kind. For the location of tribes we have used Gerland's Atlas für Volkerkunde. It is to be hoped that Dr. Boas's map for North America, now ready for publication, may not long be delayed.

* Ernst Haeckel, in his Anthropogenie, gives an interesting map with a restoration of this continent as a center of dispersion for mammals.

human equator of the earth. Such is as it should be; for while the greatest extremes of environment are offered between the steaming plains of the Ganges and the frigid deserts and steppes of the north, at the same time direct intercourse between the two regions has been rendered well-nigh impossible by the height of the mountain chain itself. In each region a peculiar type has developed without interference from the other. At either end of the Himalayas proper, where the geographical barriers become less formidable, and especially wherever we touch the sea, the extreme sharpness of the human contrasts fails. The Chinese manifest a tendency toward an intermediate type of head form.

Negro Type, Central Africa. Cephalic Index, 70±.

Japan shows it even more clearly. From China south the Asiatic broad-headedness becomes gradually attenuated among the Malays, until it either runs abruptly up against the Melanesian dolichocephalic group or else vanishes among the islanders of the Pacific. Evidence that in thus extending to the southeast the Malays have dispossessed or absorbed a more primitive population is afforded by the remnants of the negritos. These black people still exist in some purity in the inaccessible uplands of the large islands in Malaysia.

Compared with the extreme forms presented in the Old World, the Americas appear to be quite homogeneous and at the same time intermediate in type, especially if we except the Eskimo; for in the western hemisphere among the true Indians the extreme variations of head form are comprised between the cephalic indices of 85 in British Columbia and Peru, and of 76 on the southeast coast of Brazil. Probably nine tenths of the native tribes of America have average indices between 79 and 83. Many American peoples among whom customs of cranial deformation prevail are able artificially to raise their indices to 90 or even 95; but such monstrosities should be excluded for the present, since we are studying normal types of man alone. Translated into words, this means that the American Indians should all be classified together as, in a sense, a secondary race.

With them we may place the great group of men which inhabits the islands of the Pacific. These people manifest even clearer than do the American Indians that they are an intermediate type. They are, however, more unstable as a race, especially

Kalmuck Girl, Western Asia. Cephalic Index, 86.

lacking homogeneity. They seem to be compounded of the Asiatic and Melanesian primary racial elements in varying proportions. It is the most discouraging place in the world to measure types of head, because of their extreme variability. We shall have occasion shortly to compare certain of their characteristics other than the head form with those of the people of Europe. This we shall do in the attempt to discover whether these last are also a secondary race, or whether they are entitled to a different place in the human species. We shall then see that one can not study Europe quite by itself without gaining thereby an entirely false idea of its human history.

Before proceeding to discuss the place which Europe occupies in our racial series, it may be interesting to point out certain curious parallelisms between the geographical localization of the several types of head form and the natural distribution of the flora and fauna of the earth. Where, as in Africa and Australia, there is marked individuality in the lower forms of life, there is also to be found an extreme type of the human species. Where, on the other hand, realms, like the Oriental one which covers southeastern Asia and the Malay Archipelago, have drawn upon the north and the south alike for both their flora and fauna, several types of man have also immigrated and crossed with one another. Often the dividing lines between distinct realms for varieties of man, animal, and plant coincide quite exactly. The Sahara Desert, once a sea, and not the present Mediterranean, as we shall show, divides the true negro from the European, as it does the Ethiopian zoölogical and botanical realm from its neighbor. Thus the Berber of Tunis, on page 580, is properly placed in our series of European types. The Andes, the Rocky Mountains, and the Himalayas, divide types of all forms of life alike, including man. Even that remarkable line which Alfred Russel Wallace so vividly describes in Island Life, which divides the truly insular fauna and flora from those of the continent of Asia, is duplicated among men near by. The sharp division line for plants and animals between Bali and Lombok we have shown upon the map. It is but a short distance farther east, between Timor and Flores, where we suddenly pass from the broad-headed, straight-haired Asiatic Malay to the long-headed and frizzled Melanesian savage—to the group which includes the Papuans of New Guinea and the Australian.*

Following out this study of man in his natural migrations just as we study the lower animals, it can be shown that the differences in geographical localization between the human and other forms of life are merely of degree. The whole matter is reducible at bottom to terms of physical geography, producing areas of characterization. Where great changes in the environment occur, where oceans or mountain chains divide, or where river systems unite geographical areas, we discover corresponding effects upon the distribution of human as of other animal types. This is not because the environment has directly generated those peculiarities in each instance; certainly no such result can be shown in respect of the head form. It is because the several varieties of man or other mammals have been able to preserve their individuality through geographical isolation from intermixture, or contrariwise, as the case may be, have merged it in a conglomerate whole compounded of all immigrant types alike. In this sense man in his physical constitution is almost as much a creature of environment as the lower orders of life. Even in Europe he has not yet

* A good ethnological map of this region is given in Fr. Ratzel's History of Mankind, i, p. 144.

wholly cast off the leading strings of physical circumstance, as it is our purpose ultimately to show.

By this time it will have been observed that the differences in respect of the head form become strongly noticeable only when we compare the extremes of our racial series; in other words, that while the minor gradations may be real to the calipers and tape, they are not striking at first glance to the eye. As a matter of fact, it is the modesty of this physical trait—not forcing itself conspicuously upon the observer's notice as do differences in the color of the skin, the facial features, or the bodily stature—which forms the main basis of its claim to priority as a test of race. Were the head form as strikingly prominent as these other physical traits, it would tend to fall a prey to the modifying factor of artificial selection: that is to say, it would speedily become part and parcel among a people of a general ideal, either of racial beauty or of economic fitness, so that the selective choice thereby induced would soon modify the operation of purely natural causes. However strenuously the biologists may deny validity to this element of artificial selection among the lower animals, it certainly plays a large part in influencing sexual choice among primitive men and more subtly among us in civilization. Just as soon as a social group recognizes the possession of certain physical traits peculiar to itself—that is, as soon as it evolves what Prof. Giddings has aptly termed a "consciousness of kind"—its constant endeavor thenceforth is to afford the fullest expression to that ideal. Thus the nobility in Japan are as much lighter in weight and more slender in build than their lower classes as the Teutonic nobility of Great Britain is above the British average. The Japanese aristocracy in consequence might soon come to consider its bodily peculiarities as a sign of high birth. That it would thereafter love, choose, and marry—unconsciously perhaps, but no less effectively—in conformity with that idea is beyond peradventure.

Is there any doubt that where, as in our own Southern States, two races are socially divided from one another, the superior would do all in his power to eliminate any traces of physical similarity to the menial negroes? Might not the Roman nose, light hair and eyes, and all those prominent traits which distinguished the master from the slave, play an important part in constituting an ideal of beauty which would become highly effective in the course of time? So uncultured a people as the natives of Australia are pleased to term the Europeans, in derision, "tomahawk-noses," regarding our primary facial trait as absurd in its make-up. Even among them the "consciousness of kind" can not be denied as an important factor to be dealt with in the theory of the formation of races.

Such an artificial selection is peculiarly liable to play havoc with facial features, for which reason these latter are rendered quite unreliable for purposes of racial identification. And yet, because they are entirely superficial, they are first noted by the traveler and used as a basis of classification. A case in point is offered by the eastern Eskimos, who possess in marked degree not only the almond eye, so characteristic of the Mongolian peoples, but also the broad face, high cheek bones, and other features common among the people of Asia. Yet, notwithstanding this superficial resemblance, inspection of our world map of the head form shows that they stand at the farthest remove from the Asiatic type. They are even longer-headed than most of the African negroes. Equally erroneous is it to assume, because the Asiatic physiognomy is quite common among all the aborigines of the Americas, even to the tip of Cape Horn, that this constitutes a powerful argument for a derivation of the American Indian from the Asiatic stock. We shall have occasion to point out from time to time the occurrence of local facial types in various parts of Europe. On the principle we have indicated above, these are highly interesting as indications of a local sense of individuality, but they mean but little, so far as racial origin and derivation are concerned.

Happily for us, racial differences in head form are too slight to suggest any such social selection as has been suggested; moreover, they are generally concealed by the headdress, which assumes prominence in proportion as we return toward barbarism. Obviously, a Psyche knot or savage peruke suffices to conceal all slight natural differences of this kind; so that Nature is left free to follow her own bent without interference from man. The color of skin peculiar to a people may be heightened readily by the use of a little pigment. Such practices are not infrequent. To modify the shape of the cranium itself, even supposing any peculiarity were detected, is quite a different matter. It is far easier to rest content with a modification of the headdress, which may be rendered socially distinctive by the application of infinite pains and expense. It is well known that in many parts of the world the head is artificially deformed by compression during infancy. This was notably the case in the Americas. Such practices have obtained and prevail to-day in parts of Europe. For example, the people about Toulouse in the Pyrenees are accustomed to distort the head by the application of bandages during the formative period of life. This deformation * is sometimes so extreme

* For a full account of such deformation, *vide* L'Anthropologie, Paris, vol. iv, p. 11, *seq.* The illustrations of such deformation, of the processes employed, and of the effect upon the brain development, are worthy of note.

as to equal the Flathead Indian monstrosities which have been so often described. Fortunately, these barbarous customs are rare among the civilized peoples which it is our province to discuss. Their absence, however, can not be ascribed to inability to modify the shape of the head; rather does it seem to be due to the lack of appreciation that any racial differences exist, which may be exaggerated for social effect or racial distinction.

Another equally important guarantee that the head form is primarily the expression of racial differences alone, lies in its immunity from all disturbance from physical environment. As will be shown subsequently, the color of the hair and eyes, and stature especially, are open to modification by local circumstances; so that racial peculiarities are often obscured or entirely reversed by them. On the other hand, the general proportions of the head seem to be uninfluenced either by climate, by food supply or economic status, or by habits of life; so that they stand as the clearest exponents which we possess of the permanent hereditary differences within the human species.* Ranke, of Munich, with Virchow, the leader of anthropological science in Germany, has long advocated a theory that there is some natural relation between broad-headedness and a mountainous habitat. He was led to this view by the remarkable Alpine localization, which we shall speedily point out, of the brachycephalic race of Europe. Our map of the world, with other culminations of this type in the Himalayan plateau of Asia, in the Rocky Mountains, and the Andes, may seem to corroborate this view. Nevertheless, all attempts to trace any connection in detail between the head form and the habitat have utterly failed. For this reason we need not stop to refute it by citing volumes of evidence to the contrary, as we might.† Our explanation for this peculiar geographical phenomenon, which ascribes it to a racial selective process alone, is fully competent to account for the fact. The environment is still a factor for us of great moment, but its action is merely indirect. In the present state of our knowledge, then, we seem to be justified in ruling out environment once and for all as a direct modifier of the shape of the head.

Having disposed of both artificial selection and environment as possible modifiers of the head form, nothing remains to be eliminated except the element of chance variation. This last is

* For a curiously old-fashioned statement of the exact opposite of this view, see A. H. Keane's Ethnology, recently published by Macmillan, pp. 43 and 177. There is one custom which is effective. The peoples who use hard cradles or wooden pillows for infants' use are undoubtedly modified in head form by it. This is a disturbing factor in the Americas, and to some extent in parts of Europe.

† This theory is best stated in J. Ranke, Beiträge zur physischen Anthropologie der Bayern, Part I, chap. ii, p. 75 *seq.*

readily counterbalanced by taking so many observations that the fluctuations above and below the mean neutralize one another. Variation due to chance alone is no more liable to occur in the head than in any other part of the body. Rigid scientific methods are the only safeguard for providing against errors due to it. It is this necessity of making the basis of observation so broad that all error due to chance may be eliminated, which constitutes the main argument for the study of heads in the life rather than of skulls; for the limit to the number of measurements is determined by the perseverance and ingenuity of the observer alone, and not by the size of the museum collection or of the burial place. It should be added that our portraits have been especially chosen with a view to the elimination of chance. They will always, so far as possible, represent *types* and not *individuals*, in the desire to have them stand as *illustrations* and not merely *pictures*. This is a principle which is lamentably neglected in many books on anthropology; to lose sight of it is to prostitute science in the interest of popularity.

The most conspicuous feature of our map of cephalic index for western Europe * is that here within a limited area all the extremes of head form known to the human race are crowded together. In other words, the so-called white race of Europe is not physically a uniformly intermediate type in the proportions of the head between the brachycephalic Asiatics and the long-headed negroes of Africa. A few years ago it was believed that this was true. More recently, detailed research has revealed hitherto unsuspected limits of variation. In the high Alps of northwestern Italy are communes with an average index of 89, an extreme of round-headedness not equaled anywhere else in the world save in the Balkan Peninsula and in Asia Minor. A typical Italian from this district, chosen for me by Dr. Livi, of Rome, from among three regiments of recruits, is shown on page 581. In profile the back of the head is even less developed than that of the Kalmuck girl in our illustration. This type of head prevails all through the Alps, quite irrespective of political frontiers. These superficial boundaries are indicated in white lines upon the map to show their independence of racial limits. There is no essential difference in head form between the Bavarians and

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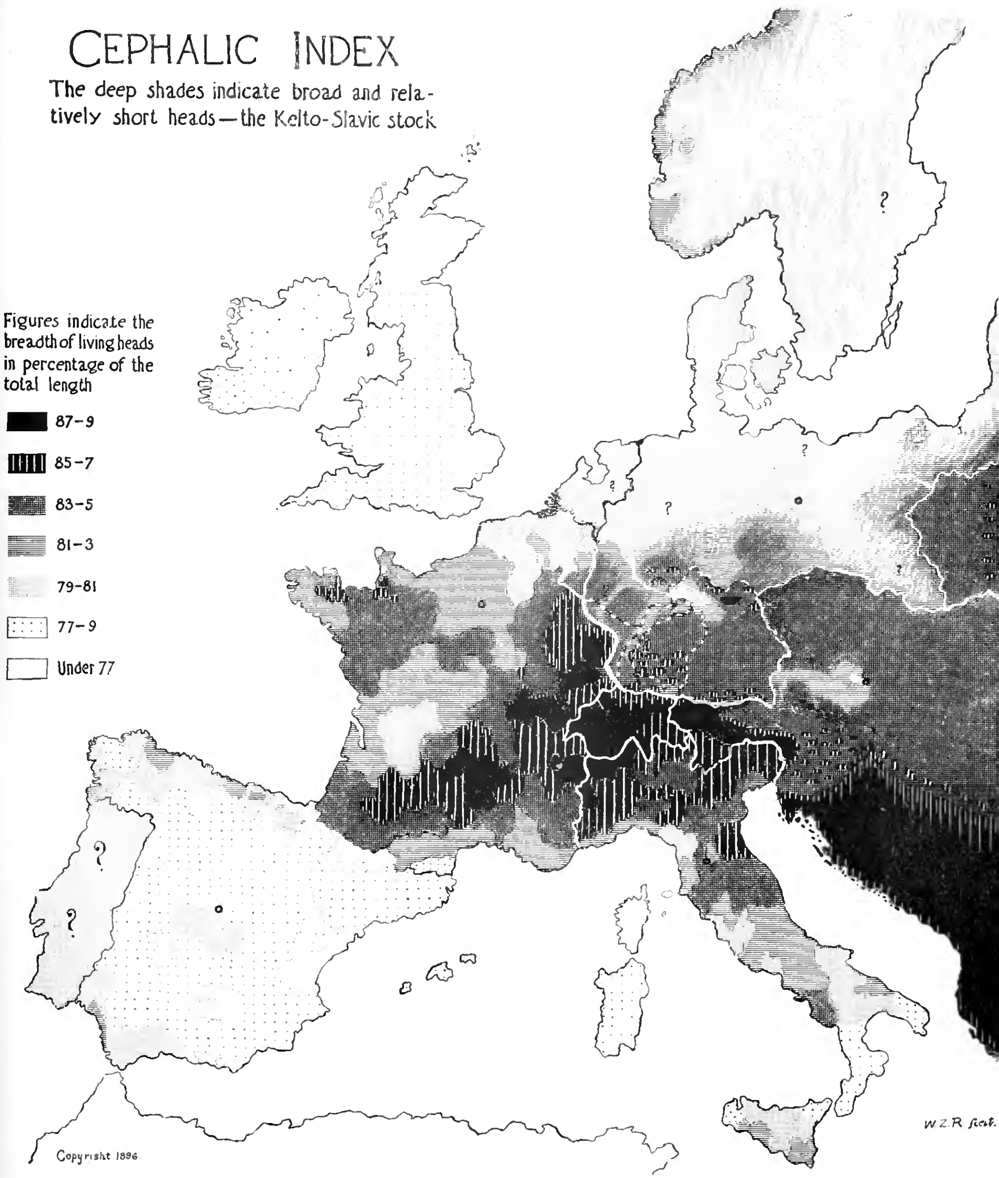
* Complete technical details by the author as to the mode of construction, with full references for each portion of the continent, will be found in L'Anthropologie, Paris, vol. vii, pp. 513 *seq.* Since the above map was drawn, certain minor changes have been made, in conformity with suggestions received from European experts. They all appear in the map in L'Anthropologie to which reference is here made; most of them were so unimportant for present purposes that this map was left unchanged. The only serious modification would be to make Silesia much darker, as I believe it to be less Teutonized than this map indicates.


CEPHALIC INDEX
The deep shades indicate broad and relatively short heads—the Kelto-Slavic stock
Figures indicate the breadth of living heads in percentage of the total length
87–9
85–7
83–5
81–3
79–81
77–9
Under 77
W.Z.R. fecit.
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the Italian Piedmontese, or between the French Savoyards and Tyrolese.

From what has been said, it will appear that these Alpine populations in purity exceed any known tribes of central Asia in the breadth of their heads. Yet within three hundred miles, as the crow flies, in the island of Corsica, are communes with an average cephalic index of 73. These mountaineers of inland Corsica are thus as long-headed as any tribe of Australians, the wood Veddahs of Ceylon, or any African negroes of which we have extended observations. A little way farther to the north there are other populations in Scotland, Ireland, and Scandinavia which are almost as widely different from the Alpine peoples in the proportions of the head as are the Corsicans. An example of extreme individual variation downward is shown in our illustrated Teutonic type, which has a lower index than any recorded for the longest-headed primitive races known. Nor is this all. Pass to northern Scandinavia, and we find among the Lapps again, one of the broadest-headed peoples of the earth, of a type shown in our series of portraits.

So remarkably sudden are these transitions that one is tempted at first to regard them as the result of chance. Further examination is needed to show that it must be due to law. Proof of this is offered by the map itself; for it indicates a uniform gradation of head form from several specific centers of distribution outward. Consider Italy, for example, where over three hundred thousand individuals, from every little hamlet, have been measured in detail. The transition from north to south is perfectly consistent. The people of the extreme south are like the Tunisian shown in our portrait; while at the knee of Italy, halfway up, the mean type in our series of illustrations stands between the two geographical extremes in its proper place. So it is all over the continent. Each detailed research is a check on its neighbor. There is no escape from the conclusion that we have to do with law.

Two distinct races of man, measured by the head form alone, are to be found within the confines of this little continent. One occupies the heart of western Europe as an outpost of the great racial type which covers all Asia and most of eastern Europe as well. The other, to which we as Anglo-Saxons owe allegiance, seems to hang upon the outskirts of Europe, intrenched in purity in the islands and peninsulas alone. Northern Africa, as we have already observed, is to be classed with these. Furthermore, this long-headed type appears to be aggregated about two distinct centers of distribution—in the north and south respectively. In the next paper we shall show that these two centers of long-headedness are again divided from one another in respect of both color of hair and eyes and stature. From the final combination of all these bodily characteristics we discover that in reality in Europe we have to do with three physical types and not two. Thus we reject at once that old classification in our geographies of all the peoples of Europe under a single title of the white, the Indo-Germanic, or Aryan race. Europe, instead of being a monotonous entity, is a most variegated patchwork of physical types. Each has a history of its own, to be worked out from a study of the living men. Upon the combination of these racial types in varying proportions one with another the superstructure of nationality has been raised.

Among other points illustrated by our map of Europe is the phenomenon paralleled in general zoölogy, that the extreme or pure type is generally to be found in regions of marked geographical individuality. Such areas of characterization occur, for example, in the Alpine valleys, in Corsica and Sardinia, somewhat less so in Spain, Italy, and Scandinavia. The British Isles, particularly Ireland, at least until the full development of the art of navigation, afforded also a good example of a similar area of characterization. Europe has always been remarkable among continents by reason of its "much-divided" geography. From Strabo to Montesquieu political geographers have called attention to the advantage which this subdivision has afforded to man. They have pointed to the smooth outlines of the African continent, for example, to its structural monotony, and to the lack of geographical protection enjoyed by its social and political groups. The principle which they invoked appears to hold true in respect of race as well as of politics. Africa is as uniform racially as Europe is heterogeneous.

Pure types physically are always to be found outside the great geographical meeting places. The latter, such as the garden of France, the valleys of the Po, the Rhine, and the Danube, have always been areas of conflict. Competition, the opposite of isolation, in these places is the rule, so that progress which depends upon the stress of rivalry has followed as a matter of course. There are places where too much of this healthy competition has completely broken the mould of nationality, as in Sicily, so ably pictured by the late Mr. Freeman. It is only within certain limits that struggle and conflict make for an advance forward or upward. Ethnically, however, this implies a variety of physical types in contact, from which by natural selection the one best fitted for survival may persist. This means ultimately the extinction of extreme types and the supersession of them by mediocrity. In other words, applying these principles to the present case, it implies the blending of the long and the narrow heads and the substitution of one of medium breadth. The same causes, then, which conduce socially and politically to progress have as an ethnic result mediocrity of type. The individuality of the single man is merged in that of the social group. In fine, contrast of race is swallowed up in nationality. This process has as yet only begun in western Europe. In the so-called upper classes it has proceeded far, as we shall see. We shall, in due course of time, have to trace social forces now at work which insure its further prosecution not only among the leaders of the people, but among the masses as well. The process will be completed in that far-distant day when the conception of common humanity shall replace the narrower one of nationality; then there will be perhaps not two varieties of head form in Europe, but a great common mean covering the whole continent. The turning of swords into plowshares will contribute greatly to this end. Modern industrial life with its incident migrations of population does more to upset racial purity than a hundred military campaigns or conquests. Did it not at the same time invoke commercial rivalries and build up national barriers against intercourse, we might hope to see this amalgamation completed in a conceivable time.

EXPERIMENTS ON THE PHYSIOLOGY OF ALCOHOL, MADE UNDER THE AUSPICES OF THE COMMITTEE OF FIFTY.

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I.

THE following is Dr. J. S. Billings's statement on behalf of the committee: "This paper contains an account of some research work which has been done for the Committee of Fifty for the Investigation of the Liquor Problem, and it is to be regarded as merely a preliminary report to be considered in the final conclusions which may be reached in the future by the Committee of Fifty itself."

On my own part I desire to express to the Committee of Fifty my deep sense of appreciation for the support which has made the following researches possible. To the members of the Subcommittee on Physiology, Drs. Bowditch, Billings, Chittenden, and Welch, my especial thanks are due for hearty and sustained interest and prompt assistance at every turn of the investigation. Under their stimulus and guidance it has been throughout the keenest pleasure to work, even upon a problem so beset with prejudices that the slightest contamination of the atmosphere of pure science, in which such work, if ever effectual, must be done, would have rendered even the will to undertake it impossible.

The general point of view may be indicated in a few words. For centuries opinion has been divided on the subject, and the human experiment has been repeated, generation after generation, by individuals and on a national scale. But man is the most highly complex, most variable, most adaptable of animals, and the human problem has proved itself too complicated for scientific interpretation. Some men fail with alcohol, others fail as completely without it, and the same is true of success. Even "statistics relating to inebriety are too confusing," we find admitted in the Quarterly Journal of Inebriety.*

Some may contend that the alcohol problem does not depend upon the science of physiology for its solution; but rather upon the moral, religious, or political functions of society. It should be remembered, however, that physiology is a broad science, whose ultimate aim is no less than to discover the laws and conditions under which may be developed the highest possible type of man. By the intimate correlations between body and mind, and under the recent outgrowths of the mother science into modern psychology and neurology, physiology would cover the whole man, body, mind, and soul. And it would have not only a healthy soul and a sound mind in a sound body, but the most perfect soul, mind, and body which can be developed under physical conditions. Thus problems touching human welfare, even questions of ethics and social science, must ever draw important factors for their solutions from this science which is fundamental to the conditions and processes of life itself.

Extreme difficulty in solving such complicated equations is in part accountable for our lack of definite knowledge. But even this, it seems to me, does not constitute the most serious hindrance to the progress of science. In this country our greatest obstacle consists in a deficient notion as to what constitutes a scientific answer to a question. We are far too prone to say we "know" a thing is "true," when we lack sufficient evidence to convince an unprejudiced person of the fact. We mean simply that we "think," or we "guess," or we have a strong "prejudice" that such and such is the fact. Affirmation and prejudice are promptly met by contra-affirmation and prejudice, and with people who are satisfied with this sort of procedure scientific advance is at a standstill. We are too slow to realize that all progress in knowledge depends upon accumulation of wholly impartial evidence. Lacking this, no amount of legislating and voting and vociferating, can lay a smallest gravel corn of truth in the roadbed of human progress. As Bacon said so long ago, concerning the man who loses sight of this distinction and clothes his own

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* Kinney, C. Spencer, M. D. The Quarterly Journal of Inebriety, 1896, p. 223.

beliefs with the reality of fact, "He shall exchange things for words, reason for insanity, the world for a fable, and shall be unable to interpret."

To meet difficulties connected with the intricacies and complexities of the problem, the method of physiology is clearly to reduce the equations to their simplest possible terms. By studying the physiology of alcohol in a number of simpler organisms, sufficient light may be thrown on the human experiment to render its interpretation possible. A unicellular organism is millions times less complicated than a human body; still, fundamental activities, nutrition, excretion, growth, reproduction, appear similar in both. So, too, the lower animals are proportionally simpler and also approach man physiologically more closely for purposes of comparison. Their conditions of life, too, can be made far more nearly comparable than it would be possible to either find or procure with men. With man, even after death, the microscopical study of the tissues to demonstrate the influence of alcohol upon them is so complicated by conditions of disease and post-mortem changes that no wholly trustworthy evidence is obtainable.* On the other hand, animals may be killed in known conditions of health, and their tissues immediately prepared for examination; and in this way results have already been obtained by Berkley,† Dehio,‡ Stewart,# and others, which have materially assisted in the interpretation of uncertain findings in human material.

Such a series of experiments should clearly be made on a number of different organisms, both plants and animals, in order that our basis for comparison and judgment may be sufficiently broad to enable us to distinguish between the constant and general effects of alcohol from those which are accidental or exceptional. And observations should be continued long enough to bring out clearly any more remote effects, especially those relating to heredity, of great importance, and about which much has been said but practically nothing is known.

It is intended in the following to outline the results of three series of experiments. Although necessarily incomplete in many ways, they may serve to demonstrate methods of research, and to show some of the possibilities of further work.

I. Experiments upon the Growth of Yeast.—The yeast plant, when sown in a nutrient solution, discloses an almost

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* Berkley, H. J. The Effects of Alcohol on the Central Nervous System. Quarterly Journal of Inebriety, 1896, p. 109.

† Ibid. Studies on the Lesions produced by the Action of Certain Poisons on the Cortical Nerve Cell. I. Alcohol. Brain, 1895, p. 473.

‡ Dehio, H. Centralblatt für Nervenheilkunde und Psychiatrie, 1895.

Stewart, C. C. Journal of Experimental Medicine, 1896.

incredible power of growth and reproduction. This growth is wholly controlled by external conditions and by the composition of the nutrient medium. Probably no form of life approaches in power of rapid reproduction these minutest plants, the bacteria and yeasts, and none are probably more delicately responsive to varying conditions of life.

Yeast is able to grow until, by decomposition of sugar, its medium comes to contain fourteen per cent * of common alcohol. At this point, no matter how much sugar and other nutriment remains, further growth is impossible.

Now, of especial interest to the physiology of nutrition, and the influence upon it of waste products generally, is the question,

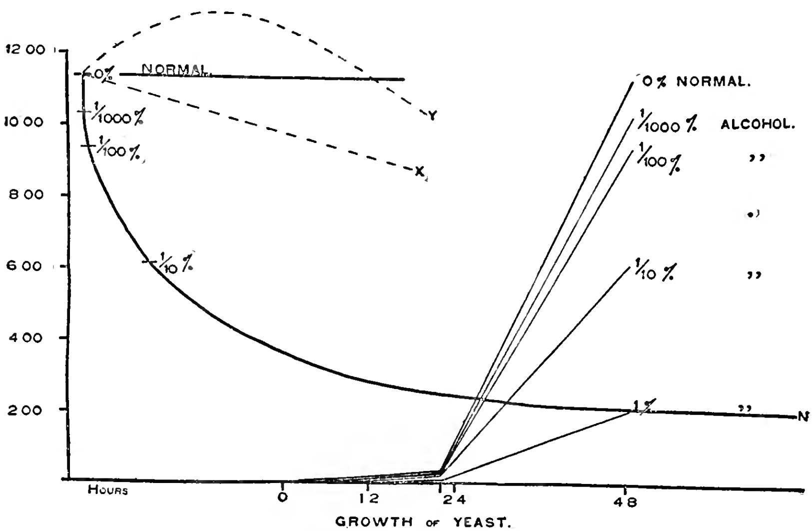

Fig. 1.

What effect have very minute quantities of alcohol on the growth of yeast?

Fig. 1 represents to the eye, in the diagram to the left, the four possible kinds of action in the four lines diverging from the point marked "0 per cent." If no slowing effect is present until the poison limit, fourteen per cent, is reached, the line marked "normal" should be continued out until directly over a point corresponding to fourteen per cent strength of solution, and then should drop perpendicularly to the zero point of growth on the base line. As a matter of fact, Flügge states that growth is slowed with twelve per cent and stopped at fourteen per cent. If this be true, instead of dropping vertically, it would fall a little obliquely from twelve per cent to fourteen per cent. This

* Flügge, C. Die Mikroorganismen. Leipsic, 1886, p. 482.

would mean that up to a very high limit of concentration alcohol is absolutely harmless, that at a certain point it becomes suddenly toxic, and that slight increase beyond this concentration worked very rapidly to bring growth to a standstill.

A second possibility would be represented by a straight line, "Z," dotted line, falling uniformly from zero per cent to fourteen

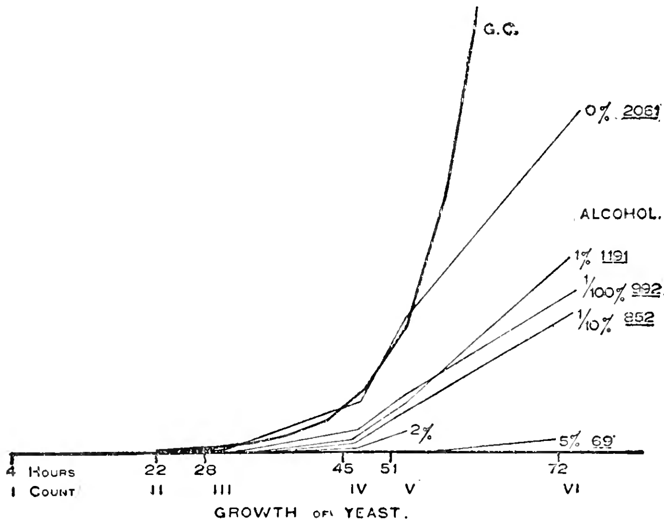

Fig. 2.—G. C., curve of a geometrical progression increasing at the rate of yeast growth in the normal cultures for the first twenty-four hours. The numbers at the right indicate the number of *torulæ* found in a cubic millimetre of the different cultures.

per cent. This would indicate that the effect of the presence of alcohol in the culture medium upon yeast growth was a purely mechanical effect, a matter of friction, a clogging of the molecules, as it were. This would signify, the less alcohol the better, but that a small quantity has a comparatively slight effect, and that probably no harm is done in the way of changing the chemical reactions concerned in the growth processes of the yeast plant.

A third possibility, represented by dotted line "Y" in the figure, is in line with an idea not infrequently carried into practice, viz., that a little alcohol increases, "stimulates," activity, a larger quantity interferes with it. If this were found to be the case, the important matter to determine would be at what point of concentration alcohol ceases to be beneficial.

The heavy line, "M," represents the fourth possibility, viz., that minute amounts of alcohol have relatively a much greater retarding effect upon the growth of yeast than larger amounts. The line is plotted from the results of a series of experiments, of which a different expression is given in the diagram to the right in the figure. One thousandth of one per cent is seen to cause a considerable retardation of growth, over half as much as ten times the amount in one hundredth of one per cent, and about one fifth as much as the retardation caused by one hundred times as much alcohol, one tenth of one per cent. That is to say, we find a truly physiological curve, of practically the same form as that obtained from the fatigue of a muscle fiber or a nerve cell. This is not so remarkable, since in all such experiments we are touching, in final analysis, the vital activities of living cells, and in muscle or nerve one of the prime factors in causation of fatigue is accumulation of the waste products of active metabolism.

In the right-hand diagram in Fig. 1 and in Fig. 2 the same fact is expressed as a race—a competitive effort—in which the culture containing no alcohol is seen to win, the others falling behind. In general, retardation of growth is directly proportional to amount of alcohol. This is the unmistakable result of the entire series of experiments, fifteen in number. In Fig. 2, however, it may be noted that the cultures containing one per cent have grown somewhat better than those of 0·1 and 0·01 per cent. This is clearly due to difficulties in uniformly "seeding" the cultures, and when these were overcome perfectly consistent results, as seen in Fig. 1, were obtained.*

Too great caution can not be used in interpreting the above results. While the physiology of the yeast cell and that of the cells of the human body may be at ground similar, in certain particulars they may be widely different. The yeast cell has not the power to oxidize alcohol. The cells of the body, or some of them at least, are most certainly able to bring about this reaction. Furthermore, if we had experimented with *Mycoderma aceti*—the normal food of which alcohol seems to be—we should have doubtless obtained a diametrically opposite result.

On the other hand, ethyl alcohol is found in minute quantities in the fresh tissues of man and animals where no alcohol has been given as a constant normal constituent. It has been distilled off from the brain, muscle, and liver.† Whether it exists as a food in process of transformation or as a waste product, as in case of the yeast cell; whether it is a waste product from the activity of

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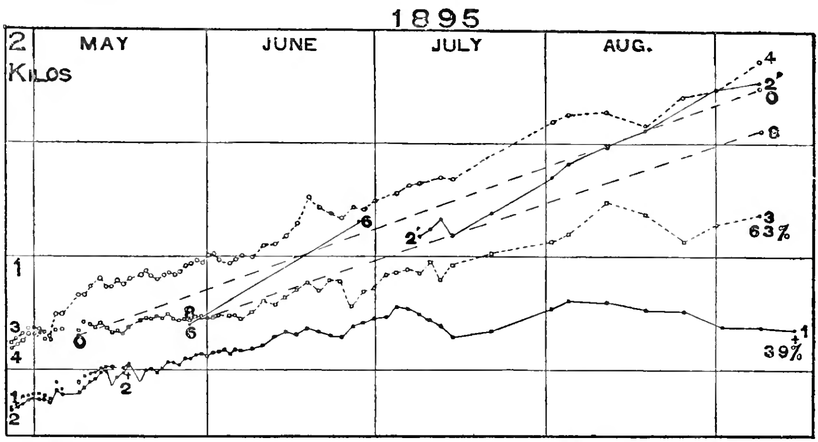
* *S. cerevisiæ*, obtained in pure culture from Fleischmann's compressed yeast, was used throughout these experiments. The chief difficulty encountered consisted in breaking up the large clusters, composed of hundreds of torulæ, so as to get a uniform seeding suspension. This was finally done by churning the culture from which it was desired to seed with a wad of sterilized absorbent cotton. The liquid squeezed out of the cotton contained only single torulæ. The seeding was always done from fresh stock solution—i. e., it was free from alcohol.

† Rajewski. Pflüger's Archiv, Bd. ii, S. 122. Hoppe-Seyler. Handbuch der chemischen Analyse, Berlin, 1893, S. 40 and 41.

some cells and a food for others, it is impossible to say. While these questions remain open, it might be safe to assume, that if a food, the tissues are possibly, in conditions of health, able to produce all they need of it. If it is mainly a waste product, they should not be burdened with any more of it than necessary.

II. Experiments upon Kittens were broken in upon and complicated by accidents and disease to such an extent that we shall pass them by with a brief mention.

During April of 1895 four kittens were obtained,* the two males, which we will call 1 and 2, from the same litter; the two



..MALE..

..FEMALE...

GROWTH OF KITTENS.

2, 4, 6, 8, 0, NORMAL.

1, 3, ALCOHOLIC.

Fig. 3.

females, 3 and 4, from an unrelated litter. The males were born April 2d; the females, March 18th.

From April 23d to 29th they were weighed daily and studied as to health, liveliness, and general comparability. All four purred and played normally, but it was evident that 1 and 3 were considerably more vigorous and active. Both 2 and 4 had sore eyes—a rather serious indication of poor nutrition. Nevertheless, these were the most nearly comparable two pairs of kittens available at the time. Some doubts were entertained, but it was thought possible to bring 2 and 4 up to a comparable health level. Accordingly, allowing this much handicap to alcohol, it was decided to take the vigorous pair (1 and 3) for alcohol, and keep 2 and 4 for normal controls.

Alcohol, chemically pure,† was now given, beginning with a dose of 1·3 gramme per kilogramme of body weight April 29th.

* Given by their respective owners with full knowledge as to the experiment to which they were to be submitted.

† Tested by evaporation at room temperature.

This dose caused scarcely appreciable intoxication, and was accordingly increased.* At about two grammes per kilogramme light intoxication with tendency to drowsiness became manifest. The dose was still further increased until May 7th to 9th, when it had reached 3·6 grammes per kilogramme. This produced characteristic symptoms of intoxication—restlessness, incoördination of muscles, which began with weakness and paralysis of the hind legs and worked forward. Sleep followed in from twenty to twenty-five minutes, and lasted from two to three hours. It was deep and quiet, but both kittens could be awakened without difficulty.

During this time both purring and playfulness had been rapidly disappearing from the lives of the alcoholic kittens, and by May 9th both had become obliterated, and both kittens were pictures of demure and forlorn sadness. May 10th the alcoholics had severe colds, with discharge of mucus from the eyes and nose. Alcohol was discontinued until recovery could be effected, but this proved impossible. Severe catarrh of the nasal passages with conjunctivitis set in, the catarrh proving incurable and becoming chronic.

The chief value of the experiment thus far is to be found in the possession of control normal animals. None of these had been

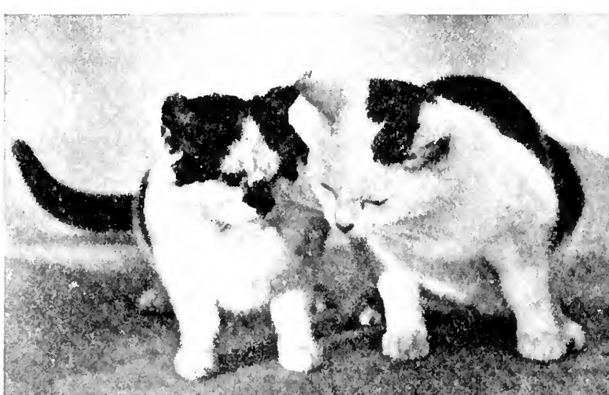
3  4

Fig. 4.—Kittens, November 27, 1895: 3, alcohol-diseased; 4, normal.

similarly affected. In fact, both 2 and 4 had improved greatly under good treatment and healthful conditions. It seems thus safe to conclude that alcohol, as administered, caused a sudden and general breakdown in the two kittens; but, while seen thus clearly

* It was first attempted to have the kittens take the alcohol mixed with warm milk. On their refusal to be thus imposed upon, it was given, diluted to twenty and thirty per cent, by stomach pump, always after meals, the normals being given an equal amount of water in the same manner.

as a cause at the beginning, there is no way of determining how long it continued to act. Hence, from this point on, the experiment becomes mainly a history of disease. Practically it is an equation in which we do not know whether there are one or two unknown quantities, hence absolutely unamenable to solution.

In Fig. 3 is graphically expressed the relations of growth for the four kittens above described, and also for several other normal kittens of about the same ages that I happened to have at the time. It is seen that the alcoholic-diseased animals are dwarfed in growth to sixty-three per cent and thirty-nine per cent respectively as compared with their normal controls (see also Fig. 4). Some might be inclined to find in this evidence of the "stunting" influence of alcohol when given to growing animals which Bevan Lewis* alludes to as "a well-known fact." This I was strongly inclined to do at first, but we are not warranted in doing so from the evidence in hand. In the autumn one of my normal kittens (not one of the four) contracted catarrh, and her growth was interrupted for a time in a similar way. Hence we are obliged to leave this important point entirely in abeyance for the present.

Fig. 5.—Alcohol-diseased kittens, 1 and 3, June 4, 1895: characteristic attitude. When the photograph was taken, 5 P. M., all the normal kittens were playing actively.

On the side of their psychological development the falling out of purring and play are matters of the most serious import. Soon after beginning alcohol my notes abound in such expressions as the following: "1 and 3 dosing, 2, 4, 0 (another kitten), all playing actively" (see Fig. 5). Along with this all the instincts characteristic of healthy kittens, care of coat, cleanliness, etc., were almost wholly annulled. Fear of dogs, hunting and game instincts, were completely lost. This psychic collapse, developing so suddenly as it did, would seem to be directly attributable to the influence of alcohol. At any rate, nothing of the sort approaching it in either kind or degree was manifested in the normal kittens during any of their periods of disease. It will be wise to bear these points in mind until further confirmation and further analysis of the experiment with kittens are possible. Among the animals thus far experimented with the cat seems to be by far the most sensitive to the influence of alcohol.

* W. Bevan Lewis. A Text-Book of Mental Diseases. London, 1889, p. 306.

From subsequent details of the experiment, a highly sensational story might be manufactured, but that could have absolutely no scientific value. We must eschew all such temptations, and never allow the thought to be dimmed that Science has a mission to perform in the world as great as the universe and as sacred as truth. She is in duty bound to yield all benefits of doubt; and she commits moral and intellectual suicide, falling to the level of the common "insanity" described by Lord Bacon, when she insists upon a single iota not supported by "evidence."

[*To be continued.*]

PRINCIPLES OF TAXATION.

By DAVID A. WELLS, LL.D., D.C.L.,
CORRESPONDANT DE L'INSTITUT DE FRANCE, ETC.

VII.—RULES OR MAXIMS ESSENTIAL TO AN ADMINISTRATION OF RIGHTFUL TAXATION UNDER A CONSTITUTIONAL OR FREE GOVERNMENT.

A PRESENTATION and discussion of the rules or maxims of administration which are in conformity with the foregoing exposition and discussion of the origin and sphere of taxation, and the limitations on the exercise of this great power which are essential to the existence and continuance of a constitutional and free government, are next in order for the proper development and understanding of the general subject under consideration. Under such a government—one happily characterized and defined by President Lincoln as "of the people, by the people, and for the people"—the following rules or maxims governing the administration of its lawful taxation would seem to be almost in the nature of economic axioms:

First. *No tax should be imposed by a state or government except by the consent of the people from whom it is to be collected, given either directly or by their authorized representatives in Congress, Legislature, or Parliament assembled.*

Second. *All taxes or enforced contributions levied by the state in virtue of its sovereignty should be solely (singly) and exclusively for public purposes.*

Third. *The sphere of taxation should be limited to persons, property, and business exclusively within the territorial jurisdiction of the taxing power.*

Fourth. *Taxes should be reasonable, regular, and not arbitrary as respects method, time, and place of assessment and payment, and, above all, proportional.*

Fifth. *Taxation should not be employed as an agency or for* *the purpose of enforcing morality, or as an instrumentality for correction or punishment.*

Sixth. *No tax should be levied the character and extent of which offer, as human nature is generally constituted, a greater inducement to the taxpayer to evade rather than pay.*

With a view of determining whether the above six propositions are so far fundamental and indisputable as to warrant their characterization as "economic axioms," attention is next asked to the following summary of reasons, or evidence to that effect, which may be separately adduced in respect to each one of them, commencing with the first—*that no tax should be imposed by a state or government except by the consent of the people from whom it is to be collected, given either directly or by their authorized representatives in Congress, Legislature, or Parliament assembled.* "The right is then wedded to the power, and representation and taxation become correlative." (*Miller, Justice S. F., on the Constitution.*)

It requires no great amount of thought to see that the principle involved in this proposition is not only an essential feature of every *just* system of taxation, but also the primary and essential condition of the existence of every system of free or popular government. If this is not at once apparent, the following brief historical retrospect ought to make it so:

The first great effort recorded in English history for its recognition and establishment as a fundamental principle of government was made by the English barons in 1215, in their notable struggle with King John, and resulted in the incorporation in the Great Charter (Magna Charta) of England of a provision which substantially forbade the king from imposing any taxes, except by permission of the General Council of the nation, duly summoned under writs regularly issued.* And it is interesting to note, as showing the broad spirit of generous patriotism that animated these rough old barons in their contest with King John, that they stipulated in the Magna Charta that they extorted from him that every limitation imposed in it for their protection upon the feudal rights of the king should be also imposed upon their rights as *mesne* lords (i. e., lords superior in the second degree) in favor of the undertenants who held of them.

In the many confirmations of the Great Charter in the ensuing reigns of Henry III and Edward I, its vital clauses as to

* The exact language of the charter was: "No scutage or aid shall be imposed in our kingdom unless by the general course of the nation, except for ransoming our person [i. e., the king], making our eldest son a knight, and once for marrying our eldest daughter; and for these there shall be taken a reasonable aid"; the barons in turn agreeing that "we will not for the future grant to any one that he may take aid of his own free tenants," other than the aids above stated.

taxation and the National Council were, however, invariably and intentionally omitted; and the latter king so reasserted the taxing power of the crown as to alarm the nation and occasion a revolution (Barons' War, 1297), which for many subsequent years prevented any like assumption on the part of Edward's successors. Under the reign of Charles I the authority to levy and collect taxes in England was, however, again claimed—as it was in all the other European states—to be vested exclusively in the king; and on the trial of John Hampden, in 1636, for his refusal to pay a tax known as "ship money," arbitrarily levied by the king for the maintenance of a naval force, this was the position taken by the crown lawyers representing the prosecution and accepted as valid by the judges in their verdict, the attorney general using in his plea language almost identical with that employed by Louis XIV, before cited, in defining his prerogative. (See Popular Science Monthly, No. 2, page 146, December, 1896.)

But when absolutism in government was overthrown in England in 1653, and a constitutional government established, no one principle was recognized as more fundamental than that the executive could levy no taxes except such as had been granted by the people taxed, through their representatives; and one of the very first statutes enacted by Parliament in 1689, under the reign of William and Mary, and accepted by the crown, was that all levying of money for the crown by pretense of prerogative should be hereafter and forever illegal; and next, in the latter third of the next century (1770), the unqualified affirmation and defense of the principle that those who pay the taxes should control the levying of them became the primary cause of the American Revolution, and eventuated in calling the United States into existence. And hence, by reason of such experiences, it has become a part of the common law of all English-speaking people that the taxing power inherent in the state is vested exclusively in the legislative department of its government.

Second. *All taxes or enforced contributions levied by a state in virtue of its sovereignty should be solely (singly) and exclusively for public purposes.*

Another and perhaps a more popular way of expressing this principle would be, to put it in the form of an affirmation, namely: *All taxes that the people pay, the government should receive.*

All recognized authorities, judicial and economic, are agreed in regarding the above proposition as in the light of a political axiom from which there can be no rational dissent. From a great number of confirmatory and illustrative legal opinions and decisions the following are especially worthy of attention:

"No State government, nor that of the United States, nor any other authority professing a regard for the rights of the people, is at liberty to take money out of their pockets for any other than a public purpose. Whenever it can be discovered that a tax is levied for something which properly can not be called such, it may be successfully resisted by all the measures that the law allows in courts of justice."—*Miller, Justice S. F., Lectures on the Constitution of the United States, p. 242.*

"We have established, we think beyond cavil, that there can be no lawful tax which is not laid for a public purpose."—*Loan Association vs. Topeka, United States Supreme Court, 20 Wallace, p. 664.*

"Taxation, by the very meaning of the term, implies the raising of money for public uses, and excludes the raising of it for private objects and purposes."—*Allen vs. Inhabitants of Jay, 60 Maine* (per Appleton, C. J.).

"Taxation is allowable only for public purposes. The name (taxation) is not rightfully applied with reference to objects of a private nature, such as a bridge, manufactory, or foundry owned by individuals. An act of the Legislature authorizing a levy for a mere private purpose, or for a purpose which, though public, is one in which the people from which it is exacted have no interest, would not be a *law*, but a judicial sentence."—*Hillard, Law of Taxation, 1875.*

What are public purposes? This question is an embarrassing one, and in attempting to answer it there is opportunity for much latitude of opinion. In the first place, the ordinary or dictionary definition of the term "public," as forming a part of the above question, is certainly infelicitous and ambiguous—namely, "pertaining to a nation, state, or community; extending to the whole people" (Webster). Thus, for example, under a purely despotic form of government any exaction of contributions (taxes) from the people, and expenditures resulting therefrom, which the heads of the state may decree, be it for the expenses of a harem, the amusement or dignity of royalty, the reward or pensions of court favorites, or the maintenance of a military force for the subjugating of the people, would be held to be for a public purpose, and any subject that should undertake to contravene this assumption would be amenable to punishment and perhaps to the charge of treason.

On the other hand, under all popular or constitutional governments it would not probably be disputed, that taxation should have but one object and taxes but one destination—namely, to supply the expenses necessitated by those services which, according to established usage, it is the business of government to provide, and in contradistinction to those which private inclination, interest, or liberality will supply whenever a necessity or demand for such action becomes sufficiently manifest. Any form of levy, therefore, under such a government upon the person or property of its citizens that does not conform to these conditions is not for a public purpose and is not entitled to be called taxation.

The following further amplification of these propositions by the Supreme Court of Massachusetts has probably also the unqualified indorsement of all judicial authorities in the United States:

"The incidental advantage to the public, or the State, which results from the promotion of private interests and the prosperity of private enterprise or business, does not justify their aid by the use of public money raised by taxation, or for which taxation may become necessary. It is the essential character of the direct object of the expenditure which must determine its validity as justifying a tax, and not the magnitude of the interest to be affected, nor the degree to which the general advantage of the community, and thus the public welfare, may be ultimately benefited by their promotion. *The principle of this distinction is fundamental. It underlies all government that is based upon reason rather than upon force."—Lowell vs. Boston, 111 Mass., 454.*

"It has become a favorite maxim that it is the duty of government to promote the happiness of the people. The phrase may be interpreted so as to mean well, but it is a very inaccurate and unhappy one. It is the inalienable right of men to pursue their *own* happiness, each man under such restraint of law as will leave every other man equally free to do the same. The happiness of the people is the happiness of the individuals who compose the mass. Speaking now with reference to those objects only which human laws can reach and influence, he is the happy man who sees his condition in life constantly and gradually, though it may be slowly, improving. Let government keep its hands off, do nothing in the way of creating the subject-matter of speculation, and things naturally fall into this channel."—*Sharswood, Legal Ethics.*

The distinction between a public and a private purpose in respect to taxation, however, is often a matter of great difficulty and embarrassment; and one eminent jurist and writer on taxation (Cooley) has indeed declared that "there is no such thing as drawing a clear line of distinction between purposes of a public and those of a private nature." But the question at issue has been so often made the subject of definition and illustration by the highest courts of the United States—speaking through jurists of the highest conceded ability—that, although complete unison of opinion does not now and probably never will exist as to whether certain particular purposes, as expenditures by the State for bounties, facilitating transportation, education, charities, amusements, celebrations, and the like, are within the requirements to make them public. The sphere for disagreement has, however, within recent years greatly narrowed. One of the most clear and comprehensive of illustrations on this topic, given by the Supreme Court of Michigan (People *vs.* Township, 20 Michigan, 452), through Justice Thomas M. Cooley, was as follows:

In respect to "certain things of absolute necessity to civilized society," the State is precluded either by express constitutional provisions or by necessary implications, from providing for at all, and which are thus left wholly to the fostering care of private enterprise and private liberality. We concede, for instance, that religion is essential, and that without it we should degenerate to barbarism and brutality; yet we prohibit the State from burdening the citizen with its support, and we content ourselves with recognizing and protecting its observance on similar grounds. Certain professions and occupations in life are also essential, but we have no authority to employ the public money to induce persons to enter them. The necessity may be pressing and to supply it may be in a certain sense to accomplish a public purpose, but it is not a purpose for which the power of taxation may be employed. The public necessity for an educated, skillful physician in some particular locality may be great and pressing, yet, if the people should be taxed to hire one to locate there, the common voice would exclaim that the public moneys were being devoted to a private purpose. The opening of a new street in a city or village may be of trifling importance as compared with the location within it of some new business or manufacture; but while the right to pay out the public funds for the one would be unquestionable, the other by common consent is classified as a private interest which the public can aid as individuals, if they see fit, while they are not permitted to employ the machinery of government to that end. Indeed, the opening of a new street in the outskirts of a city is generally very much more a matter of private interest than of public concern; yet, even in a case where the public authorities did not regard the street as of sufficient importance to induce their taking the necessary action to secure it, it would not be doubted that the moment they should consent to so accept it as a gift, the street would at once become a public object and purpose upon which the public funds might be expended with no more restraints upon the action of the authorities in that particular than if it were the most prominent and essential thoroughfare in the city.

By common consent, also, a large portion of the most urgent needs of society are relegated exclusively to the law of demand and supply. It is this in its natural operation and without the interference of the Government that gives us the proper proportion to tillers of the soil, artisans, manufacturers, merchants, and professional men, and that determines when and where they shall give to society the benefit of their particular services. However great the need in the direction of any particular calling, the interference of Government is not tolerated, because, though it might be supplying a public want, it is considered as invading the domain that belongs exclusively to private inclination and enterprise. We perceive, therefore, that the term "*public purpose*," as employed to denote the objects for which taxes may be levied, has no relation to the urgency of the public need or to the extent of the public benefit which is to follow. It is, on the other hand, merely *a term of classification to distinguish the objects for which,* *according to settled usage, the Government is to provide, from those which, by the like usage, are left to private inclination, interest, or liberality.*

Under a constitutional and representative form of government the determination of what constitutes a public purpose in respect to taxation rests primarily in the legislative department of such government; but legislative determination on this subject is not absolutely conclusive, for the question ultimately is one of law. If this was not so, a Legislature would possess unlimited power to make anything lawful which it might call taxation, which would be equivalent to an unlimited power to plunder the citizen.

In every case in which the Legislature shall have clearly exceeded its authority in this regard, and levied a tax for a purpose not public, it is competent for any one, who in person or properly is affected by the tax, to appeal to the courts for protection.—*Cooley, Law of Taxation, p. 55.*

Brief references to certain other court cases, in which the validity of this claim that certain taxes, or acts involving the imposition of taxes, were for public purposes, was the question at issue, will also help to an understanding of the subject.

In 1872 the city of Boston was authorized by the Legislature of Massachusetts to issue bonds to the amount of $20,000,000, the proceeds to be loaned to persons whose property had been destroyed by a recent great fire. The Supreme Court of Massachusetts held that, although such "a promotion of the interests of individuals might result incidentally in the advancement of the public welfare," the measure was, "in its essential character, a private and not a public object," and therefore unconstitutional. (Lowell *vs.* Boston, 111 Mass.)

A similar statute enacted by the Legislature of South Carolina in aid of sufferers by a fire in Charleston was also declared by the Supreme Court of that State as unconstitutional. (Feldman & Co. *vs.* City of Charleston, S. C., 57.)

In 1870 the town of Jay, in Maine, voted to loan $10,000 to a firm of manufacturers, on condition that they would move their works to the town and establish and maintain them there for ten years. This vote, although ratified by an act of the Legislature, the Supreme Court of the State declared void. (Allen *vs.* Jay, 60 Maine, 124.)

In connection with this case the Legislature of the State of Maine officially put the following question to the justices of its Supreme Court: "Has the Legislature authority under the Constitution to pass laws enabling towns by gifts of money to assist individuals or corporations to establish or carry on manufacturing of various kinds within or without the limits of said towns?" The question was answered in the negative. The court used the following language: "There is nothing of a public nature any more entitling the manufacturer to public gifts than the sailor, the mechanic, the lumberman, or the farmer. Our Government is based on an equality of rights. The State can not rightfully discriminate among occupations; *for a discrimination in favor of one branch of industry is a discrimination adverse to all other branches.* The State is equally bound to protect all, giving no undue advantage or special or exclusive preference to any. Taxation in aid of private enterprise is to load the tables of the few with bounty that the many may partake of the crumbs that fall therefrom."

In 1875 the Legislature of Kansas authorized townships to issue bonds for the purpose of raising money to be applied for the relief of such farmers within their limits as had been deprived, by a failure of crops, of seed with which to plant for a new season. This authorization was held by the court (Justice Brewer) to be unconstitutional, on the ground that the use of public moneys for the accommodation of a certain class was not a public purpose—"not for the benefit of the indigent, but of those who have fields to till and stocks to care for"—and that if the principle involved is once recognized, it may be invoked with equal propriety in aid of other or all classes. (State *vs.* Osawkee, 14 Kansas, 488.)

In the State of New York its Court of Appeals has held void an act of the Legislature authorizing a village to take stock in a manufacturing corporation, and to issue bonds to raise the money to pay for such subscription, and to levy taxes for the payment of the principal and interest on said bonds. (Weismer *vs.* Douglas, 64 N. Y., 91.) In a similar case (Sweet *vs.* Hurlbert, 51 Barber) Justice James expressed himself as follows:

> If this can be done, it is legal robbery; less respectable than highway robbery in this, that the perpetrator of the latter assumes the danger and infamy of the act, where this act has the shield of legislative irresponsibility.

In Cole *vs.* La Grange (113 U. S.), the case turned on an act of the Legislature of Missouri authorizing the city of La Grange, whenever two thirds of the resident taxpayers signified their approval at a special election, to levy a tax not exceeding two per cent per annum on the assessed value of the real and personal property in the city, to pay for a donation or subscription to the stock of a manufacturing company. The court held the act void; the opinion, written by Mr. Justice Gray, embodying the following language:

> The general grant of legislative power in the Constitution of the State does not enable the Legislature, in the exercise either of the right of eminent domain or of the right of taxation, to authorize counties, cities, or towns to contract, for private objects, debts which must be paid by taxes.

It can not, therefore, authorize them to issue bonds to assist merchants or manufacturers, whether natural persons or corporations, in their private business. These limits of the legislative power are now too firmly established by judicial decisions to require extended argument upon the subject.

In Burlington *vs.* Beasley (94 U. S., 310), however, taxation in aid of a public gristmill, the tolls of which the Legislature would have a right to regulate, was sustained; the construction of such a mill in a new country being probably a public necessity, and not possible without public aid.

But perhaps the most weighty opinion on this question is that of the United States Supreme Court in the case of the Loan Association *vs.* Topeka, 20 Wall, 655 (before referred to on page 153, vol. L., Popular Science Monthly). In 1872 the Legislature of Kansas passed an act authorizing cities and counties to issue bonds for the purpose of encouraging the establishment of manufactures and other like enterprises; and under this act the city of Topeka created and issued its bonds, to the extent of $100,000, and gave the same "as a donation," a majority of voters approving, to an iron-bridge company, as a consideration for establishing and operating their shops within the limits of the city. The interest coupons first due on these bonds were promptly paid by the city out of a fund raised by taxation for that purpose, but subsequently, when the second coupons became due, and the bonds had passed out of the possession of the bridge company by *bona fide* sale to a loan association, the city meanly repudiated its obligations, on the ground that the Legislature of Kansas had no authority under the Constitution of the State to authorize the issue of bonds, the interest and principal of which were to be paid from the proceeds of taxes, for any such purpose as the encouragement of manufacturing enterprises. Legal proceedings to enforce payment were thereupon commenced by the bondholders in the United States Circuit Court, and judgment having been there given for the city, the case was appealed to the United States Supreme Court, where with only one dissenting voice (Judge Clifford) the judgment of the lower court was affirmed.

The following extracts from the opinion of the court, given by Justice Miller, will forever stand as embodying economic and legal principles of the highest importance:

"Beyond a cavil there can be no lawful tax which is not laid for a public purpose. . . . It may not be easy to draw the line in all cases so as to decide what is a public purpose in this sense and what is not. But in the case before us, in which towns are authorized to contribute aid by way of taxation to any class of manufactures, there is no difficulty in holding that this is not such a public purpose as we have been considering. If it be said that a benefit results to the local public of a town by establishing manufactures, the same may be said of any other business or pursuit which employs capital or labor. The merchant, the mechanic, the innkeeper, the banker, the builder, the steamboat owner, are equally promoters of the public good, and equally deserving the aid of the citizens by forced contributions. No line can be drawn in favor of the manufacturer which would not open the public treasury to the importunities of two thirds of the business men of the city or town." *

Twelve years later a similar case was decided by the same United States Court in the same way. Under the authority of a State law, the city of Parkersburg, Virginia, had issued bonds in aid of a private enterprise. The court decided these bonds to be void for the reasons set forth in Loan Association *vs.* Topeka. The decision was rested wholly upon the decision in the earlier case, and there was no dissent from it, although one justice (Clifford) had dissented in the Topeka case. Justice Blatchford, in rendering the opinion, said: "Taxation to pay the bonds in question is not taxation for a public object. It is taxation which takes the

* Here, then, we have from the Supreme Court of the United States a decision, as recent as October, 1874, defining the limitation of the power of taxation growing out of "the essential nature of a free government"; and if under such natural limitation there is no power, as the court decided, in a State government (irrespective of anything to the contrary in the Constitution of such State) to levy taxes for the support or encouragement of manufacturers, it is difficult to see under what rule or authority the Federal Government can levy taxes like those now imposed, which, from the circumstance that they yield year after year little or no revenue to the national Treasury, are manifestly levied and maintained for other than public purposes.

Whether, if a case involving the validity of tariff taxes like those above specified could be brought before the United States Supreme Court, it would apply the same rule of principle to the Federal that it has to a State government, in respect to the limitation of the sphere of taxation, may be regarded as an open question. An opportunity for avoiding a decision on this subject might be found in the assumption that there was no evidence before the court that any particular tariff act was passed by Congress for any other than revenue purposes, and that the court could not take cognizance of a subsequent change in circumstances growing out of changes in the conditions of prices and supply and demand. And in this connection it is curious to note that in the first tariff enactments of the Federal Congress, which embodied the principle of protection, the preambles of the act openly stated and recognized the objects aimed at, viz., "the support of the Government, and the encouragement and protection of manufactures"; while in later years the latter clause, relative to manufactures, has been shrewdly omitted from the tariff act preambles—possibly from a suspicion that there was a constitutional question covered up in this matter of protective duties which some day would not be found able to stand judicial examination.

But until the contrary is proved, the opinions and judgment of the Supreme Court of the United States, as given in the Topeka case, would seem to admit of no other construction than that taxation for any other purpose than revenue, or taxation for protection, or in aid of private interests engaged in manufacturing, is beyond the province of the legislative power of either our national or State governments, and when imposed—to use the exact language of the court—"is none the less robbery because it is done under the forms of law and is called taxation."

private property of one person for the private use of another person."

Particular care has also been taken by the Courts to close the door against the possibility of making taxation subservient to any private purpose by incorporating it with some public purpose:

Public aid to private purposes can not be secured by yoking them to a public purpose. And where the public and private purposes are attempted to be aided by a single concession, the latter vitiate rather than the former uphold the grant. The entire purpose—or, if there are several, and no rule of apportionment as to the application of the proceeds—then all the purposes must be public.—*Opinion of Justice Brewer, 23 Kansas, 745.*

The cases in which the above conclusions have been apparently antagonized before the courts of the United States have been numerous, and have related mainly to the right of the Legislatures of the several States to levy taxes for purposes in respect to which the paramount object—i. e., for public or private good—was not clearly evident; as for the construction of railroads, the drainage of land, the promotion of sanitary measures, the payment of bounties in aid of educational or charitable institutions whose property is owned by and whose policy is directed by private individuals, religious sects, or corporations, and not by the State, and the like.

The question whether taxation by which aid was afforded by towns or counties to the building of railroads was for a public purpose, has been especially brought to the attention of the courts, State and Federal, in repeated instances; and, although the preponderance of opinion has been in the affirmative when legislative authority has been previously granted, yet the decision of the courts has rarely been unanimous, and in some cases has been adverse. Thus, in People *vs.* Township (20 Michigan, 452), an act of the Legislature of Michigan authorizing townships to pledge their credit to aid in the construction of a railroad from the city of Detroit to a suburban village was held void in a remarkably able opinion by Justice Cooley. Again, in Whiting *vs.* Sheboygan (25 Wisconsin, 157), an act of the Legislature of Wisconsin authorizing the county of Fond du Lac to levy a tax, the proceeds of which were to be given to aid the building of a railroad from the city of Fond du Lac to the city of Ripon, was also held by the court to be void.

The argument in favor of the unconstitutionality or wrongfulness of the application of the proceeds of the taxation of the people by States or municipalities for aiding the construction of railroads has been, that they are built by corporations organized mainly for the purpose of gain; that they are under the control of such corporations rather than that of the State; and that the taxes in question went to swell the profits of individuals, and did not result in good to the State or benefit to the public except in a remote collateral way.

On the other hand, it has been urged that roads, canals, bridges, navigable streams, and all other highways, have in all times been matters of public concern; that such channels of travel and of the carrying business have always been established, improved, and regulated by the State; and that a railroad had not lost this character because constructed by individual enterprise, aggregated into a corporation.

In rendering an opinion in the celebrated Loan Association *vs.* Topeka case, the court took up the question whether the grants of public money or credit which have been made by counties and municipalities in the United States in aid of railroad construction were not by parity of reasoning equally unconstitutional as similar grants for establishing or encouraging manufactures have been held to be; and remarked that in all such cases, which have been numerous before the courts in every State in the Union, "the decision has turned upon the question whether the taxation by which the aid was afforded to the building of railroads was for a public purpose. Those of the judges who came to the conclusion that it was, held the law for that purpose valid. Those who could not reach that conclusion held them void. And it is safe to say that no court has held debts created in aid of railroad companies, by counties or towns, valid on any other ground than that the purpose for which the tax was levied was a public use, a purpose or object which it was the right and the duty of the State governments to assist by money raised from the people by taxation." But, continues the judge, "*Of the disastrous consequences which have followed its recognition by the courts, and which were predicted when it was first established, there can be no doubt.*"

It is interesting to note in this connection that since the decision in this case many States of the Union have been forced to prohibit loans in aid of the construction of railroads and like enterprises in the revision of their Constitutionss.

When the purpose of taxation is evidently to primarily promote the interests of individuals—i. e., to establish a manufactory, a brick company, a hotel, and the like—the courts whose province it is to decide whether the purpose is public or private will as a rule undoubtedly declare it void.

A noted and the almost solitary instance in which the above proposition and precedents have been clearly antagonized by a judicial decision is to be found in a case in Louisiana, where an act of the State Legislature authorizing a municipal subscription to the stock of a company incorporated to build a theater was held valid, on the ground that "it would contribute to the wealth and embellishment of the city, afford a place of relaxation and amusement, and would tend to correct and enlighten the morals of the citizens." (First Municipality *vs.* New Orleans Theater Company, 2 Rob., Louisiana, 209.)

THE BOUNTY CASE OF 1891.—A review of this department of the application of taxation would be incomplete that failed to notice a legal contention before the Supreme Court of the United States in 1891, respecting the constitutionality of the tariff act of 1890, which was questioned on several grounds; one of them being a provision requiring the payment of bounties to every producer of sugar of certain saccharine strength * from beet, sorghum, sugar cane, or maple sap, grown or produced within the United States. Under this provision of the tariff enactment of 1890, the citizen of Connecticut was taxed for the benefit of the farmer of Nebraska or California, and the farmer of New York for the benefit of the Louisiana planter; the farmer who raised wheat and corn at ten or twelve dollars an acre was taxed for the benefit of a farmer in a distant State who raised sugar cane or sugar beets at fifty or a hundred dollars an acre. There was, moreover, but little doubt that the inclusion of sugar, made from maple sap, in the bounty provision, was not originally contemplated by the originators and promoters of the act; inasmuch as the manufacture of such sugar is one of the most profitable industries of the country, and as a rule readily calls for a fancy or artificial price; but was included in the act, while under consideration by Congress, for the reason that its enactment into law would otherwise have been difficult or impossible. Another interesting and anomalous feature of this case was that it originated in an attempt to obtain the bounty after the enactment (law) offering it was repealed, on the ground that the claimants planted cane in expectation of the continuance of the bounty, and would suffer loss if they did not get it. The question of the validity of the entire tariff act, by reason of the unconstitutionality of the bounty provision contained in it, having been raised, the attorney general of the United States antagonized such assumption before the court as follows:

First, that under the clause of the Federal Constitution (section 8 of Article I) which empowers Congress to levy taxes, duties, etc., "to pay the debts and provide for the general welfare" of the United States, Congress has the power to expend taxes for anything which, in its judgment, is "for the general welfare." Second, that the judicial decisions of the State courts, to the effect that taxation, to be lawful, must be for public purposes, have no application to this controversy, inasmuch as they were all of them

* Two cents per pound on sugar testing not less than 90° by the polariscope, and one and three fourths cents per pound on sugar testing less than 90°, but not less than 80°.

cases of municipal taxation, which must be for public municipal purposes; and that it is obvious that the establishment of a particular industry in one place, by a bonus to specified private individuals, is a very different object for taxation than the encouragement by the national Government of a widespread industry in many quarters of the Union for national purposes, with a view of diversifying the industries of the country and making it independent of other countries for its necessities." (*Speech of United States Attorney-General Miller.*) Third, that the assumption that "public purposes" in respect to taxation by Congress means something different than the same phrase when applied to State taxation is sustained by instances in which Congress has authorized the expenditure of public moneys for bounties or relief to people in this and other countries; some forty cases of this character being cited, in which relief in the form of money or supplies was given to sufferers by fire, grasshoppers, overflow of the Mississippi, yellow fever, earthquakes (one in Venezuela, South America), and for defraying the expense of transporting food to Ireland, France, and Germany. To these instances may perhaps be added the "codfish bounty," which was practically a drawback upon the duty on imported salt used for preserving fish.

In rejoinder it was contended: First, that if Congress has power to expend taxes for anything which in its judgment is "for the general welfare," then there is practically no limitation whatever upon its constitutional power to raise and appropriate taxes; and that its power to treat the public purse as its own, and give away the proceeds of taxation is as unlimited as is the cupidity of congressional lobbyists. It was also ingeniously pointed out that the position of the attorney general was equivalent to saying that when a tax is levied by a State for a given purpose it is not for public use, but when levied by the national Government for the same or a like purpose it is for public use. Again, such an assumption of unlimited power on the part of Congress directly antagonizes the opinions of Chief-Justice Marshall (see page 149, vol. L, Popular Science Monthly) and also the declaration, made in special reference to the taxing power by the United States Supreme Court through Mr. Justice Miller in the Topeka case (page 153, ditto), "*That the theory of our governments, State and national, is opposed to* the deposit of unlimited power anywhere." Justice Story (on the Constitution, section 990) also asks and answers the precise question at issue: "Has Congress a right to raise and appropriate the public money to any and to every purpose according to their will and pleasure? *They certainly have not.*" The same jurist, in his lectures on the Constitution, thus further amplified his ideas on this subject, and evidently thought that he had in the following brief paragraphs brought the argument in support of the "unlimited" theory to a *reductio ad absurdum:*

"A power to lay taxes for the common defense and general welfare of the United States is not in common sense a general power." It is "a power exclusively given to raise revenue, and it can constitutionally be applied to no other purpose. The application for other purposes is an abuse of the power; and in fact, however it may be in form disguised, is a premeditated usurpation of authority." A grant under the Constitution to Congress "to do any act they pleased which ought to be for the good of the Union . . . would reduce the whole instrument to a single phase, that of instituting a Congress with power to do whatever would be for the good of the United States; and as they would be the sole judges of good or evil, it would also be a power to do whatever evil they pleased" (1 Story, Constitution, section 926).

Second, to the assumption that the decisions of the State courts in respect to the limitations of the power of taxation do not apply to this controversy, it was replied that the relation of the State courts to their State Constitutions is substantially the same as that existing between the Federal Supreme Court and Congress; that the State decisions (which have not been, as was claimed, "all cases of municipal taxation") frequently treat such legislation, independently of Constitutions, as being in violation of natural right, and that there are limitations imposed upon legislative power by reason of "general principles" has been recognized by the United States Supreme Court (Bartemeyer *vs.* Iowa, 12 Wallace). It would further seem that natural rights must be the same, whether against legislation by Congress or by the Legislature of a State. If a State can not levy and expend taxes for other than public purposes, it may be presumed, *a fortiori*, that the national Government can not, "for the former can do *anything* which the Constitution (and natural right) do not forbid; while the latter can do nothing which the Constitution does not first sanction." The Federal Government has "no right to raise money by taxation for a thousand things for which the State may impose taxes and collect them of the people" (Miller, Justice, Lectures on the Constitution).

Third, in respect to the instances cited, in which Congress has expended moneys for bounties, or relief of private interests, in this and other countries, it was replied that they were all matters of national charity; were never subjected to judicial scrutiny, or even seriously challenged in debate; were never for large amounts, and did not contemplate any special levy of taxes, but were from funds already in the Treasury. It was also claimed that this was the first case in which the constitutionality of a congressional bounty, whether direct or indirect, for "protection," has ever been before the United States Supreme Court for discussion. And pertinent to the case it should be further noted, that when it was proposed in the Convention that framed the Federal Constitution to incorporate in it a provision for bestowing "rewards" for "the promotion of agriculture," the proposition was rejected.

The facts about the bounty for codfisheries are, that it was given under the first revenue laws (levying duties) of the United States in 1792, and was intended to offset bounties and other measures adopted by England, as was believed, for the purpose of destroying the fisheries, not only of the United States, but also of France. Its enactment was strenuously resisted at the time, on constitutional grounds, and especially by as good a constitutional authority as Madison, who held that the enactment of a bounty was beyond the power of Congress (4 Elliot's Debates, Philadelphia edition, 1875, 525, 526). Its legality was never judicially examined, and the act expired by its own limitation in seven years. Subsequent acts expressing limitation were passed of the same character from time to time; and since their final expiration, many years ago, it is claimed that no Congress, until the Fifty-ninth, 1890, has asserted its right to levy taxation embodying the bounty principle.

The court, in giving an opinion affirming the constitutionality of the tariff act of 1890, evaded the question of the constitutionality of its bounty provision, on the ground that the invalidity of one part of a revenue act does not invalidate the whole act; and when that principle was settled, the objections to the act based on separate clauses really disappeared.*

The disbursement of the money voted by Congress for the payment of the sugar bounties having been withheld by the Comptroller of the United States Treasury on the ground that the appropriation was unconstitutional, the court held that if Congress made promises and thereby induced people to incur expenses which they would not otherwise have incurred, and has then appropriated the money to indemnify the parties, the payment can not be stopped by an administrative officer on the ground of the unconstitutionality of the primary bounty enactment.

A question of interest in connection with this case, which may naturally suggest itself, especially to those not learned in the law, is, How happens it that repeated acts of expenditure of money raised by taxation for admittedly private purposes have been

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* One of the best reviews of this celebrated case, one to which the writer has been greatly indebted, is to be found in an article contributed to and published in the Harvard Law Review for February, 1892, by Charles B. Chamberlain, Esq., of Boston.

authorized by Congress, without any challenge before the proper courts of their constitutionality? The answer is to be found in the legal fact that "the question of the constitutionality of a law can never be presented and determined abstractly. It must always be raised by somebody whose person or property is affected by the execution of the statute the validity of which he impugns.* Until the opportunity for raising and the individual who can raise the question of constitutionality present themselves, there can be no presumption from the existence of such legislation upon the statutebook."

In Maine, a law which for more than half a century—almost as long as the State has existed—had been enforced, and reproduced in each revision of the statutes, was declared unconstitutional so soon as challenged; the chief justice meeting the reason for such acquiescence by saying that "the judicial opinion and the public sense were not so much awakened to the principle underlying this then as now." (Brief of Smith and Clarke, averring the unconstitutionality of the tariff act of 1890.) *

The nature, definition, and limitations of the service for public purposes, which a free representative government can render or perform by the expenditure of moneys raised by taxation having been once ascertained and enunciated by the supreme judicial authority of the State (as would seem to have been done in the United States), the instant, thereafter, that taxation essays to become anything but taxation—i. e., for an unquestionable public purpose; the instant that it is made an instrumentality for effecting any results other than such as are directly necessary or beneficial to the whole public, that instant it becomes inequitable and antagonistic to the very idea of a just government; and the citizen whose person or property is thereby affected has at least a moral right to demand protection and redress.

[*To be continued.*]

According to Mr. Meredith Nugent, in Our Animal Friends, elephants like fun. Two little elephants at Bridgeport, he says, take evident pleasure in the tasks that are set them. Even in the stable, when no trainer was about, one of them "would stand on its head just as it was used to do in the circus, and the other would look anxiously on until its own turn came to stand on its head and be admired by its companion."

* "It is by facts and instances that the people are taught their Constitutions and their laws. Constitutions are framed; laws established; institutions built up; the processes of society go on, until at length, by some opposing, some competing, some contending forces of the State, an individual is brought into the point of collision, and the clouds surcharged with the great force of the public welfare burst over his head."—*Speech of Mr. Evarts for the Defense, in the Impeachment of President Johnson.*

"CONFESSIONS" OF A NORMAL-SCHOOL TEACHER.

By MARY HALL LEONARD.

IN this age of frank subjective expression when we are taken into the confidence of so many interesting personalities, when authors write their "reminiscences" or recall their "literary passions," when men of business recount the steps by which they climbed the ladder of success, and when even the public-school teachers have found a welcome for their "confessions" in the literary magazines, it seems good to me also, having been a normal-school teacher from the first (that is, having spent most of the years since, a girl in my teens, I graduated at a State normal school, in teaching in similar institutions of different sections of the country), to set forth in order a few of the things that are surely believed by the members of our craft.

It is currently reported that we normal-school people are not an erudite class; that there are many things in the philosophies of heaven and earth that are not included in the horizon of our mental vision. Indeed, we have heard this so many times that it begins to seem like a "chestnut" to our indurated ears. Brethren of the college and out of the college, when next you feel moved to characterize our mental status, please tell us something new.

As to the charge itself we have no desire to enter into controversy regarding it. We have a high respect for knowledge, especially of the *real* kind. We prefer this to the sort possessed by a certain fabled princess of one of Henry James's novels, who had been told all the facts in the universe, but had never in her life perceived anything. For this latter kind of "knowledge" we are not perhaps so greedy as some, while recognizing that "information" also has its value and uses.

But we confess, jointly and severally, to a measure of truth in the indictment. There are halls in the temple of knowledge where the feet of some of us have never trod; there are shrines at which some of us have never worshiped. Friend Critic, forgive us if we sometimes question whether you yourself have tasted of every "apple" that grows upon the tree of knowledge, unless by proxy as it were, after the manner of the fabled princess aforesaid.

We are inclined to the belief that native ability and persistent effort have more to do with the acquisition of mental power than the question of what seat of learning one studies in. Much that a student thinks he learns while acquiring a so-called "education" is only "skin-deep," and has little appreciable effect upon the after-efforts of life. But if a mind of good ability has learned how to study, and has a strong desire for improvement and is expending its energies upon worthy subjects of thought, it is difficult to see how the results of a given period of study—whether two, four, or ten years, or a whole lifetime—could be very unequal in the total sum, whether these years be passed in the normal school, or in the college, or in one's own well-furnished library, or in a pioneer's cabin with only a few "best" books that are pored over and pondered till they become part of one's very life. Not that the results would be alike in the several cases. Far from it. But all disabilities have their compensations; and perhaps the total gain for a like amount of effort may not vary so much as is sometimes supposed.

For my own school education—to make a more personal "confession"—I had a desire for the seminary course that some of my young friends entered upon (it was before the days of the multiplication of women's colleges); but, in reviewing the results of school life after the lapse of years, I see no reason to blame the dispensation of Providence, which, by making me one of a large family of children, caused the financial straitness that sent me to a normal school instead. The normal school taught me how to study and deepened the desire for study that I already possessed. Even if the school had done nothing else, it would have deserved my lasting gratitude.

But it did other things for me. It opened before me a definite line of work worthy of my best endeavors. It gave me a practical touch with some of the phases of school work and saved me from some of the crudities and mistakes that hamper a young teacher's efforts. It did not save me from all such mistakes. It has been truly said, "No matter what the training, every teacher needs experience." But I am sure that the normal school gave me some aids to my work as a teacher that I should not have been likely to receive in any other kind of school.

There is one view of the relation of normal-school graduates to the teaching profession that may be illustrated by the following incident: A young lady, after graduating at a high school, took the classical or four years' course at a New England normal school, and afterward taught successfully for twelve years in the high schools of Massachusetts. Then came family changes, followed by a period of enforced rest. When she was able to resume her profession she first took a year of special study in a private institution of high reputation, without remaining long enough, however, to receive the diploma of the "college."

She then proposed to enroll herself in the leading teachers' agencies as a candidate for a high-school position. But she was met with the statement: "It is not easy for a teacher to obtain a high-school engagement unless she is a college graduate. Let us advise you to turn your attention to school supervision, or to the kindergarten, or to some form of work connected with the lower grades of schools."

"But," said the teacher, "I do not feel ready for those other lines of work. My teaching has always been in high schools, and this is what I can do best."

"We do not doubt," was the reply, "that you can do better teaching in high schools than most of those who apply. Nevertheless, we have to cater to the demand."

"But there are a great many normal-school graduates in the high schools, to my certain knowledge."

"Oh, yes; the normal-school graduates who are in that work do not lose their positions. But women's colleges are in the mind of the public now, and an application for a high-school teacher usually specifies that one of their graduates is wanted."

Without pausing to suggest that the conceded fact that the normal-school graduates retain their high-school positions argued something regarding their ability to fill them, the teacher continued: "I should think the training and experience that I have had ought certainly to count for as much as the college course."

"Yes. It is really worth much more; but it is the name that is chiefly desired. School men are not satisfied with knowing that a teacher has had a collegiate training. They want the full college *degree*. The other day we recommended a young lady who has just graduated from —— College, ranking second in her class. The superintendent, after making a note of the fact, remarked, 'How finely that will sound in my report to the school board and in the advertisements of the school!'"

We are conscious of no acerbity or envious cravings on account of the academic degrees and honors of the universities. We appreciate that a real value attaches to such marks of recognized attainment when honestly bestowed, and held with no exaggerated sense of their importance. So also the titles of nobility, heraldic insignia, and military decorations of the Old World are of value, unless they have become divorced from the sentiments which gave them birth.

But, as self-respecting Americans, we do not wish to feel ourselves dependent upon such factitious means for success in life. Nor do we feel so. We call to mind that the greatest American of this half century was "graduated" from school life after a few months' study in a backwoods school. When he came to the highest position of responsibility ever held by a citizen of the United States, it was said by a distinguished college president, "Lincoln may have good sense, but he will need some one to write his messages for him." Yet the two great classic prose utterances of the war period are Lincoln's Emancipation Proclamation and his Gettysburg address.

As we mingle freely and on equal terms with our friends and kinsfolk and acquaintance who are among the Ph. D.'s and LL. D.'s and D. D.'s of scholarly fame, and also with the younger sisterhood of educated women who are wearing recent college honors, we are sensible of no feeling of abashed inferiority, as though in the presence of things too high for us; nor do the attainments of these scholars, which we appreciate and greatly rejoice in, seem to dwarf in any degree the apparently equally valuable powers of many another friend whose mental acquirements have been gained in some widely different course of training in the great university of American life.

But there is something in the experience of that high-school teacher with the agencies which raises a query as to the relations of the high schools to the educational status of the modern age. If there is one point that seems fully proved by the educational progress of the last half century it is that kindergarten and primary-school teachers need professional training for their work. The time was, and not so very long ago, when it was thought that any one with a common-school education could teach little children. But it seems a far cry back to that position to-day.

Is it, then, true that the high school is the only part of our public-school system in which the teacher does not need to be a student of pedagogical science, to be in sympathetic and intelligent touch with modern school methods, and to have gained a degree of tried skill through supervised schoolroom experience before being placed in full charge of schoolroom work? This would indeed be passing strange. One would suppose that the high-school teacher must need for his equipment an intelligent understanding of the methods and plans of the lower schools from the kindergarten up, with some added study of the special needs of high schools—a more comprehensive rather than a shorter course of professional training. If not, then will some one tell us why not?

The question is not whether the high-school teacher should have a broad and thorough scholarship. That "goes without saying." And if it be said that the best place to gain this scholarship is within the walls of a good college, we of the normal school have no desire to challenge the assertion. But, given all that scholarship, all that native ability can do, the idea that high-school teachers have less need than primary teachers to professionalize their work is a baseless assumption which is certain to be undermined sooner or later by the tide of educational progress. It is not hard to predict that the near future will require of the would-be high-school teacher as much of scholarship as the college gives, and as much professional equipment as is given by the normal schools in their best and longest courses.

As to how and in what kind of schools this double equipment can best be given—ah! that is another question, beyond the limits of this paper to discuss, and, like all questions that deal with expedients, hard to settle—differing minds will always prefer differing expedients for the same end.

Will the professional training be included in the college curriculum? Has any college yet provided for it? I mean, not simply by a course of lectures on Herbartian Philosophy, but also by a close and vital study of all the conditions of public-school work. It is a healthy sign of the times that the colleges are addressing themselves to pedagogical questions. The combined efforts of all the institutions of learning will be none too effective for the work of public education. But all real aid to public schools must be given in the spirit of those who would build up rather than pull down, who can distinguish in the work of others a right ideal in the midst of the crowding obstacles that prevent the full realization of that ideal, and who do not hold themselves aloof from personal labor as mutual helpers and learners with other earnest and open-minded thinkers who are already carrying the burdens of the work.

Can the normal schools give this double preparation for high-school work, providing the requisite scholarship as well as the practical and professional training? If it be true that they have not heretofore done so, perhaps the importance of the work they have been doing for the elementary schools offers a partial explanation. But it would be a matter of public interest if educationists should really inquire and find out how nearly the best normal schools in their four years' courses reach the standard of the colleges in scholastic attainments, and also how much difficulty there would be in superadding to these courses whatever they may now lack of such attainments. It would certainly seem to be feasible for a State system of public instruction to prepare at least some of the teachers needed for all grades of its own work. To delegate the work for the higher grades entirely to private institutions which have no practical relations with the lower-grade work, would be to establish a break in the public-school system that it would be hard to justify.

But here again the experience of that high-school teacher raises a question. It would almost seem that in the minds of the managers of the agencies such a breach is known to exist; that while the lower schools belong to the masses of the people, the high school is supposed to be intended primarily as a feeder for the colleges, so that to introduce any other than a collegiate element into its teaching force suggests a "poaching upon the college preserves." There is more than a suspicion abroad that the high schools do stand in just this position of uncertainty, whether their work is chiefly that of a college preparatory school, or whether they are also the head and crown of the school system in which the child of the people finds his best school preparation for whatever career his future may hold. To sustain this double responsibility is more than the high school can do, unless perchance the colleges and the elementary schools can be so brought into harmony—by the modification of one or the other or both—that fitting for college and for general American citizenship shall become one and the same thing.

That the high-school course ought to lead to the door of the college was the unanimous verdict of the able committee whose Report on Secondary Schools has become so famous. But if this be interpreted as meaning that the colleges alone can set the pace for high-school instruction, or if the influence of that report should be to separate the high school from the lower schools, both in its aim and the *personnel* of its teaching force, then, indeed, it is certain that time must bring a reaction. There can be no fundamental reason for an explicit change of policy in the public-school work at the end of the ninth grade.

Since the high schools must sustain such intimate relations with colleges and lower schools, with public and private institutions, it would seem to be the necessary policy of their managers to keep them in fullest touch with both of the leading schools of current educational thought. And here we come face to face with what is perhaps the bottom fact in the situation. It must be confessed that in the educational world there are two types of thinking and thinkers, neither of them confined in its affiliations to the college or to the elementary schools, yet each having its own peculiar relations both with the one and with the other. The one type represents time-honored ideals, it may be of scholarship and culture, or it may be of practical forms and methods—ideals which experience has wrought out, and which are therefore held to be worthy of acceptance. The other type seeks to build up an improved system of education according to principles that are held to be fundamental; and, believing that "new wine must be put into new bottles," it does not scruple to turn aside, if occasion arises, from the standards of the past.

Nor is this true of education alone. It is the same in politics, in religion, in literature, and in every form of art. The traditional or conventional ideals coexist side by side with a newer philosophy, which seems antagonistic until a later view unites them both in its larger perspective.

In the educational world within two or three years these types in a measure seem to have focused themselves in two famous documents, the report of the Committee of Ten on Secondary Schools, and the later report of the Committee of Fifteen—or, as is sometimes said, the Committee of Five, since it is the report of one third of the committee—on the Correlation of Primary Studies, that has become most noted. Though these are ostensibly on different subjects, the report on secondary schools could not fail to take into account the previous school training, nor could the primary work be reported without a long look forward.

Both reports aim at progressive effort for the improvement of the lower schools, and are valuable contributions to the educational literature of the age. The specific suggestions of the two apparently differ less than the guiding principles that seem to have moved the committees. For, consciously or unconsciously, the one seems to have the eye fixed upon certain established ideals of culture and scholarship which are held as the standards for the colleges, and hence, it is assumed, must be the goal of effort for the lower schools. In the other report we seem to hear the note of a different philosophy—a reaching forward toward all the possible activities of the child's future. Yet in this also there is an ideal which beckons onward; but it is not found in traditional types. It is based on the complex needs of our great American life—to prepare the child to understand and to meet those needs and to direct the forces of the future.

If it be said that the collegiate standards are shaped according to the same ideal, the answer must be: Perhaps so; yet the American people will not accept their standards at second hand, or as established for them by a single class in the community. In determining their own educational needs, the great middle class of the people is also in the jury box. The schools that are "for the people" must be planned in a good degree "by the people," instead of following wholly the lead of the highly educated few.

There is a time-honored maxim of the universities that educational influences proceed from the top downward. But, like all epigrams, it is a brilliant half-truth. There is no "top" to education, or if there be it is higher than all human standards, reaching into the very heavens. And this is a ladder over which the angels must pass both ways, ascending and descending upon it. The way must be kept open, and the touch must be free all along the line. There must be no dividing gap where either type of thought can say to the other, "Thus far shalt thou go and no farther." Especially in the high school should there be the largest welcome to good influences from either side. Then the one that can show the largest sympathy and most intelligent understanding of the whole problem will have the greatest influence in the final shaping of affairs.

Yet even as I write a growing doubt arises. Is there really any such conflict in the forces that move educational affairs as we sometimes think? Or, if there be, is it wholly to be deprecated? We know that friction of opinion is the pioneer's axe that clears the path for progress. And whichever side of a question we may find ourselves upon, we should not forget that "the strong opposition is the balancewheel of all parliaments," in the educational as well as the civic world.

But is there really a gap in our educational system? The "bloody chasm" that a few years ago divided two great sections of our country seems to have been chiefly an abstract entity after all. Whenever individuals met in human relations they usually forgot that it had ever yawned between them. We seem to see a multitude of teachers ranged in two great ranks. But their hands are constantly reaching out toward each other in friendly aid, and there is therefore no gap between them, scarcely a dividing line. Collegiate schools are studying the problems of childhood, and normal and public school teachers have no intention to rest satisfied with feeble results in the first of their trinity of aims—knowledge, power, and skill. The faces of the teachers may be turned toward different parts of the horizon; but when we lift our eyes upward we are looking into the same boundless sphere of truth and of life, whose mysteries we are all trying to discover and interpret.

But in a personal "confession" one should not wander into mazes of rhetoric and philosophy. Coming back to my personal bearings, I am strongly reminded of an American gentleman who took an extended tour in Europe. After some months of travel, being a good Christian as well as a tourist, he wrote home to America: "I have discovered that there are just two religious denominations, the prayer-book denomination and that of the prayer-*meeting*. The more I see of each, the more I recognize that I have a genuine sympathy with both. I can worship with pleasure and with profit in 'churches' and in 'chapels.' But when it comes to Christian work I feel that, however it may be with others, I myself can find my best field for endeavor in the prayer-meeting denomination."

It is with a feeling akin to his that I write: I have much fellow-feeling with both "denominations" of educational thought; yet I do not regret that the circumstances of my life have fixed my lines of work more especially with the "denomination" that is in closest touch with the masses of the American people.

HIS object being the systematic exploration of the Franz-Josef Archipelago and the unknown seas adjacent, Mr. Harmsworth, it is announced, intends to keep an expedition in the arctic regions till a complete map can be made of all accessible parts of the still undiscovered north polar world. The Jackson-Harmsworth Expedition is spending its third winter in the arctic regions, and will make another advance in the coming season.

THE MALARIAL PARASITE AND OTHER PATHOGENIC PROTOZOA.*

By GEORGE M. STERNBERG, M. D., LL. D.,
SURGEON GENERAL, UNITED STATES ARMY.

GENTLEMEN: My presidential address last year had for its subject The Practical Results of Bacteriological Researches, and at its conclusion I showed you upon the screen photomicrographs of the principal pathogenic bacteria, including the micrococcus of pneumonia; the micrococci concerned in the production of boils, abscesses, wound infection, puerperal fever, erysipelas, etc.; the bacilli of tuberculosis, of diphtheria, of typhoid fever, of glanders, of anthrax, of influenza, of tetanus, of leprosy; the spirillum of relapsing fever, the spirillum of Asiatic cholera, and various other pathogenic bacteria. These micro-organisms are now generally recognized as belonging to the vegetable kingdom, and as a specialist in this department of scientific investigation your president may perhaps be considered a botanist *in a small way*. But the Biological Society includes among its members many distinguished specialists in that branch of natural history which relates to the animal kingdom, and I think it due to the zoölogists to show that the botanists have no monopoly of mischief-making micro-organisms. In speaking of the pathogenic protozoa I shall devote special attention to the hæmatozoon which is now recognized as the specific cause of the malarial fevers; and in consideration of the importance of this blood parasite from a sanitary point of view, as well as of the interest which attaches to it from a biological standpoint, I shall occupy a little time in giving you an account of its discovery and the grounds upon which it is accepted by well-informed pathologists as the specific infectious agent in the class of fevers referred to.

The malarial parasite was discovered in 1880 by Laveran, a surgeon in the French army, at that time stationed in Algeria, but now a professor in the military school at Val de Grâce.

In my work on Malaria and Malarial Diseases, published in 1884, I refer to Laveran's alleged discovery as follows:

"According to this observer, there are found in the blood of patients attacked with malarial fever pigmented parasitic elements which present themselves under three principal aspects. This parasite is said to be a kind of animalcule which exists at first in an encysted state. In the blood these organisms present themselves as motionless, cylindrical, curved bodies, which are

* Presidential Address delivered before the Biological Society of Washington, December 5, 1896.

pointed and transparent and have a pigment spot; also as spherical bodies, about the diameter of a red blood-corpuscle, showing active movements and containing in their interior numerous pigment granules. The movements of these bodies are due to the action of elongated filaments attached to their circumference—flagella. A third form in which these parasites present themselves in the blood is as motionless, spherical, or irregular-shaped bodies containing dark-red, rounded pigment grains. These bodies have no nucleus, and do not stain with carmine; they appear to be the ultimate stage of development of the above.

"The blood also contains free pigment granules, pigmented leucocytes, and vacuolated red corpuscles which contain pigment granules.

"These parasitic elements have only been found in the blood of persons sick with malarial fever, and they disappear when quinine is administered.

"They are of the same nature as the pigmented bodies which exist in great numbers in the vessels and organs of patients dead with pernicious fever, which have been described as melanotic leucocytes. Laveran, at the time his report was published, had found these bodies in one hundred and eighty out of one hundred and ninety-two persons examined in Algeria and in Tunis who were affected with various symptoms of malarial poisoning.

"The presence of the parasite described by Laveran in the blood of persons suffering from malarial diseases is confirmed by Richard, who has studied the subject at Philippeville, France, where malarial diseases abound. This author has invariably found the parasite of Laveran in the blood of malarial-fever patients, and has never seen it in the blood of persons suffering from other diseases. He finds that its special habitat in the blood is the red corpuscles, in which it develops and which it leaves when it has reached maturity. During the attack of fever many blood globules are seen which possess a small, perfectly round spot. Otherwise they preserve their normal appearance; they are simply, so to speak, stung (*piqués*). Beside these globules are others in which the evolution of the microbe is more advanced. The clear spot is larger and is surrounded by fine black granules. The surrounding hæmoglobin forms a ring which decreases as the parasite augments in volume. After a time only a narrow, colorless zone remains at the margin. This corresponds with the body No. 2 of Laveran, 'having about the dimensions of a red corpuscle and inclosing an elegant collarette of black granules.' This collarette is the microbe which has arrived at its perfect state, and which is provided with one or several slender prolongations, measuring twenty-five micromillimetres or more in length. Richard has several times seen the fully developed parasite emerge from its 'shell'—the remnant of the invaded red corpuscle—to which it may remain attached, and which can only be seen with great difficulty. Sometimes only the motile filaments penetrate the envelope in which the body of the parasite remains inclosed. In both cases the filament is seen to undergo active movements, and when its extremity is caught in the fibrinous reticulum the body itself oscillates. This movement may last for an hour. Usually, however, no movement is observed, and the corpuscles containing very small parasites never move. The infected corpuscles become disorganized, the pigmentary collarette is broken down, and a grayish mass inclosing some black granules remains. The pigment granules when set free are rapidly picked up by the leucocytes; the melaniferous leucocytes are therefore epiphenomena."

Commenting upon the observations of Laveran and Richard, I say, in the work just referred to:

"We can not doubt that a true account has been given of what the observers believe they have seen. But there is a wide field for doubt as to the deductions made from the various observations recorded; for in microscopical studies of the blood made with high powers there is a great liability to error and to misinterpretation of what is seen. We may question, for example, whether the belief of Laveran and Richard that the appearances noted by them are due to parasitic invasion of the blood-corpuscles is well founded, without calling in question the accuracy of their observations."

At the time this was written pathologists generally were not disposed to attach much importance to the alleged discovery of Laveran, and this was especially true in Germany and in those countries in which physicians were in the habit of awaiting the verdict of German bacteriologists before accepting a new "disease germ." One reason for this failure to give proper consideration to the discovery of Laveran was the fact that there was a rival in the field. A year before the publication of Laveran's paper, giving an account of his observations, the distinguished German pathologist Klebs, in association with the prominent Italian physician Tommasi-Crudeli, had announced the discovery of a bacillus which they believed to be the cause of the malarial fevers, and which they named *Bacillus malariæ*. Their experimental investigation was made in Rome with material obtained from the malarious marshes in the vicinity of that city.

The evidence offered in the original memoir of Klebs and Tommasi-Crudeli in favor of the view that the bacillus described by them is the cause of malarial fevers in man, is derived from experiments made upon rabbits, in which culture fluids containing the bacillus in question, and washings from malarious soils, were injected subcutaneously.

In my work on Malaria and Malarial Diseases, already referred to (published in 1884), I say:

"The importance of this alleged discovery induced the National Board of Health, soon after the publication of the first report published by Klebs and Tommasi-Crudeli, to undertake control experiments in a recognized malarial locality in this country. The writer, who had established a laboratory in New Orleans for the purpose of studying the micro-organisms present in the atmosphere of that city, was therefore instructed to repeat the experiments of Klebs and Tommasi-Crudeli, and during the autumn of 1880 devoted a considerable portion of his time to this investigation. The results obtained were not favorable to the view that the fever produced in rabbits by the injection beneath their skin of infusions of swamp mud, etc., was a truly malarial fever; and, for reasons stated, the conclusion was reached that the evidence offered by Klebs and Tommasi-Crudeli in their first report, which alone had been published at this time, was unsatisfactory. (The full report of these investigations is given in Supplement No. 14, National Board of Health Bulletin, published in Washington, D. C., July 23, 1881.)"

Referring to subsequent observations, I remark:

"Since the publication of the report above referred to the belief that the *Bacillus malariæ* is the true cause of malarial fevers has received considerable support from observations made in Rome, under the direction of Tommasi-Crudeli, by Marchiafava, Cuboni, Peroncito, Ceri, and others.

"We do not feel prepared to estimate the value of this evidence in detail, but will, in a general way, give our reasons for considering it in a spirit of scientific skepticism, and for demanding substantial confirmation from other parts of the world where malarial fevers prevail, and especially in our own country, where malaria is so well known by its effects, and where the *Bacillus malariæ* should be easily found if it is constantly present in the blood during the cold stage of intermittents, as has been claimed by some of the Roman observers. . . .

"The writer's observations lead him to be very cautious in accepting evidence relating to the discovery of organisms in the blood, when these are few in number and require diligent search for their demonstration; for the possibilities of accidental contamination or of mistake in observation are very great. . . .

"The writer has many times examined carefully the blood of malarial-fever patients with a one-eighteenth-inch oil-immersion objective (of Zeiss), and has not been successful in finding either rods or spores. But few of these examinations have, however, been made during the chill, and the blood has not been drawn directly from the spleen; these observations are therefore to be considered as incomplete, and, if opportunity offers, will be supplemented by more extended microscopical researches."

Notwithstanding this adverse criticism, based upon an experimental research made for the purpose of confirming the alleged discovery, if it should prove to have a scientific foundation, the *Bacillus malariæ* was pretty generally regarded by physicians in this country and in England as being the veritable cause of malarial fevers, and for several years it was frequently mentioned in medical journals and even in standard text-books of medicine as one of the demonstrated disease germs. But truth is mighty, and in the end must prevail. To-day no one speaks of the *Bacillus malariæ* of Klebs and Tommasi-Crudeli except to refer to it as one of the pseudo-discoveries, which for a time passed current, like a counterfeit coin, but which was detected and thrown aside when subjected to approved scientific tests.

The first confirmation in this country of Laveran's discovery of amœboid parasites in the blood of malarial-fever cases was made by the present writer in the pathological laboratory of the Johns Hopkins Hospital in March, 1886. In May, 1885, I had visited Rome as a delegate to the International Sanitary Conference convened in that city under the auspices of the Italian Government, and while there I visited the Santo Spirito Hospital for the purpose of witnessing a demonstration, by Drs. Marchiafava and Celli, of that city, of the presence of the *Plasmodium malariæ* in the blood of persons suffering from intermittent fever. Blood was drawn from the finger during the febrile attack and from individuals to whom quinine had not been administered. The demonstration was entirely satisfactory, and no doubt was left in my mind that I saw living parasitic micro-organisms in the interior of red blood-corpuscles obtained from the circulation of malarial-fever patients. The motions were quite slow, and were manifested by a gradual change of outline rather than by visible movement. After a period of amœboid activity of greater or less duration, the body again assumed an oval or spherical form and remained quiescent for a time. While in this form it was easily recognized, as the spherical shape caused the light passing through it to be refracted and gave the impression of a body having a dark contour and a central vacuole; but when it was flattened out and undergoing amœboid changes in form, it was necessary to focus very carefully and to have a good illumination in order to see it. The objective used was a Zeiss's one-twelfth-inch homogeneous oil immersion.

The changes in form which a single plasmodium, included in a red blood-corpuscle, was observed by Marchiafava and Celli to undergo within a period of twenty minutes I shall show you upon the screen at the close of my address (see Fig. 1).

The confirmation of Laveran's discovery, as already stated, was first made by Richard in a communication to the French Academy of Sciences (February 20, 1882), then by Marchiafava and Celli

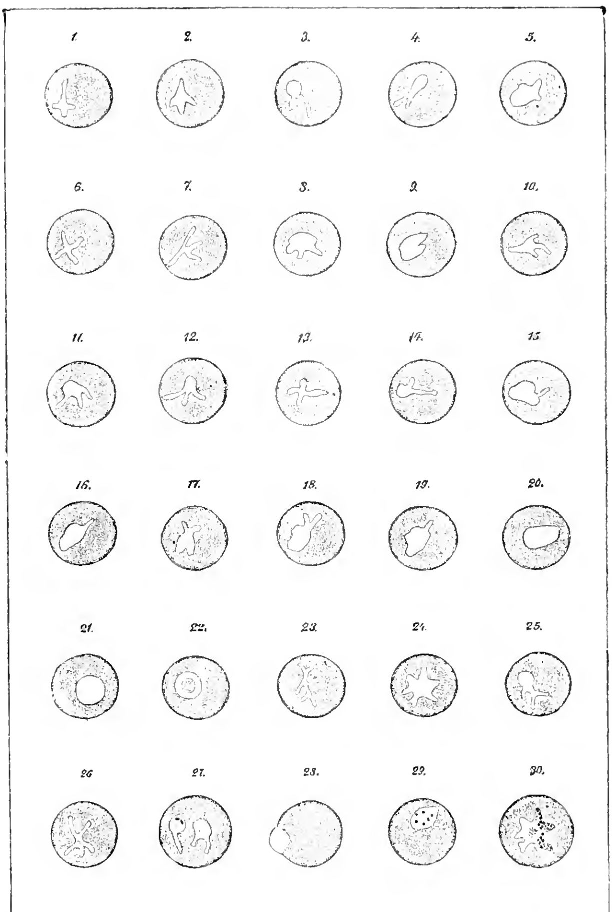

FIG. 1.—Figures 1 to 22 represent the changes in form which a single plasmodium, included in a red blood-corpuscle, was observed to undergo within a period of twenty minutes. Figures 23 to 27, 29, and 30 show other forms assumed by plasmodia, some with and some without pigment. Figure 28 shows a motionless plasmodium emerging from a red blood-corpuscle; the blood was taken after the paroxysm of fever and administration of quinine. (Marchiafava and Celli.)

(1883), and subsequently by Councilman and by Osler in this country, by Golgi in Italy, by Manson of England, and by many other competent microscopists in nearly all parts of the world where malarial diseases prevail.

The intracorpuscular development of the plasmodium has been traced by Golgi and others, and results in the formation of a number of bodies arranged in the form of a rosette, with a mass of pigment granules at the center (see Fig. 2). The growth of the plasmodium seems to be at the expense of the hæmoglobin of

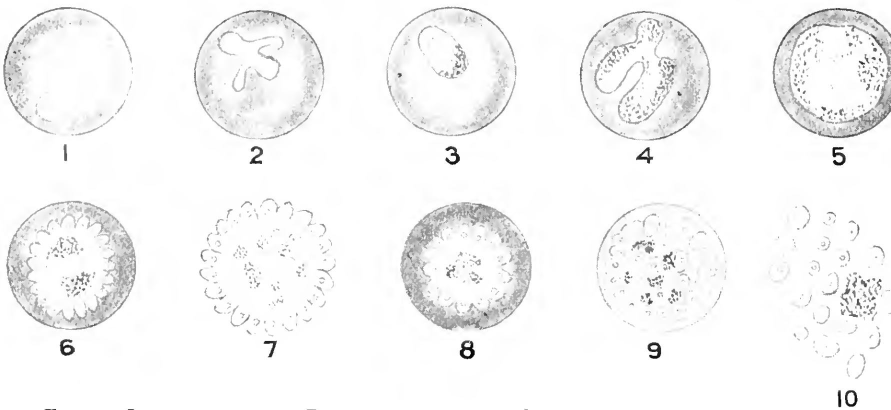

Fig. 2.—Intracorpuscular Development of the Parasite of Tertian Intermittent Fever: 1, 2, young hyaline forms; 3, 4, more advanced pigmented forms; 5, fully grown parasite; 6, 7, 8, 9, segmentation and production of free spores (10).

the infected red blood-corpuscle, and the pigment granules are probably to be regarded as an excrementitious product. The segments of the rosette, which represents the final stage of intracorpuscular development, are finally set free by a breaking down of the remains of the corpuscle, and are supposed to correspond with the elementary body which invaded the corpuscle in the first instance. The periodicity of this class of fevers is believed to depend upon the fact that a certain time is required for the intracorpuscular development of the plasmodium, and that successive crops of these elementary bodies are set free at regular intervals. We have also in the blood of malarial-fever patients certain pigmented bodies which are believed to represent different stages in the development of the same parasite, or of a nearly related parasite, which is concerned in the ætiology of a different type of malarial fever. The form most frequently encountered is associated with the so-called "æstivo-autumnal" malarial fevers which prevail in the vicinity of Rome and elsewhere. The bodies characteristic of this type of fever are crescentic in form and contain black pigment granules, usually centrally located (see Fig. 3). These crescentic bodies are not usually found in the blood of persons suffering from intermittent fever of the tertian or quartan type. Golgi, who has made very extended studies of the blood of malarial patients, asserts that each intermittent paroxysm is associated with the segmentation of a group of intracorpuscular organisms—that is to say, that the paroxysm corresponds with the ripening of a generation of the parasites. He also concludes from his observations that the number of parasites shown to be present by a microscopical examination of the blood corresponds, in a general way, with the severity of the attack. These observations have been confirmed by Osler, Antolisei, and others. Golgi has noted differences between the plasmodium as found in the tertian type of intermittent and that found in quartan fevers; and these differences are sufficiently marked to enable him to determine the type of fever by a blood examination. These observations have been confirmed by numerous competent pathologists in various parts of the world. When a daily paroxysm occurs, according to Golgi, this is due to the alternate development of two groups of quartan parasites. He has not been able to demonstrate a special parasite of quotidian fevers having a cycle of intracorpuscular development lasting twenty-four hours.

The differences between the evolution of the tertian and quartan parasite are summarized as follows by Laveran, from the data given by Golgi:

The tertian parasite completes its evolution in two days, the quartan in three days.

The amœboid movements of the tertian parasite are much more active than those of the quartan.

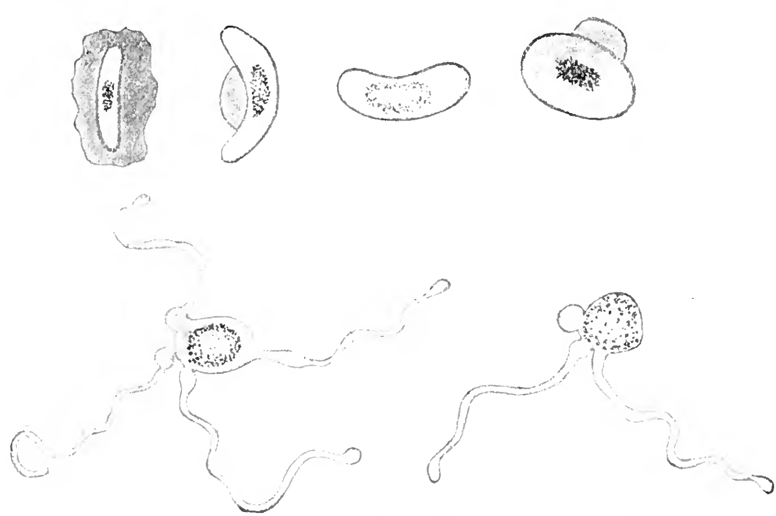

Fig. 3.—Crescentic and Flagellate Forms Characteristic of "Æstivo-Autumnal" Malarial Fevers.

The tertian parasites cause a rapid decoloration of the red blood-corpuscles invaded by them, while the corpuscles retain their characteristic color when invaded by the quartan parasite up to the time that they are almost destroyed as a result of its intracorpuscular development.

In the quartan type the red blood-corpuscles containing the parasite have a tendency to become smaller than normal corpuscles; in the tertian type they are usually larger.

In the tertian the protoplasm of the parasites is very transparent; in the quartan it is less so, and the outlines are better defined.

In the quartan the pigment is seen in the form of grains or rods of greater size than in the tertian.

Finally, the principal difference is found in the segmentation of the intracorpuscular elements. The number of spores resulting from segmentation is greater in the tertian parasite—usually more than twice as many.

That these parasitic protozoa are in truth the cause of the forms of malarial fever with which they are found to be associated can scarcely be doubted, in view of the facts that this association is a constant phenomenon, that the infected blood-corpuscles are destroyed by the parasite, that a rapid loss of red corpuscles is one of the most marked results of malarial infection, and that the parasites disappear when quinine is administered in suitable doses, thus accounting for the specific action of this drug. Finally, it has been shown by inoculation experiments that when blood containing the plasmodium is drawn from the circulation of a malarial-fever patient and injected beneath the skin of a healthy person there is a reproduction of the parasite in the blood of the inoculated individual, and, after a certain period of incubation, typical malarial paroxysms occur. Successful inoculation experiments have been made by Marchiafava and Celli, by Gualdi and Antolisei, by Bein, by Bacelli, by Di Mattei, and others.

The life-history of the malarial parasite outside of the bodies of infected individuals has not been traced. Thus far attempts to cultivate it in artificial media have failed. Nor has the presence of the plasmodium been demonstrated in water or mud taken from the marshy localities which are recognized as the source of malarial fevers, and which we therefore believe to be the normal habitat of this mischievous micro-organism. The facts relating to the seasonal and regional occurrence of malarial fevers sustain the view that they are caused by living organisms, the external development of which depends upon conditions relating to temperature, moisture, vegetable growth and decay. But among the vast number of micro-organisms of an infinite variety of species found in localities which are recognized as malarious, the little specks of protoplasm which—with a first-class oil-immersion objective, and by careful manipulation of the light—we recognize as parasitic invaders of human blood-corpuscles could scarcely be detected, and could not be differentiated from other sporelike bodies in the absence of methods for obtaining each species separately, in pure cultures.

Thayer and Hewetson, in their admirable monograph on the Malarial Fevers of Baltimore (1895), in which they give an account of six hundred and sixteen cases observed by themselves, have summarized their observations relating to the parasite as follows:

"We have distinguished three varieties of the malarial parasite:

"1. *The tertian parasite.*

"2. *The quartan parasite.*

"3. *The æstivo-autumnal parasite.*

"(1) The *tertian parasite* requires about forty-eight hours to accomplish its complete development, and is associated with relatively regular tertian paroxysms, lasting on an average between ten and twelve hours, associated, almost always, with the three classical stages—chill, fever, and sweating. Frequently, infection with two groups of tertian organisms gives rise to quotidian paroxysms; rarely, infection by multiple groups of organisms gives rise to more irregular, subcontinuous fevers.

"(2) The *quartan parasite* is an organism requiring about seventy-two hours for its complete development. It is rare in this climate, and is associated with a fever showing regular quartan paroxysms, similar in nature to those associated with the tertian organism. Infection by two groups of the parasite causes a double quartan fever (paroxysms on two days, intermission on the third). Infection with three groups of the parasite is associated with daily paroxysms.

"(3) The *æstivo-autumnal parasite* passes through a cycle of development, the exact length of which has not as yet been determined; it probably varies greatly, from twenty-four hours or under to forty-eight hours or more. But few stages of development of the parasite are found, ordinarily, in the peripheral circulation, the main seat of infection being, apparently, in the spleen, bone marrow, and other internal organs. Infection with this organism is associated with fevers varying greatly in their manifestations. There may be quotidian or tertian intermittent fever, or, more commonly, more or less continuous fever with irregular remissions. The individual paroxysms last, on an average, about twenty hours. The irregularities in temperature depend, probably, upon variations in the length of the cycle of development of the parasite, or upon infection with multiple groups of organisms.

"We have not been able to separate two distinct varieties of the æstivo-autumnal parasite, though we feel that more investigation is needed upon the subject.

"The cases of malaria in the spring and early summer are of the milder, more regularly intermittent varieties (tertian and quartan fever), the severe æstivo-autumnal infections beginning to appear only in the later summer, and reaching their maximum in September."

Manson has recently suggested that the mosquito is an intermediate host for the malarial plasmodium. We have an analogy for this in the part played by the mosquito in withdrawing embryo filariæ (*Filaria sanguinis hominis*) from the blood of infected individuals and returning them to the stagnant pools frequented by the insect. Manson says, in discussing this hypothesis in his Gulstonian Lectures (1896):

"We can readily understand how the mosquito-bred plasmodium may be swallowed by a man in water, as so many disease germs are, and we can readily understand how it may be inhaled in dust. Mosquito-haunted pools dry up. The plasmodia in the larvæ and those that have been scattered about in the water, finding themselves stranded by the drought, and so placed in a condition unfavorable for development, pass into a resting stage, just as they do when by quinine or other means man is rendered temporarily unsuited for their active life. They may, probably do, become encysted, as so many of the protozoa do in similar circumstances. The dried sediment of the pool, blown about by winds and currents of air, is inhaled by man, and so the plasmodium may find its way back again to the host from whom its ancestors had, perhaps, started generations back."

This theory appears plausible, but we find it difficult to believe that man is essential for the completion of the life cycle of the plasmodium, for the most concentrated and deadly malarial emanations may be given off from marshy places which are far removed from the haunts of men. It may be, however, that the mosquito is an essential factor in the development of the plasmodium, and that man, instead of being a necessary intermediate host, only serves occasionally, and in a certain sense accidentally, as such. Perhaps other mammals or birds may serve the same purpose. It has frequently occurred to the writer that the malarial plasmodium, like other amœboid protozoa, may find its normal habitat, external to the bodies of its insect or animal hosts, upon the stems and leaves of water plants, rather than in the water itself. The fact that malarial fevers do not prevail in the vicinity of swamps when the marsh vegetation is submerged by high water is in favor of this view; as is also its apparent need of plenty of oxygen, which we infer from its active multiplication in the blood and its parasitic invasion of the red blood-corpuscles.

Possibly the mosquito is an intermediate host for the *Plasmodium malariæ* on a larger scale than Manson suggests. The natural food of this insect is the juices of plants, and, no doubt, a vast majority of them never have a chance to fill themselves with the rich red fluid from their human victims which they are so eager to substitute for their normal diet when opportunity offers. If, as we have suggested, the plasmodium abounds upon the stems and foliage of herbaceous plants in marshy localities, the mosquito would be very likely to pick it up in following its everyday method of gaining a livelihood.

Parasitic protozoa, closely resembling the malarial parasite, have been found in the blood of birds and of reptiles, and possibly one or more species of lower animals may serve as an "intermediate host" for the hæmatozoon under consideration. Laveran has given a drawing, in his work on Paludism, of a parasite found in the blood of the lark, which is evidently of the same family. The fact that a parasite may develop in the blood, or elsewhere, in one or more species of animals without giving rise to any evident symptoms of disease can not be taken as evidence that it is not pathogenic for man, or for some other animal. On the contrary, we have numerous instances which show that animals may have a natural or acquired immunity to the pathogenic action of parasitic micro-organisms which are deadly for other animals of the same or different species.

Texas fever, an infectious disease of cattle which prevails as an endemic disease in certain regions in the southern portion of the United States, has been shown, by the researches of Theobald Smith and other bacteriologists belonging to the Agricultural Department, to be due to a blood parasite belonging to the protozoa (*Pyrosoma bigeminum* of Smith). In this disease the tick has been shown to be the intermediate host of the parasite. The ticks which fall from infected animals give birth to a numerous progeny in the pastures frequented by them, and these young ticks attach themselves to other animals which subsequently feed in the same pastures and transmit to them the fatal infection.

The tsetse fly disease of Africa has recently been shown by the researches of Bruce to be due to a flagellate infusorium which is found in the blood of infected animals. This disease is fatal to the ox, the horse, the dog, the sheep, and the ass, but not to the indigenous wild animals in the region infested by the tsetse fly. The researches of Bruce indicate that the fly acts as a carrier of the parasite from diseased to healthy animals. He has shown by experiment that after feeding on the blood of an infected animal the tsetse fly can communicate the disease to a healthy animal by its bite. After a short period of incubation the hæmatozoa appear in the blood concurrently with the development of fever, and followed by rapidly progressive anæmia, dropsy, and death.

The so-called "surra disease," which prevails in certain portions of India, is believed to be due to a similar parasitic protozoan (*Trypanosma Evansi*). According to Lingard, this infusorium exists as an innocuous parasite in the blood of rats in India. It is not pathogenic, or only feebly so, for the native ox of India, but gives rise to a fatal infectious disease in horses, dogs, and camels.

Another pathogenic micro-organism belonging to the protozoa is the *Amœba coli*, which is found in great numbers in the large intestine in cases of tropical dysentery and also in liver abscess secondary to this disease.

The rapid progress of our knowledge of the bacteria has been due to the fact that satisfactory methods (staining) have been devised for detecting these minute micro-organisms in the blood and tissues of infected individuals and for cultivating them in artificial media. Unfortunately, these methods have only a limited utility when applied to investigations relating to the protozoa. The bacterial cell has considerable stability, owing to its cellulose envelope (cell wall), and it is readily stained by the aniline dyes. The protozoa, on the contrary, very readily undergo disintegration, and the more fluid protoplasm of these unicellular organisms is not so easy to demonstrate by the usual staining reagents. It has also been found very difficult, and in many cases quite impossible, to obtain pure cultures in artificial media. Again, the recognition of protozoa in the blood of infected animals by means of the microscope requires special skill in making preparations, in the management of the light, etc., and expert knowledge of the normal elements of the blood and of the changes they undergo as a result of various methods of preparation. This is illustrated by the fact that many persons, more or less familiar with the use of the microscope, have failed to discover the malarial parasite in blood which undoubtedly contained it, while others have evidently mistaken vacuoles in normal blood-corpuscles for the plasmodium, the crenated red corpuscles for pigmented cells, and deformed corpuscles for malarial crescents.

Notwithstanding the painstaking researches which have been made during the past few years for the purpose of determining the nature of certain bodies which may be demonstrated by special staining methods in the cells of carcinomatous tumors, we are still uncertain as to the nature and ætiological import of these bodies. Some investigators believe them to be protozoa, and from their location infer that they are the specific ætiological agents in the development of malignant growths of this character. But, so far as we are informed, this view has not as yet received any very substantial support, and has not been accepted by the leading pathologists of the world.

The presence of amœboid micro-organisms in the contents of the pustules of variola and in vaccine lymph has been reported by several investigators: Guarnieri (1892), Monti (1894), Piana and Galli-Valerio (1894), L. Pfeiffer (1894), Clarke (1895), von Sicherer (1895), E. Pfeiffer (1895). Guarnieri in 1892 published a paper in which he claimed to have cultivated the amœboid micro-organism found by him in vaccine lymph by successive inoculations in the cornea of rabbits. E. Pfeiffer has since (1895) confirmed this observation, and has seen the parasite undergoing amœboid movements and in progress of multiplication by spontaneous fission. During the past two years investigations relating to the ætiology of vaccinia and variola have been made at the Army Medical Museum in Washington, by Major Walter Reed, surgeon United States Army. These investigations show that in vaccinated monkeys and in children an amœboid parasite makes its appearance in the blood on the sixth or seventh day after vaccination, and may be found during a period of from five to seven days, when it disappears. Reed has found the same parasite in the blood of patients with variola and in his own blood after an accidental vaccination in the finger. The parasites are not numerous. They are less than a third the diameter of a red blood-corpuscle, and may be observed to undergo amœboid movements in a drop of blood, properly mounted for microscopical examination, during a period of twenty-four hours or more. These amœboid bodies, like the malarial parasite, would be easily overlooked by one not an expert in blood examinations.

The presence of a ciliated amœboid micro-organism in the mucous secretion coughed up by children suffering from whooping-cough has recently been reported by Deichler and confirmed by Kourlow. This may prove to be the cause of the disease, but further researches will, of course, have to be made before this can be determined. In view of the extended investigations made during the past few years by competent bacteriologists, it seems probable that in most of those infectious diseases in which the specific infectious agent has not yet been discovered it belongs to some other class of micro-organisms than the bacteria; and it seems not improbable that some of them at least will prove to be due to infection by "germs" belonging to the class to which your attention has been invited in the present address—viz., the pathogenic protozoa.

M. Henri de Kerville describes fifteen yew trees in Normandy which are supposed to be a thousand years old and more; a number of oaks from three hundred to nine hundred years old; cedar trees from a hundred to a hundred and fifty; a hawthorn, two hundred; a pear tree, more than a hundred; a holly tree, a hundred or a hundred and fifty; and an American tulip tree, a hundred or a hundred and twenty years old.

THE STABILITY OF TRUTH.*

By DAVID STARR JORDAN,
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WITHIN the last few years three notable assaults have been made on the integrity of science. Two of these have come from the hostile camp of mediæval metaphysics, another from the very front of the army of science itself. Salisbury, Balfour, and Haeckel agree in this, that "belief" may rest on foundations unknown to "knowledge," and that the conclusions of science may be subject to additions and revisions in accordance with the demands of "belief." To some considerations suggested in part by Balfour's Foundations of Belief and Haeckel's Confession of Faith of a Man of Science I invite your attention to-day.

The growing complexity of civilized life demands with each age broader and more exact knowledge as to the material surroundings and greater precision in our recognition of the invisible forces or tendencies about us. We are in the hands of the Fates, and the greater our activities the more evident become these limiting conditions. The secret of power with man is to know its limitations. To this end we need constantly new accessions of truth as to the universe and better definition of the truths which are old. Such knowledge, tested and placed in order, we call science. Science is the gathered wisdom of the race. Only a part of it can be grasped by any one man. Each must enter into the work of others. Science is the flower of the altruism of the ages, by which nothing that lives "liveth for itself alone." The recognition of facts and laws is the province of science. We only know what lies about us from our own experience and that of others, this experience of others being translated into terms of our own experience and more or less perfectly blended with it. We can find the meaning of phenomena only from our reasoning based on these experiences. All knowledge we can attain or hope to attain must, in so far as it is knowledge at all, be stated in terms of human experience. The laws of Nature are not the products of science. They are the human glimpses of that which is the "law before all time."

Thus human experience is the foundation of all knowledge. Even innate ideas, if such ideas exist, are derived in some way from knowledge possessed by our ancestors, as innate impulses to action are related to ancestral needs for action.

But is human experience the basis also of belief as it is of knowledge?

* President's address, California Science Association meeting, Oakland, December, 1895.

One of the questions of the day is this: Is "to believe" more than "to know"? Shall a sane man extend belief in directions where he has no knowledge and in lines outside the reach of his power to act? Can belief soar in space not traversable by "organized common sense"? If such distinction is made between "knowing" and "believing," which of the two has precedence as a guide for action? Is belief to be tested by science? Or is science useful only where belief is indifferent to the subject-matter? If belief is subordinate to the tests of science, to be accepted or rejected in the degree of its accord with human experience, then it is simply an annex to science, a footnote to human experience, and the authority of the latter is supreme. If, however, truth comes to us from sources outside of human experience, it must come in some pure form, free from human errors. As such it must claim the first place. In this event the progress of science will be always on a lower plane than the progress of belief.

In a recent address before the British Association for the Advancement of Science, the Marquis of Salisbury made in brief this contention: The central thought of modern science is evolution, the change from the simple to the complex. This implies not only the fundamental unity of all life, but the fundamental unity of all matter and perhaps of all force as well. In spite of the claims of scientific men, even the fact of organic evolution is far from demonstration; while of inorganic evolution, the development of the chemical elements, science can tell us nothing. Wherefore the marquis, in view of the failure of science to keep up with the progress of belief, grows jocose and patronizing. His advice to his scientific associates might be stated in the words of Thackeray, that "we should think small beer of ourselves and pass around the bottle."

More recently another English statesman, Mr. Arthur J. Balfour, has discussed the Foundations of Belief. He has shown that the methods of science can not give us *absolute truth*. Its methods are "of the earth, earthy." Its claim of trust in the infallibility of its own processes has no higher authority than the claim of infallibility made at times by religious organizations. For as only the senses and the reason can be appealed to in support of the claims of the senses and the reason, the argument of science is of necessity reasoning in a circle. Science can give us no ground solid enough to bear the weight of belief. Belief must exist, and it may therefore rest on the innate needs of man and the philosophy which is built on these needs in accordance with the authority which the human soul finds sufficient.

Balfour calls attention to the fact that human experience is not in its essence objective. It consists only of varying phases of consciousness. These phases of consciousness at best only point toward truth. They are not truth itself. They vary with the varying nerve cells of each individual creature on whom phases of consciousness are impressed, and again with the changes in the cells themselves. The tricks of the senses are well known in psychology, as is also the failure of the senses as to material outside their usual range. Life is at best "in a dimly lighted room," and all the objects about us are in their essence quite different from what they seem. This essence is unknown and unknowable. We are well aware that we have no power to recognize all phases of reality. The electric condition of an object may be as real as its color or its temperature, and yet none of our senses respond to it. Our eyes give but an octave of the vibrations we call light, and our ears are dull to all but a narrow range in pitch of sound.

Likewise is reason to be discredited. The commonest things become unknown or impossible when viewed "in the critical light of philosophy." Balfour shows that the simple affirmation, "the sun gives light," loses all its meaning and possibility when taken out of the category of human experience and discussed in terms of philosophy. In like manner can any simple fact be thrown into the category of myths and dreams. A man can be led by the methods of metaphysics to doubt the existence of himself or of any object about him. For instance, take the discussion of "John's John" and of "Thomas's John," as given by Dr. Holmes. Is the real John the John as he appears to John himself? Or is he real only in the form in which Thomas regards him, or as he looks to Richard and Henry, whose interest in him is progressively less? All we know of the external universe is through the impressions made directly or indirectly on our nervous systems and through recorded impressions made on the systems of others; and a part of this external universe we ourselves are. All that we know of ourselves is that which is external to ourselves. Thus with all this, each man forms in his mind a universe of his own. "My mind to me a kingdom is," and this kingdom in all its parts is somewhat different from any other mental kingdom. It is continually changing. It was made but once, and will never be duplicated. When my vital processes cease, this kingdom will vanish "like the baseless fabric of a vision, leaving not a wreck behind." Our mind is the "stuff that dreams are made of"—and our bodies—what are they? Physically each man is an alliance of animals, each one of a single cell, each cell with its processes of life, growth, death, and reproduction, each one with its own "cell-soul" which presides over these processes. In the alliance of these cells, forming tissues and organs, we have the phenomena of mutual help and mutual dependence. In man we find the phenomena of animal life on a larger and more differentiated scale, but the fact of self grows faint as our study is continued. What is this vital force, and what have we to do with it; and is it, after all, more than another name for the movement of molecules? And of what are our cells composed? Carbon, oxygen, hydrogen, nitrogen, we know by name, but what are these in essence, and how are they different one from another? Does matter really exist? Mathematicians have claimed that all relations of ponderable matter and force might exist if the atoms of matter were not realities, but simply relations. Each of these atoms possessed of attraction or weight may be a vortex ring or eddy in the ether, the ultimate units of which have vibration but not attraction. If, therefore, the body of man be an alliance of millions of animal cells, each cell formed of millions of eddies in an inconceivable and impossible ether; if all things around us are recognized only by their effect on the most unstable part of this unstable structure, then again "let us think small beer of ourselves and pass around the bottle."

Each fact or law must be expressed in terms of human experience, if it is expressed or made intelligible at all. To such terms, the word reality applies, and beyond such reality we have never gone. Apparently beyond it we can not go, at least in the only life we have ever known. Balfour's plea for "philosophic doubt" of the reality of the subject-matter of science is simply a rhetorical trick of describing the known in terms of the unknown. By the same process we may call a fishwife an "abracadabra" or an "icosahedron," and by the same process we can build out of the commonest materials "an occult science" or a new theosophy. The measure of a man is the basis of human knowledge, and whatever can not be brought to this measure is no part of knowledge. In converse fashion Balfour speaks of the unknown in terms of the known; of the infinite in terms of human experience. This gives to his positive foundations of belief an appearance of reality as fallacious as the unreality he assigns to the foundations of science. This appearance of reality is the base of Haeckel's sneer at conventional religion as belief in a "gaseous vertebrate."

It is perfectly easy for science to distinguish between subjective and objective nerve conditions. It can separate those produced by subjective nervous derangements, or by conditions already passed, from those which are contemporary impressions of external things. It is perfectly easy for common sense to do the same. To be able to do so is the essence of sanity. The test of sanity is its livableness, for insanity is death. The borderland of spirit of which we hear so often of late, the land in which subjective and objective creations jostle each other, is the borderland of death. The continued existence of animals and men is based on the adequacy of their sensations and the veracity of their actions. The existence of any creature is, in general, proof of the sanity of its ancestry, or at least of the sanity of those who controlled the actions of its ancestors.

This veracity is gauged by the degree of coincidence of subjective impressions and objective truth. Whoever makes a fool's paradise or a fool's hell of the world about him is not allowed to live in it. This fact in all its bearings must stand as a proof that the universe is outside of man and not within him. In this objective universe which lies outside ourselves we find "the ceaseless flow of force and the rational intelligence that pervades it." No part of it can be fully understood by us, but in it we find no chance movement, "no variableness nor shadow of turning." That such a universe exists seems to demand some intelligence capable of understanding it, of stating its properties in terms of absolute truth as distinguished from those of human experience. Only an Infinite Being can be conceived as doing this, hence such knowledge must enter into our conception of the Infinite Being, whatever may be our theology in other respects. For to know an object or phenomenon in its fullness, "all in all," "we should know what God is and man is."

It is therefore no reproach to human science that it deals with human relations, not with absolute truths. "The ultimate truths of science," Dr. Schurman has said, "rest on the same basis as the ultimate truths of philosophy"—that is, on a basis that transcends human experience. This is true, for science has no "ultimate truths." There are none known to man. "The perfect truth," says Lessing, "is but for Thee alone." With ultimate truths human philosophy tries in some fashion to deal. To look at the universe in some degree through the eyes of God is the aim of philosophy. In its aim it is most noble. Its efforts are a source of strength in the conduct of human life. But its conclusions are not truth. They range from the puerile to the incomprehensible, and only science—that is, "common sense"—can distinguish the two. For this reason just in proportion as philosophy is successful it is unfit as a basis of human action. Human knowledge and action have limitations. The chief of these is that whatever can not be stated in terms of human experience is unintelligible to man. Whatever can not be thought can not be lived.

Philosophy has its recognized methods of procedure. These are laid down in the mechanism of the human brain itself. Science has found these methods untrustworthy as a means of reaching objective truth. The final test of scientific truth is this: Can we make it work? Can we trust our life to it? This test the conclusions of philosophy can not meet. In so far as they do so they are conclusions of science. As science advances in any field philosophy is driven away from it. The fact has been often noted that every great conclusion of science has been anticipated by philosophy, in most cases by the philosophy of the Greeks. But every conclusion science has shown to be false has been likewise anticipated. The Greeks taught the theory of development centuries before Darwin. But if Darwin's studies in life variation had led to any other result whatsoever, he would have been equally anticipated by the Greeks. In other words, every conceivable guess as to the origin and meaning of familiar phenomena has been exhausted by philosophy. Some of these guesses contain elements of truth. Which of these have such elements it is the business of Science to find out. Philosophy has no means of doing so. A truth not yet shown to be true is in science not a truth. It has no more validity than any other generalization not shown to be false. Helmholtz tells us that philosophy deals with such "*schlechtes Stoff*," such bad subject-matter, that it can give no trustworthy conclusions. Science alone can give the test of human life. The essence of this test is experiment.

The tests of philosophy are mainly these: Is the conception plausible? Has it logical continuity? Is it satisfying to the human heart? And in this connection the figurative word "heart" is best left undefined. In other words, its sources and its tests are alike subjective—intellectual or emotional. If we take from philosophy the "heart" element, the personal equation, it becomes logic or mathematics. Mathematics is metaphysics working through methods of precision. It is a most valuable instrument for the study of the relations and ramifications of knowledge, but it can give no addition to knowledge itself. Dr. William James defines metaphysics as "the persistent attempt to think clearly." This definition is good so far as it goes, but to think clearly is a function of science also. Metaphysics is rather the "attempt to think clearly" in fields where exact data are unattained or unattainable. In so far as philosophy is simply clear thinking it is a most valuable agency for testing the deductions of science. But, while it can reject false conclusions, it can add no new matter of its own.

For example, the claim is made in the name of evolutionary philosophy that all matter is one in essence, therefore all the chemical elements, some seventy in number, must be the same in substance. In this case all must be derived from the same primitive stuff, and the hypothetical basis of all ponderable matter has been called protyl. As a working theory this is most ingenious. But is it science? Is it worthy of belief? Certainly Science knows nothing as yet of the identity of these elements. In a general way Science is finding out that the processes of Nature are more complex than man supposed, while the elements on which these processes rest, matter and force, are more simple. How far can this generalization go? To every test human experience has devised each chemical element remains the same, its atoms unchangeable as well as indestructible. Therefore, to speak of them as forms of one substance is to go beyond knowledge. Science does not teach this. But to philosophy this offers no difficulty. It is still plausible to suppose that by some combination of primitive units these variant atoms are formed. Such an idea would have logical continuity, and, as we are becoming used to the notions of primal unity, we find such an idea satisfying to our consciousness. If this is true, somewhere, somehow, lead will be resolved into its primal elements, and these elements may be united in the form of gold. Then will the dream of the alchemist become fact. But Science must make this objection: "Not until then." Such transmutation is as yet no part of knowledge. We certainly do not know that lead can be changed into that which is transmutable into gold. We do not know it, I say; but may we believe it? Is the foundation of belief less secure than that of knowledge? Can we trust Philosophy to tell us what to believe while we must look to Science to tell us what we know?

This brings us to the question of definitions. If knowledge and belief are of like rank, both must rest on science, and the results of philosophy must come to science only as hints or suggestions as to lines of research.

If knowledge implies stability and belief does not, the relation of the two is also clear. In that case belief would be a word of light meaning, expressive of whim or of the balance of opinion. Such weight as it has would be drawn from its association with prejudice. Belief would then be the pretense of knowledge as compared with knowledge itself. Among its paths life can not march with courage and effectiveness. It is not for such beliefs as this that the martyrs have lived or died. Their inspiration was the positive belief of science or the negative belief of the falsity of the ideas that tyranny or superstition had forced upon them.

To avoid a discussion foreign to my purpose, I wish, if possible, to separate the word belief—as used in this paper—from the word religion. The essence of belief is the categorical statement of propositions. These may be built into a creed, which word is the Latin synonym of belief.

Religion implies rather a condition of the mind and heart—an attitude, not a formula. Faith, hope, charity do not rest on logic or observation. Religion implies a reverent attitude toward the universe and its forces, a kindly feeling toward one's fellow mortals and immortals. "Pure religion and undefiled" has never formulated a "creed," has never claimed for itself orthodoxy. It has no stated ritual and no recognized cult of priests. Much that passes conventionally as religious belief among men has no such quality or value. It is simple the *débris* of our grandfathers' science. While religion and belief become entangled in the human mind, so as not to be easily separable, the one is not necessarily a product of the other. In the higher sense no man can follow or inherit the religion of another. His religion, if he has any, is his own. Only forms can be transferred, realities never; for realities in life are the product of individual thought and action.

As the third of these efforts to discredit science I have placed Prof. Haeckel's recent address, The Confession of Faith of a Man of Science. This remarkable work is an eloquent plea for the acceptance of the philosophic doctrine of monism as the fundamental basis of science. This doctrine once adopted, we have the basis for large deductions, which forestall the slow conclusions of science; for monism brings the necessity for the belief in certain scientific hypotheses resting as yet on no foundations in human experience, incapable as yet of scientific verification, but which are a necessary part of the monistic creed. The primal conception of monism is, first, "that there lives one spirit in all things, and that the whole cognizable world is constituted and has been developed in accordance with one common fundamental law." This involves the essential oneness of all things, matter and force, object and spirit, Nature and God. This philosophical conception of monism and pantheism can not be made intelligible to us, because it can be stated in no terms of human experience. But it has certain necessary derivatives, according to Haeckel, and these are intelligible, because their subject-matter is available for scientific experiment.

First among these postulates, called by Haeckel "Articles of Faith," comes "the essential unity of organic and inorganic Nature, the former having been evolved from the latter only at a relatively recent period." This involves the "spontaneous generation" of life from inorganic matter. It also resolves "the vital force," or the force which appears in connection with protoplasmic structures, into properties shown by certain carbon compounds under certain conditions. Life is thus, in a sense, an emanation of carbon, "the true maker of life," according to Haeckel "being the tetraedral carbon molecule."

This "Article of Faith" implies also the unity of the chemical elements, each of which is a product of the evolution of the primal unit of matter. Force and matter are likewise one, because neither appears except in the presence of the other. The inheritance of acquired characters is also made a corollary of monistic belief.

Now, all these hypotheses are possibly true, but none of them are as yet conclusions of science. They meet the conditions required by philosophy. They are plausible. They have the merit of logical continuity, and, excepting to those persons biased by early subjection to contrary notions, they satisfy the "human heart." There should be no natural repugnance to monism or to pantheism, difficult as it is to associate the idea of truth and reality with either or with the opposite of either. Speaking for myself, I feel no repugnance to them. They lend themselves to poetry; they appeal to the human heart. In Haeckel's own words, referring to something else, "such hereditary articles of faith take root all the more firmly, the further they are removed from the rational knowledge of Nature and enveloped in the mysterious mantle of mythological poesy." The present resistance to them may in time be turned into superstitious reverence for them; for, of all the philosophic doctrines brought down as lightning from heaven for the guidance of plodding man, these seem most attractive, and least likely to conflict with the conclusions of science.

But can we give them belief? Let us pass by the doctrine of monism, with which science can not concern itself. What of the corollaries? Spontaneous generation, for example, has been the basis of many experiments. Like the transmutation of metals, it seems reasonable to philosophy. The one idea has been the Will-o'-the-wisp of biology as the other has of chemistry. We know absolutely nothing of how, if ever, non-life becomes life. So far as we know, generation from first to last has been one unbroken series—"all life from life." We have no reason to believe that spontaneous generation exists under any conditions we have ever known. We have likewise reason to believe that if it exists at all we have no way of recognizing it. The organisms we know have all had a long history. Even the smallest shows traces of a long ancestry, a long process of natural selection, and of many concessions to environments. We know of no life that does not show such concessions. We know no creature that does not show homologies with all other living beings whatsoever. So far as this fact goes, it tends to show that all life is one. If this is true, spontaneous generation, whatever it may be, is not one of the ever-present phenomena of life.

If life does now appear without living parentage, if organisms fresh from the mint of creation now appear from inorganic matter, they are so simple that we can not know them. They are so small that we can not find them. They would be made, we may suppose, each of a small number of molecules. If there is truth in the calculations of Lord Kelvin and others, that a molecule is as small in a drop of water as a marble in comparison with the earth, then we may not look for these creatures. If we can not find them, we do not know that they exist. If we do not *know* that they exist, shall we "believe" that they do? Is it not better, as Emerson suggests, that we should not "pretend to know and believe what we do not really know and believe"?

It may be that the existence of life in a world once lifeless renders spontaneous generation a "logical necessity." But the "logical necessity" exists in our minds, not in Nature. Science knows no "logical necessity," for the simple reason that we are never able to compass all the possibilities in any given case.

If we are to apply philosophic tests to the theories of reincarnation, we may find them equally eligible as articles of belief. They are plausible, to some minds at least; they have logical continuity. They are satisfying to the human heart, at least this is claimed by their advocates. Their chief fault is that they can be brought to no test of science and have no basis in inductive knowledge. In other words, their only reality is that of the vapors of dreamland. If plausibility and acceptability serve as sufficient foundations for belief, then belief itself is a frail and transient thing, no more worthy of respect than prejudice, from which indeed it could not be distinguished. Some such idea as this seems to be present in the mind of Mr. Gladstone. In a recent article, quoting in part the language of the honest Bishop Butler, he ascribes to certain doctrines "a degree of credibility sufficient for purposes of religion, and even a high degree of probability." In other words, religion, which deals with human hopes and fears, has less need of certainty than science, which is ultimately concerned with human action.

Haeckel makes the same distinction clearly enough. He uses the term "belief" for "hypotheses or conjectures of more or less probability" by which "the gaps empirical investigation must leave in science are filled up. . . . These," he says, "we can not indeed for a time establish on a secure basis, and yet we may make use of them in the way of explaining phenomena, in so far as they are not inconsistent with the rational knowledge of Nature. Such rational hypotheses," he says, "are scientific articles of faith." It is not clear, however, that so large a name as faith need be taken for working hypotheses confessedly uncertain or transient. The word "make-believe," used by Huxley in some such connection, might well be applied to hypothetical "articles of faith," until given a basis by scientific induction. But it seems to me that it is not necessary for the man of science to say "I believe," in addition to "I know." He should put off the livery of science when he enters the service of the Delphian oracles.

That all the doctrines above mentioned are necessarily included in monism may perhaps be doubted. Monism would still flourish were all these theories disproved. For human philosophies have wonderful recuperative power. Their basis is in the structure of the brain itself, and external phenomena are only accessory to them.

If monism is purely a philosophic conception, it can have no necessary axioms or corollaries, except such as are involved in its definition. These could not be scientific in their character, because they could in no way come into relation with the realities of human life. If, however, monism be a generalization resting in part on human experience, then it must be tested by the methods of science. Until it is so tested, however plausible it may be, it has no workable value. There is no gain in giving it belief, or in calling it truth. Still less should we stultify ourselves by pinning our faith to its postulates as to the matters yet to be decided by experiment, and to be settled by human experience only. Haeckel says, for example: "The inheritance of characters acquired during the life of the individual is an indispensable axiom of the monistic doctrine of evolution. . . . Those who with Weismann and Galton deny this entirely exclude thereby the possibility of any formative influence of the outer world upon organic form." Here we may ask, Who knows that there is any such formative influence? What do we know of this or any other subject beyond what in our investigations we find to be true? When was monism a subject of special revelation, and with what credentials does it come, that one of the greatest controversies in modern science should be settled by the simple word? "*Roma locuta est; causa finita est*" is a dictum no longer heeded by science.

The great bulk of the arguments in favor of the heredity of acquired characters, as well as most of those in favor of the opposed dogma, the unchanged continuity of the germ-plasm, are based on some supposed logical necessity of philosophy. All such arguments are valueless in the light of fact. Desmarest's suggestion to the contending advocates of Neptunism and Plutonism was, "Go and see." When they had seen the action of water and the action of heat, the contest was over, for argument and contention had vanished in the face of fact. To believe without foundation is to discredit knowledge. Such "Confessions of Faith" on Haeckel's part lead one to doubt whether in his zeal for belief he has even known what it is to know. In fact, if we may trust his critics, much of Haeckel's scientific work is vitiated by this mixture of "believe" and "make-believe." The same confusion is shown in this remarkable passage which President White quotes from John Henry Newman: "Scripture says that the sun moves and the earth is stationary, and science that the earth moves and the sun is comparatively at rest. How can we determine which of these opposite statements is the very truth till we know what motion is? If our idea of motion is but an accidental result of our present senses, neither proposition is true and both are true; neither true philosophically; both true for certain practical purposes in the system in which they are respectively found."

Again, if we are to allow the revision of the generalizations of science by the addition of acceptable but unverified doctrines, we must allow the right of similar revision by rejection. Mr. Wallace, for example, would be justified in adding to the certainties of organic evolution his idea of the special creation of the mind of man. The old notion of the separate existence of the Ego, which plays on the nerve cells of the brain as a musician on the keys of a piano, would still linger in psychology. The astral body would hover on the verge of physiology, and a strong plea would go up for the reality of Santa Claus.

I have a scientific friend who finds it necessary to exclude by force, from his biological beliefs, all that is unpleasant in the theories of evolution. And he has the same right to do this that Prof. Haeckel has to insist that any scientific beliefs, for which science has yet no warrant, are a necessary part of the orthodoxy of science.

For Haeckel is not content to speak for himself, asking tolerance by tolerance toward others. His belief is no idiosyncrasy of his own. He speaks for all. Every honest, intelligent, courageous scientific man, he tells us, so far as he is truthful, competent, and brave, shares the same belief. His confession of faith is nothing if not orthodox. He says:

"This monistic confession has the greater claim to an unprejudiced consideration in that it is shared, I am firmly convinced, by at least nine tenths of the men of science now living; indeed, I believe, by all men of science in whom the following four conditions are realized: (1) Sufficient acquaintance with the various departments of natural science, and in particular with the modern doctrine of evolution; (2) sufficient acuteness and clearness of judgment to draw by induction and deduction the necessary logical consequences that flow from such empirical knowledge; (3) sufficient moral courage to maintain the monistic knowledge, so gained, against the attacks of hostile dualistic and pluralistic systems; and (4) sufficient strength of mind to free himself by sound, independent reasoning from dominant religious prejudices, and especially from those irrational dogmas which have been firmly lodged in our minds from earliest youth as indisputable revelations."

Against such assumption we must protest. I have nothing against the doctrines save that they are not yet true. In themselves, as I have said, they are attractive. One may naturally feel a hopeful interest in wide-reaching theories which seem possible, but are still unproved or unworkable. This is, however, not "belief." It is rather open-mindedness, open to negative evidence as well as to the positive.

As science goes wherever the facts lead, so science must stop where the facts stop. It can not add to its methods the running high jump, nor place the divining rod with the microscope, crucible, and calculus among its instruments of precision. Beyond the range of scientific knowledge extend the working and the unworkable hypotheses. Beyond the confines of these extends the universe of the mind, the boundless realm which is the abode of philosophy. None should better realize those distinctions than men of science.

[*To be continued.*]

A YEAR OF THE X RAYS.

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THE incredulity which greeted the first reports of Prof. Röntgen's famous discovery gave place, upon their confirmation, to a delirium of enthusiasm, experimentation, and expectation. So startling and so novel were the facts reported by the discoverer that no prediction seemed too wild, no penetration into the unknown either impossible or improbable. The condition of mind actually prevailing at that time with a large number of persons is admirably shown by President Jordan's amusing article on the Sympsychograph in the Popular Science Monthly for September, 1896.

Prof. Röntgen reported his investigations in a paper before the Physico-Medical Society of Würzburg, in December, 1895. The account of his paper was transmitted to America in a few brief statements, January 7, 1896, the full report not arriving until some weeks later. Popular interest was focused upon the fact that the X rays, as its discoverer provisionally named the mysterious agency, would reveal a bony skeleton within its case of fleshy tissue, and the famous picture of a hand in which the bones thus stood revealed was soon to be found in every city of Europe and America. The realism of this weird picture simply fascinated all who beheld it. Attempts were made to repeat and extend the original experiments wherever there was any semblance of apparatus suited to the purpose. An electric potential high enough to give a spark of several inches in air, and a vacuum tube in which the spark was to be discharged, seemed to be requisites, and wherever these were obtainable the experiments were attempted. Poor facilities led to efforts to dispense with good ones, the prevailing meagerness of equipment becoming thereby a means all the earlier of deciding the limitations for successful operation. Of course, the excitement quieted when the novelty wore off, but investigations in this new field must continue for a long time.

The pure physics of the subject was, naturally, the side which most appealed to scientific professors. How was the strange agent to be set to work, and how did it work? Was it light, or was it electricity? Was it material, or ethereal? Was it due to the cathode or to the anode terminal of the vacuum tube? The year's work upon these questions leaves them answered only partially and unsatisfactorily. Very little indeed has been added to the facts brought out by Dr. Röntgen in the first instance. The Physical Society of London, in its abstracts of physical papers from foreign sources, classes all work with the Röntgen rays under the head of "Light," but upon very scant grounds. Numerous experiments have been made to test the character of these mysterious activities by the accepted criteria of light—namely, reflection, refraction, interference, and polarization—all results being negative, or so slight and uncertain as to leave them still open to question, and to make the name "X rays" not only the most common one by which they are mentioned, but the one best suited to express our knowledge—or ignorance—of their nature. Several attempts have been made to determine a length for them, supposing them to be waves, resulting in a supposed upper limit of length not greater than one hundredth that of violet light, and probably not greater than one three-hundredth. In the first few months of the furore of experimentation and discussion scarcely a result was announced by one observer that was not controverted by another; yet out of this very contradictoriness came a rational conclusion that at all events the rays are not homogeneous, but differ among themselves in their properties, as do the constituent rays of ordinary heterogeneous light. This would account for their non-interference. Of refraction there is as yet no evidence, nor, so far as known, is there any possibility of bringing the rays to a focus and thus producing an image of any object by means of them. All that can be done in that way as yet, as at first, is to obtain a shadow of varying intensity by reason of the various penetrability of different objects or portions of one object; and so the pictures thus produced are called by various names, as skiagraphs, radiographs, X-ray pictures, etc.—all chosen to avoid the idea that they are real light-pictures or photographs. Since these shadows are produced by straight rays from a small surface, they are usually as large as the object itself, or larger. Many experiments were made to determine the source from which the rays proceed before it was learned definitely that they emanate from the surface upon which the cathode rays first impinge—a fact that was announced almost simultaneously by several experimenters. It is one of the important points that have been determined, and even this was distinctly intimated by Prof. Röntgen in the twelfth section of his original paper.

In intensity they vary inversely as the square of the distance from their source.

They electrify some bodies positively and some negatively, and whatever charge a body may already have they reduce or change it to the charge which they would independently give to the body. Their penetrating power depends upon the length of time they act.

Thus, gradually, these and many additional isolated facts have been established, and no doubt enough data will be accumulated eventually to permit generalization into laws; but that stage has not yet been reached.

Four theories have been suggested:

1. "They are ether waves, like ordinary light, but of exceedingly brief period, therefore ultra ultra-violet."

2. "They are streams of material particles."

3. "They are vortices of the intermolecular ether, forced from the cathode when the gas pressure is sufficiently low. Rectilinear propagation, absence of reflection, etc., follow from the properties of vortices."

4. "They are variations of stress in the dielectric surrounding the vacuum tubes."

Each of these theories is entitled to the Scotch verdict "Not proven," though the preponderance of opinion is on the side of the first. Still, it can not yet be said to be more than opinion.

Of the hundreds of papers that have been written during the year, the greater number have had reference to some special feature of manipulation, or detail of action of the rays, so that more has been learned of how to work with them than of their essential character. This has led naturally to improved apparatus.

It is well to keep in mind that the X rays do not make objects visible by their direct action, as light does. They do make certain *substances* self-luminous, causing them to emit a soft light of a grayish-blue or yellow or green color, depending on the nature of the substance, but this color is ordinary light, and not, at least to any considerable extent, the X rays. This luminosity, called fluorescence, is also excited in many substances by the ultra-violet or colorless portion of light, but the X rays are especially strong in producing it. The substance employed by Dr. Röntgen was barium platino-cyanide, which is expensive. Experiment soon showed that other substances were more efficient as well as cheaper, hundreds having been tested under the rays for this effect. The best are tungstate of calcium, tungstate of zinc, barium platino-cyanide, and potassium platino-cyanide, the first named being at present the most common, though the last named has been a favorite with English experimenters. A screen of cardboard covered with a layer of fine crystals of either of these substances and exposed to the rays in a dark room, immediately lights up under their action, and a body impervious to the rays, when placed before the screen, is seen upon it as a shadow. If this screen is the front end of a light-proof box, into the other end of which the eyes can look while all light is excluded, we then have the fluoroscope, by which examinations can be made in a lighted room. Probably few X rays pass through and beyond the fluoroscopic screen. The effect of radiant energy upon a body is determined not by the rays that pass through it, but by those that are absorbed by it. It is difficult, therefore, to understand how the light which the blind have been said to see on peering into a fluoroscope can be really due to X rays.

The invention and improvement of the fluoroscope constitute an important part of the progress that has been made. The effect of the rays on photographic plates is heightened by similar means. The sensitive plate to be exposed to the rays is itself carefully inclosed in a wrapper so as to shut out every trace of light. If, before thus wrapping up the plate, a fluoroscopic screen is placed with its surface of crystals directly in contact with the photographic film, then where the rays penetrate to this crystalline surface it becomes luminous, and the light immediately affects the sensitive plate except in those spots where the object intercepts the X rays, and where consequently they do not cause fluorescence of the screen. This device has greatly reduced the time needed to obtain a photographic impression. Fig. 1 is an illustration of such action. A photographic plate was partly covered by such a screen, and the hand was placed partly over the screen and partly over the plate not covered by the screen. An exposure of twelve seconds was more than sufficient to produce a strong picture of the interior of the hand, under the screen, the flesh almost disappearing from view, while the effect upon the other portion of the plate (the dark part) is much less pronounced. The line of demarcation is very sharp.

Also photographic plates or films have been adapted to this particular use by preparing them so as to absorb the energy of the rays. X-ray plates are now used of which the mode of preparation is of course the manufacturer's secret, but which are

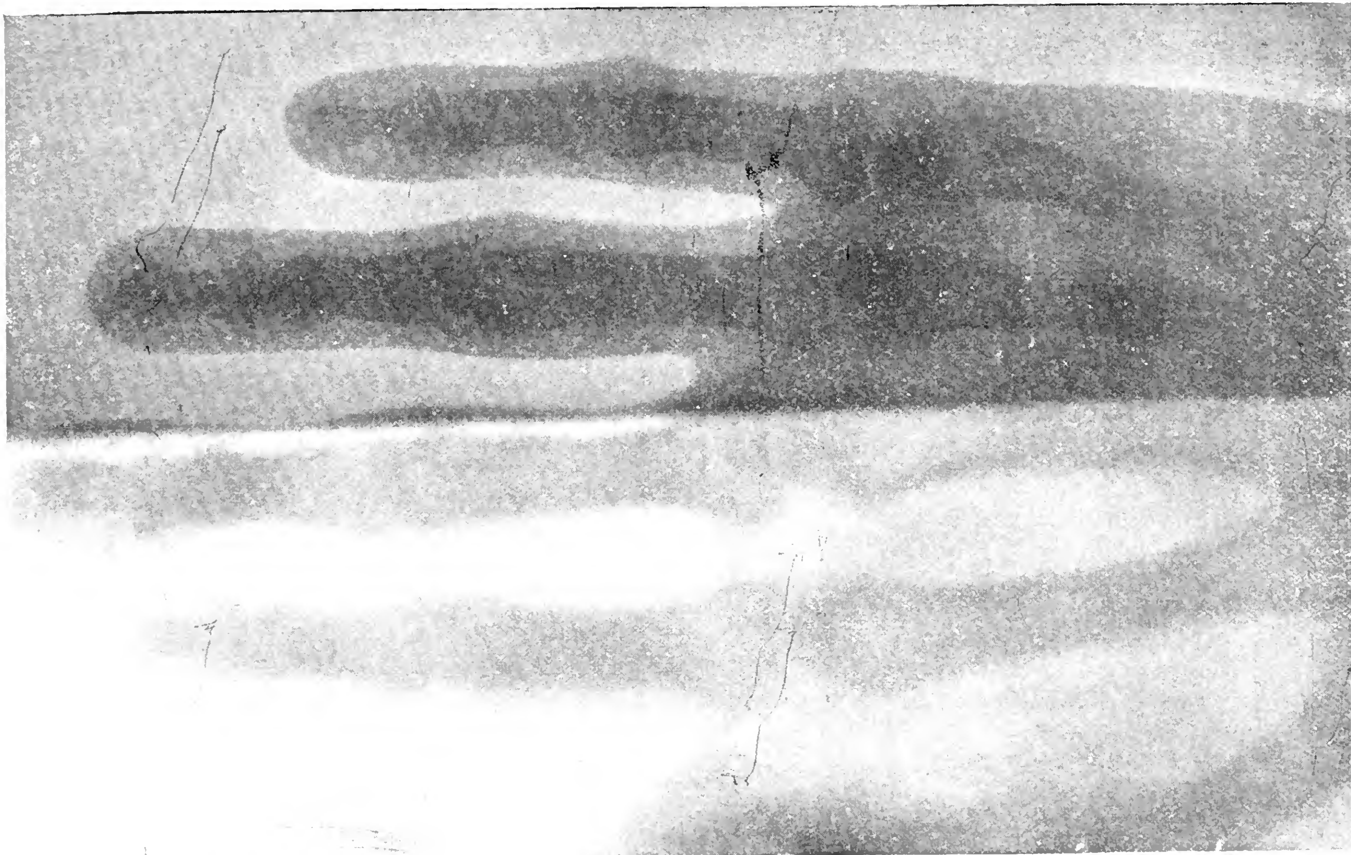


FIG. 1.—EFFECT OF FLUOROSCOPIC SCREEN. Exposure, twelve seconds.

coated with a very thick film apparently impregnated with some substance that fluoresces under the X rays. The time of exposure of such plates is less than with ordinary ones, though not much less than is required for a quick plate covered by the fluorescent screen, but the latter will not give the detail and differentiation of parts which are unequally penetrable by the rays that can be got from the X-ray plates.

The rays also affect sensitive paper, especially bromide paper, and now so-called X-ray paper is in use requiring even briefer exposures than plates. The picture on such paper is a negative—that is, shadows are light and parts affected by the rays are dark. Fig. 2 is an example of a picture taken on such paper, the objects being such as were greatly in vogue for the early pictures—a purse, a pincushion, etc. In the early efforts such a picture re-

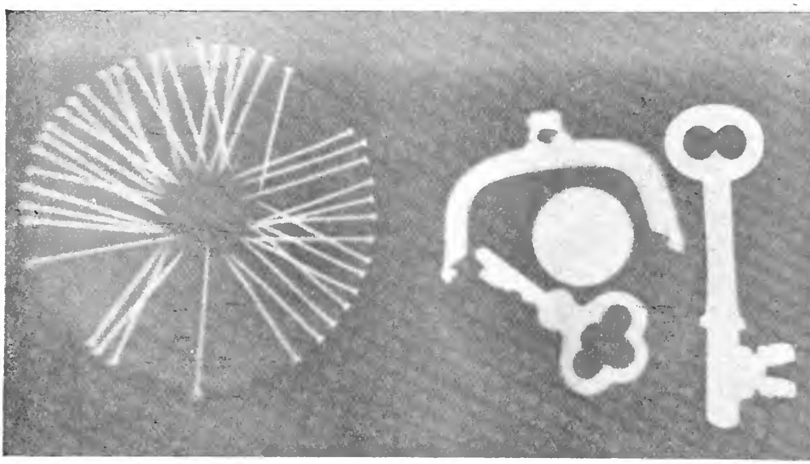


Fig. 2.—An Early Picture Repeated. Exposure, two and a half seconds.

quired fully twenty minutes' exposure to the rays; the example here was produced in two and a half seconds, or about one five-hundredth part of the former time. The writer has obtained a perfectly distinct picture of the same kind by a single fluorescent flash in the tube. That is practically instantaneous.

Fig. 3 shows the principal changes in style of tubes that have been approved. Nos. (1), (2), and (3) are forms that were to be found in most collections of Crookes's tubes in physical laboratories when the X rays were first made known. No. (1) was one of the earliest to give satisfactory results; then (2) was found to be preferable, and this "pear shape" was recommended as the most suitable form. Almost at the same time No. (3) was found to be particularly efficient. In this the cathode rays converge from a concave terminal upon a platinum plate used as an anode, such plate becoming the source of Röntgen rays proper. This form was immediately developed into what was called a "focus tube," in which a similar concave focusing cathode was employed, and a platinum plate inclined at forty-five degrees to the axis of the cathode rays was inserted between the two electrodes of the tube to receive the impact of the cathode rays as in No. (4). A plate so placed is called an anticathode. This idea was carried still further to produce the double-focus tube shown in No. (5), which is especially suited to oscillatory discharges from the electrodes, and therefore adapted to use with alternating current apparatus, especially Tesla coils. In this form of tube the anti-

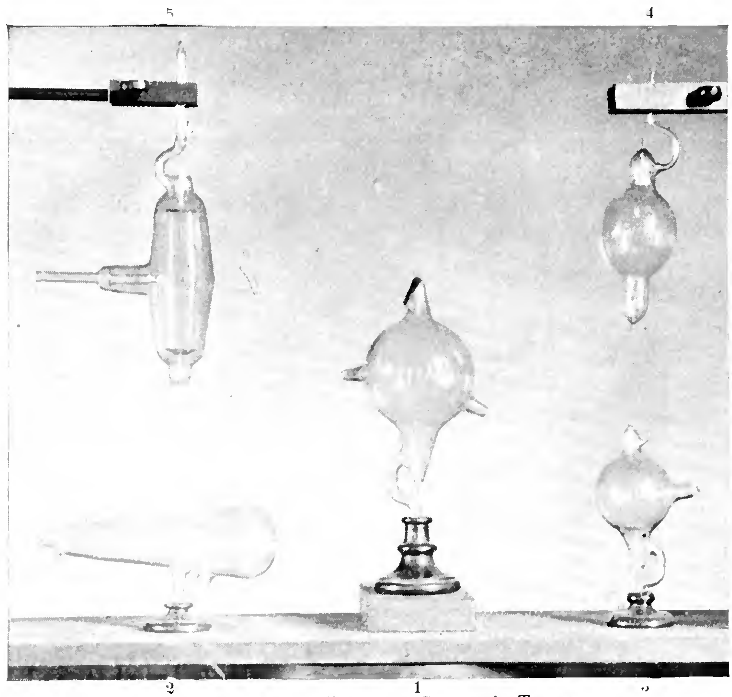


Fig. 3.—Typical Forms of Crookes's Tubes.

cathode consists of a wedge-shaped piece of platinum midway between the ends of the tube. If this platinum terminal be connected with the positive pole and both end electrodes with the negative pole, this tube is very efficient with a Ruhmkorff coil giving unidirectional discharges. For any tube there is a critical degree of vacuum as well as electric potential, with which it is most efficient. Tubes can be made suitable for a coil giving a spark of not more than an inch, but they are not very energetic. Since the vacuum rises with continued use of a tube, some forms—e. g., No. (5)—have a small side tube communicating with the main bulb and containing caustic potash or other substance which volatilizes on being heated, so that its vapor will reduce the vacuum. These are called adjustable vacuum tubes, and afford a means of controlling the requisite sparking gap of the coil within certain limits. Nos. (4) and (5) are now almost the only styles of tubes that meet with favor.

Three types of apparatus have been employed in exciting the X rays. All are necessarily such as are capable of producing a high electric potential, and all were in use prior to Dr. Röntgen's discovery. They are the Ruhmkorff induction coil, the plate influence machine (either the Wimshurst or the Töpler-Holtz), and the Tesla coil. The only development in these machines has been in some instances the improvement of their quality and enlargement of their capacity—without, however, introducing any novelty in the type of the apparatus, unless we except making the condenser of the induction coil adjustable in capacity. The most suitable rate of interruption of the primary current for each coil and tube may best be found by trial. Where a continuous current is supplied from a commercial circuit of a hundred and ten volts or more a rotating segmental wheel as interrupter with a rheostat in circuit is of advantage, but many experimenters get as good results by using a storage battery of six to ten cells, with an ordinary hammer break in the coil. The Ruhmkorff coil is used to give a unidirectional discharge in the Crookes's tube. Influence machines having several rotating plates act in the same way, and with excellent effect. Tesla coils are employed to give exceedingly rapid discharges to and fro in the tube, which require, therefore, two terminals that can both act as cathodes. It can not be said that either of these three forms is *per se* the best. With proper accessories one will give as good results as another, but the ordinary induction coil with suitable single-focus tube is the most generally practicable.

Fig. 4 shows an outfit of apparatus for X-ray use. It consists, in this instance, of a variable rheostat connected to one main of a hundred-and-ten-volt continuous current; in series with this is, next, a rotary interrupter, which is also driven by a current from the same main circuit; then comes an ammeter, then a pole changer or reverser, which connects back to the other main and forward to the primary of the large Ruhmkorff coil. This coil has in its base a condenser which is united with an additional adjustable condenser. There are, further, a double-focus tube, fluoroscope, and screen.

The most obvious suggestion of usefulness for the new agent was in surgery. It was so easy to discover any foreign substance in portions of the body, or to perceive the nature of any bony malformation, that it was hoped that surgery had received a valuable assistant in these rays. From time to time reports of successful operations based upon such revelations have been made, but the early expectations were exaggerated. Methods of making examinations by these means have been so far simplified as to require no highly specialized knowledge for this purpose, and one would expect that hospitals, at all events, would be provided with an X-ray outfit if there is any advantage in it. Replies from a large number of prominent hospitals in six of the leading cities of America, which were asked concerning their employment of the X rays, showed that, of those replying, one third have such outfits; about one fifth have none, but expect to have one soon; and nearly half of those without such equipment have had examinations made for them. All that have used the rays testify to

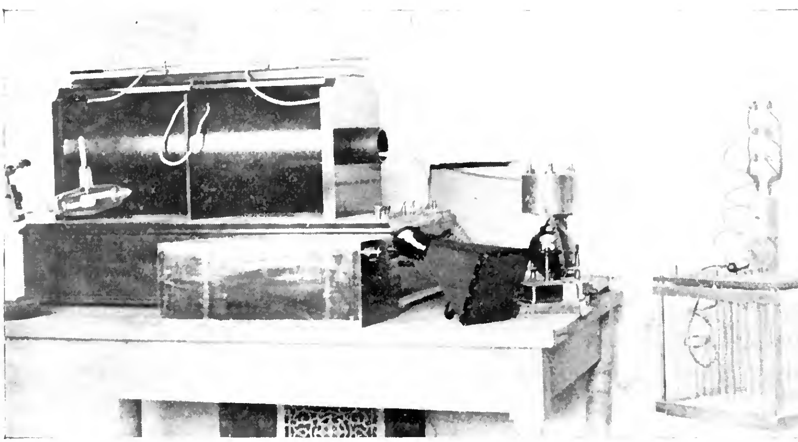


Fig. 4.—An X-Ray Outfit.

their helpfulness, some of the physicians being enthusiastic over the method. Enough is told to show that the X ray is already an important aid to diagnosis, and, unless the future experience of the hospitals should be quite disappointing, such apparatus will soon be thought an indispensable feature of their equipment. The interior of the trunk, as well as of the limbs, has been successfully shown, the fluoroscopic revelation being immediate, while for photographic reproduction exposures of varying lengths of time are needed. The hand is the easiest member, requiring from five to thirty seconds, while the trunk requires half an hour or more. In general, it may be said that for pictures showing distinctions of structure, the time now required is from one hundredth to one fiftieth of that necessary at first. Pictures thus taken are being supplied to schools for the use of classes in anatomy and physiology.

THE BLASCHKA FLOWER MODELS OF THE HARVARD MUSEUM.

By MARCIA E. HALE.

THE Ware Collection of glass flower models in the University Museum of Cambridge is now so widely known and appreciated that a written introduction to it seems at first superfluous. Still, the fact remains that the interest and curiosity felt in regard to the history of the collection increase in proportion to its increasing fame.

Among the vast number of people who visit the exhibition rooms of the botanical department of the museum there must be few who do not feel on leaving that a revelation has been disclosed to them. The *savant* finds the rendering of the minutest details of vegetable organism almost inconceivably accurate, while the general public can hardly fail to derive from the beauty of these models an awakening interest in the mysteries of plant life.

Before considering the scope of the collection it might be well to examine the nature of the models themselves.

To the casual observer it seems almost incredible that these sprays of leaf and blossom—these magnified details of flower and fruit, true to Nature not only in form and color but also in texture—that these models before us should be made of glass. Not even the daintiest productions of the Venetian and Bohemian glass workers have prepared us for the delicacy and pliability which we find here, and it seems hardly necessary to state that the process employed in making these models is in no sense that of ordinary glass blowing. From the simpler methods of making window glass and bottles to the artistic fashioning of such work as this is a wide step, and it may be interesting to sketch incidentally a brief outline of the history of glass making.

The origin of this art, unlike that of pottery, seems to have spread from a single center, instead of having been discovered by different nations independently. The early history of the art is shrouded in the dim mists of tradition, but the ancients seem to agree in giving the credit of the invention to the Phœnicians.

The story is too well known to need repetition of the party of Phœnician merchants who, having kindled a fire on the banks of the river Belus, proceeded to cook their dinner in pots supported by blocks of niter (carbonate of soda) supplied from their stores, in place of the stones which this sandy region did not furnish. Under the heat of the flames the fusion of the alkali with the sand produced glass. Thus far tradition. The earliest known specimens of glass, however, are Egyptian, and there may be seen in the British Museum a small lion's head of blue-green glass found at Thebes, which is probably the oldest specimen extant.

Under the Egyptians the art developed in all its details. They knew how to melt, color, and carve it.

The Greeks, too, used it, and many beautiful medallions were made from it by them. By far the greatest number of specimens of ancient glass preserved to us are Roman, and many quaint cups, vases, and images in both public and private collections attest the skill of the Roman glass workers. Pliny gives many curious details in regard to the glass making of his time, and mentions the invention of mirrors. He also speaks of the manufacture of glass in Italy from "a sort of sand found on the banks of the river Volturno," and adds that the same process is used in Gaul and in Spain.

Many of the Gallo-Roman cemeteries have yielded treasures of cups, necklaces, and tear bottles, iridescent fragments in which the metallic reds, blues and greens, still keep their original splendor. For many centuries it was supposed that the secret of this prismatic luster was lost, but modern glass workers have succeeded in reproducing or at least in approximating it.

One might dwell at length on the gradual development and perfection of this wonderful art were it not that space forbids and that its course has been traced by abler pens. Let us, then, touch only on the Venetian fabrications, which seem to have had their origin somewhere toward the fifth century, when the Venetian population, hunted and persecuted by barbarous tribes, sought refuge in the seclusion of the lagoons. Here in unmolested peace they pursued their work, into whose mysteries they had been initiated perhaps by the Egyptians or the Phœnicians, and to which their own skill and artistic sense lent much. It was not until the middle of the thirteenth century that the city regulations, fearful of accidents from fire, compelled the glass makers of the Rialto to establish themselves on the island of Murano, at a safe distance from the homes of men. Since that time the name of this little island has been closely associated with the production of exquisite objects which seem to embody in their fragile forms the transparent clearness or opalescent tints of the waters of the Adriatic.

Strange stories have come down to us of the vigilance with which Venice guarded the secrets of her delicate handicraft. Throughout the intricately woven, many-colored web of her history runs the thread of her glass-makers' chronicle, like the gleaming lines of gold which intermingle on some fantastic Venetian goblet.

In the thirteenth century a fresh impetus was given to the art by the Venetian traveler Marco Polo, who brought home reports of the demand among Eastern nations for imitation gems, especially pearls, and these were consequently made in vast quantities for exportation.

Not all her jealous care, however, could prevent the art of Venice from spreading to other countries. The makers of these flower models of the Ware Collection claim that their ancestors brought from Venice to Bohemia the secrets of their craft. Be this as it may, Bohemia was the next country to manufacture glass, and the Bohemians introduced a new decorative system, that of engraving glass. To this succeeded the art of glass cutting and of luster making as well as that of painting glass.

Germany, France, and Belgium were not slow to follow Bohemia, and in each country new processes and new decorative ideas were developed. Thus the manufacture of glass spread throughout the civilized world.

To come down to the personal history of the artists in question, Leopold Blaschka was born in 1822, in Aicha, a village of northern Bohemia. His father, Joseph Blaschka, was not only a skilled glass worker, but was also an able mechanic and electrician.

After his early education in the grammar school of his native town, Leopold Blaschka was placed in the studio of the painter Elsner, with whom he studied for some time. At the same time he acquired from his father a thorough knowledge of the goldsmith's trade, becoming expert in the cutting and setting of gems and in gold and silver work—a knowledge which he put to a practical use in the manufacture of fancy articles for exportation.

From childhood, however, he had felt an absorbing interest in natural history, and when in the interest of his business he made a voyage in a sailing vessel to America in 1854, he found ample opportunity during a calm at sea to make many studies and drawings of marine invertebrates. On his return he began what proved to be his life work—the modeling of plants and animals in glass.

Some of these earlier models came under the notice of the botanist Prince Camille de Rohan, for whom Blaschka made a collection of about sixty orchids in glass. These were first exhibited in Prince de Rohan's palace in Prague in 1862. They afterward came into the possession of the museum at Liége, where they were unfortunately destroyed by fire in 1863.

Certain annoying circumstances connected with one of these earlier collections, together with the fate of the Liége models, gave Blaschka a distaste for this branch of his work, which he abandoned forthwith, devoting himself exclusively to the manufacture of animal models.

In this work he was assisted by his only son, Rudolf, who was born in 1857, and who became, in 1870, his father's associate in his work. He was the only apprentice whom the elder man initiated into the mysteries of his art—the only person, therefore, since the death of Leopold Blaschka, in 1895, who possesses the secret of these marvelous productions. Both father and son were diligent and careful students of zoölogy, and their accurately rendered models met with a ready sale for museums throughout the world, the most complete of these collections being perhaps that which was purchased by the Harvard Museum of Comparative Zoölogy.

In 1885 the privilege of constructing for its own use the central portion of the University Museum at Cambridge was offered to the Botanical Department by Mr. Alexander Agassiz, who has carried so far toward completion his father's plans for a Museum of Comparative Zoölogy. Through the advice and coöperation of Mr. Agassiz, and through the untiring zeal and energy of Prof. George L. Goodale, who succeeded Dr. Asa Gray in the Fisher Professorship of Natural History, the large sum necessary for the construction of the building was obtained by subscription, the result being a most satisfactory structure which furnished ample space for laboratories and for exhibition rooms in which to display illustrations of all the chief types of plants. It was now necessary to provide these illustrations, and no means hitherto employed seemed wholly adequate to the desired end.

Flowers in all known states of preservation are apt to lose both color and character, and to become unsightly as well as uninteresting. Even if accurately represented by colored drawings, something is still wanting, as they must fail in expressing at least one of the dimensions of space. Gelatin seemed too perishable a substance to be used, *papier-maché* was hardly desirable, and the idea of wax models was altogether distasteful. It was a happy inspiration of Prof. Goodale's when one day studying the beautiful glass models in the Zoölogical Museum which led to the solution of the problem. If these marvels of the sea could be copied in glass with such beauty and fidelity, why should not the same medium be employed for the models of flowers?

Acting promptly upon this suggestion, the next step to be taken was a journey to Dresden for the purpose of making the proposition to the artists. At first Dr. Goodale's trouble seemed likely to prove useless, for he found the Blaschkas most unwilling to abandon the making of animal models, which occupied all their time, and for which there was an unfailing demand.

Up to this time, Prof. Goodale had never seen any glass flowers made by the Blaschkas, and it was during this first visit to their home at Hosterwitz, near Dresden, that his attention was drawn to a vase of orchids, apparently freshly cut, but whose freshness proved to be perennial, since they were the work of the elder Blaschka, who had made them for his wife some twenty years before this date! During all these years the flowers had stood uninjured from exposure to the air and dust of the room, though without even the protection of a glass shade. Here was a convincing argument in favor of glass models for the Harvard Museum.

After much consideration on the part of the Blaschkas, they consented to undertake, on their own terms, the preparation of a certain number of models.

In consenting to this, Leopold Blaschka was strongly influenced by his wish to afford his son further opportunities for carrying on his studies in botany, a science to which he had given much attention; another potent factor in gaining his consent being the kindly sentiment he had cherished for America since his early voyage to that country.

Feeling that he had accomplished the first and most important step in his mission, Prof. Goodale returned to America, and in the autumn of 1887 the first consignment of flower models reached him—shattered to fragments in the New York Custom House, whose inspectors had done their work "not wisely but too well!" The fragments were, however, sufficient to show the quality of the models, and to inspire much enthusiasm.

Among the first to appreciate the excellence of the models, both from an artistic and a scientific point of view, were the two ladies who later became known as the donors of the collection. At first, by their own wish, their names were not connected with the enterprise, which afterward took the form in which the public now recognizes and honors the collection—that of a beautiful and lasting memorial to a graduate of Harvard University, the late Dr. Charles Eliot Ware, of the class of 1834. Each successive step toward the accomplishment of this purpose has been attended by the happiest results, and no element has been wanting to give completeness to the collection.

The second consignment of models arrived, passed safely through the perils of the custom house, and proved satisfactory in every way.

The undertaking hitherto had been a personal experiment of Dr. Goodale's, and he has had from its very inception the entire charge of it. Under the new conditions new contracts became necessary, the final one of which, executed at the consular office in Dresden in 1890, engaged all the time of the two Blaschkas, thus securing a fixed number of models to be sent in two consignments each year, until the collection is completed. The time necessary for this completion is at present uncertain, owing to the death of Leopold Blaschka in July, 1895, since the work now falls wholly on his surviving son.

One of the questions asked most often is whether there is no one besides Rudolf Blaschka who can make these models, or who can at least assist him in making them.

When the nature of the work is investigated, it becomes evident that the only answer to this question is a negative one. This is due, not so much to the existence of any one secret connected with the production of the flowers, as to the fact that they are the result of the keenest artistic perceptions, and of absolute scientific accuracy, combined with a wonderful delicacy of manipulation, and also with infinite patience! That the family possesses certain technical secrets is not to be denied; and not only these hereditary secrets, but many new devices of the art have been called into requisition by these two wonder-workers in whose hands the brittle substance has assumed a plastic character. It is not glass *blowing* but glass *modeling* which has produced these marvelous imitations of Nature. Glass of all degrees of fusibility has been used in their composition, and the colors have been subjected to many experiments: some are imparted to the glass while fused, some while cooling, and some are applied afterward. All the pigments used are mineral colors, as an attempt to supplement these with aniline tints failed utterly.

During the lifetime of the elder Blaschka, the father and son were inseparable in their work; no one step, however slight, was taken by the one without first consulting the other. They worked at the same table, and Prof. Goodale, who alone has been privileged to see the process, confesses himself even more puzzled by their rapidity and skill after seeing the work than before!

The highest degree of excellence, too, has been attained in the use of cements and in the method of securing the models to the tablets; the reproduction of the widely different textures of leaf and petal is a marvel by itself, and such perfection can have been reached only by infinitely painstaking experiment and study. All these matters, as may readily be seen, are not easily acquired or imparted, and for these reasons the collection seems likely to remain, as it is at present, absolutely unique. The artists have been given every opportunity and advantage in the way of plants for study. A photograph of their pleasant home in Hosterwitz shows a large but unpretending house, surrounded by a garden in which American plants are grown. The Blaschkas have had the benefit, too, of the Royal Gardens at Pilnitz, the summer home of the court of Saxony, which is situated on the Elbe within a mile of Dresden.

The Blaschka house contains two studios, in which the models of the Ware Collection are exhibited to a number of invited guests before each consignment is sent to this country. The method of packing is in itself interesting, so carefully are these fragile treasures prepared for their long journey. Each model is secured to its tablet by means of fine wire, then the tablet is fitted into its pasteboard box; under every curve of stem and tendril, supporting each leaf and petal, wherever there is space for it between tablet and model, are soft folds of tissue paper. More of the same paper, lightly crushed, fills the box to the brim, the cover is fastened on, and the boxes are then placed in a strong wooden case, which is in turn embaled in straw and finally enveloped in coarse sacking. It may readily be imagined that the task of unpacking is an equally delicate one, and it is a proof of the skill with which both processes are accomplished that so few of the flowers have suffered in either.

Rudolf Blaschka has made two visits to America in search of subjects for models—the first in 1892, when he made a journey to Jamaica in order to study subtropical plants, as well as one to Arizona and California, returning by way of Colorado and the nearer Western States. These journeys yielded rich results in the way of sketches and studies, which were for the most part rapid pencil drawings made from the living plant, with only slight washes or crayon touches of color, Blaschka's minute memoranda furnishing all further necessary detail.

The second trip to America was made in the summer of 1895, and from this expedition Rudolf Blaschka was recalled by the sad news of his father's death.

The original plan of the collection had been to represent only the flora of North and South America, as it had seemed doubtful if the services of the two artists could be secured for a longer time than would be necessary for this. After beginning to make models of flowers, however, the Blaschkas had found their old work of making marine animals, which must be duplicated, extremely distasteful, and had signified their willingness to devote themselves wholly to the new enterprise, which they evidently wished to be considered their monumental work.

From the very beginning of the undertaking, both father and son have acted from the highest principles and with perfect integrity, and the relations on both sides have been of a most cordial and pleasant nature.

All subsequent offers, no matter how advantageous they might appear to be, have been steadfastly declined by them; and that the contract has been fulfilled, not in the letter alone, has been ably proved by the evident fact that the flower models have, if possible, shown greater excellence in the later than in the earlier instances.

So greatly has the proposed scope of the original scheme been enlarged, that it now seems probable that five or six years' time will see illustrated by this collection all the great types of plant life throughout the world, all except eight of these types being represented among the plants native to North or South America. Already more than one hundred orders are represented, and here it must be clearly understood that no attempt has been made to show every *species* of plant. This would indeed be an impossibility! Not more than six or seven species of an order are given, but the collection thus illustrates a large proportion of the genera. Certain tablets, prepared for demonstration, exhibit a larger number of details than others; sometimes several species of a genus are shown, in order to emphasize the more or less strongly marked variation of certain characteristics, but in general the aim has been to show the typical species of different genera.

The three exhibition rooms are so arranged as to illustrate plant life in all its relations, from a biological point of view. The models are displayed in admirably constructed cases of plate glass and bear labels giving the names of the plants as well as other details in regard to them, thus offering every opportunity for study. The first room or hall, which one enters from the staircase, is intended to show plants in the following relations:

1. In relation to soil, water, air, heat, light, electricity, and gravitation.

2. In relation to insects and other animals by which plants are benefited.

3. In relation to insects and other animals by which plants are injured.

4. The relation of plants of the past to plants of the present time.

Here are also seen the plants used as forage.

The room on the left of this hall represents the Department of Economic Botany. Here we find illustrated plants in their relation to man—i. e., the plants used for shelter, clothing, and food; then those used for drugs, dyes, etc.; and here also are the plants of historic interest.

In the third and largest room the lower floor is devoted to flowering plants (by far the greater proportion of the collection), while the balcony contains the illustrations of cryptogams. In regard to the quality of the work, it is hardly possible to speak too highly. The mastery of color alone is marvelous, but when we appreciate the fact that the most minute detail of the tiniest flower, even to the starlike hairs on the sepal of a calyx, will bear the scrutiny of a microscope, words fail us in which to express our admiration for the creative power of these artists. The closer the study the more extraordinary seems the fact that the material employed for these models is glass! As in Nature no two flowers or leaves of a single plant are exactly the same, so in the glass reproduction every infinitesimal variation is rendered with a fidelity which is almost painful. A distinguished local botanist has made a test of this accuracy by selecting at random a number of specimens from various orders and submitting them to the lens. In one of these examples, that of *Aralia spinosa*, L., he counted nearly eight thousand buds and flowers, some of the former so small as to be indistinguishable to the naked eye, while every flower was yet found to be complete even to the number of petals and stamens. The same exactness is shown in the large compound leaf of this plant, even in the under surfaces, which are hidden from the eye of the observer by being turned toward the cardboard on which it rests. The result, as may be imagined, is simply unequaled, and one hardly knows whether to give the greater credit to the genius which inspired such work, or to the conscience and patience which have made its execution possible. Let us linger before one or two of the object lessons taught in the economic room. One of the most complete studies is that of the Indian corn (*Zea mays*). Here we find, first, the glass model, a stalk of corn from two to three feet in length, showing the long, wavy-margined leaves, the tasseled flowers, and the developed ear in its infolding wrappings of husk and with its delicate plume of "silk." The magnified details in this instance give a single flower, a stamen, and a single grain of maize in its development from the flower. On a shelf above the models, but still in the same case, are displayed dried ears of ripe corn of all sizes and varieties, from the tiny pop corn to the largest and most highly cultivated product of the market garden.

Next these are arranged glass jars containing the articles of commerce prepared from corn: here are corn meal, hominy, bran and cattle feed, corn oil and oil cake, starch in all its forms, climax sugar, anhydrous sugar and caramel, American and British gum, dextrin, mucilage, and whisky.

A beautiful specimen is that of the nutmeg (*Myristica fragrans*), one spray of which gives the amber-tinted flowers in their small, axillary clusters, while another branch shows the ripened fruit. There is also in glass a thin section or slice, showing the nut in its surrounding aril which forms the *mace* of commerce, and the enveloping husk outside this again.

A number of small, open boxes hold various kinds of nutmegs, some from India, some from Java, and there is even a *wooden* nutmeg to complete the collection!

The exhibit which seems to awaken perhaps the most popular interest (at least among the children, who visit the museum in throngs) is that of the chocolate tree (*Theobroma cacao*). The beautiful glass reproduction is interesting enough in itself, as it shows the way in which the flowers and fruit grow from the old wood instead of from the young twigs. From a section of woody trunk or branch, perhaps two inches in diameter, spring the delicate pinkish flowers on their threadlike crimson pedicels. They grow in clusters of three to six, and the effect of these little galaxies of pale stars against the dark background of bark is very charming. The model shows, too, a spray of the glossy green leaves, and one of the ripened orange-colored fruits. Photographs beside it give an excellent idea of the growth of the plant in Central America and Jamaica, and accompanying the prepared products are printed slips containing the desired information—as, for instance, that "chocolate consists of the roasted seeds of the cacao freed from their shells," or that "cocoa is made from the roasted seeds freed not only from the shells but from the excess of oil." Here, in the glass jars, are many varieties of the cocoa seeds and of chocolate pods preserved in alcohol. Here, too, we find both raw and roasted cocoa from Trinidad and Carácas, from Santo Domingo and from Ceylon, from Surinam and from Bahia. Among the finished products are cocoa shells and breakfast cocoa, chocolate of all grades, and cocoa butter.

This slender stalk of blue-flowered flax seems a fragile wand to wield such widespread power until we study its manifold products and comprehend its range. Contributions have come from all lands, from Friesland to China, and we see them in all stages of manufacture. With the model of the cotton plant are some seed capsules from one of the Southern States; and here we find a set of the standard types of cotton arranged in boxes and presented by the Classification Committee of the New York Cotton Exchange.

In the larger room the flowers are arranged in close accordance with the accepted synopsis of orders. Of course, in following this method of classifying the models, little attention could be paid to the juxtaposition of colors, yet at the same time one is impressed by the admirable harmony of these kaleidoscopic tints.

This harmony may be in a measure due to the large proportion of white flowers, as well as to the perfection of color and texture shown in the foliage.

The shades of red rank next the white flowers in number, then come the yellows, and last of all the blues, with their gradations of purple, lilac, and lavender. The distribution of color seems to bear no relation to the conditions of climate or of soil, though we find that certain species grown in the German garden of the Blaschkas have deviated slightly from the colors which the same flowers wear in our own fields and forests; the Mayflower (*Epigæa*), for instance, seems paler and less vigorous and the wild geranium of a more intense shade than with us; but we may be sure that the models are absolutely true to the subjects furnished for them, wherever they were grown.

It is interesting to make a study of several species of a single order, noting at the same time the typical characteristics and the variations of detail. Take, for instance, one of the most common and easily recognized orders—that of the *Malvaceæ*. Here we have no less than eight species, representing six genera. They are: *Hibiscus clypeatus, Hibiscus palustris, Spheralcea acerifolia, Sida carpinifolia, Sida napæa, Nuttallia malvæflora, Anoda Dilleniana*, and *Malva miniata*.

All these species show the distinguishing characteristics of the family—the translucent texture of the petals, with their clearly marked veinings; the delicate tints of the corolla, varying from white to deep rose-purple, or, as in the case of the *Sidas*, to a tawny, crimson-throated orange. All have certain enlarged details in which we again easily recognize the distinguishing features of the order—the column of stamens, the peculiarly shaped anther (in the example of *Hibiscus palustris* shown in two stages of its development, while an immature anther of *H. moscheutos* is given), the style with its capitate stigmas, and also both longitudinal and cross sections of the ovary showing the arrangement of the ovules in their cells.

In *Spheralcea acerifolia* the inflated, heart-shaped anther is speckled with pale red like a bird's egg, and here we have also a pollen grain magnified one thousand times. Among the details of the *Nuttallia* is a sepal with its stellate hairs and a single one of these hairs enlarged two hundredfold and looking like a tiny snow crystal. Probably none of the models illustrate better the value of these magnified details, in studying the more recondite orders, than those of the *Euphorbiaceæ*, where the inflorescence owes its beauty to a highly colored involucre, while the flower proper is reduced to a single organ. So in *Jatropha officinalis* the brilliant, flame-colored involucre attracts the eye, while the insignificant flower is represented by a solitary stamen or pistil. The three-celled ovary, the three styles each with its two-cleft stigma, may here be carefully studied without recourse to the aid of the lens. Especially delicate is the little *Euphorbia montana*, gray as if with the dust of the California deserts it comes from. A detail of the inflorescence shows the inner side of the involucral bract to which the sterile flowers or stamens are attached.

Still another plant of the same order is most baffling to the student, from the arrangement of the pale pink flowers on the margins of what appear to be flat, cactuslike leaves, but which are in reality the rudimentary branches of this curious growth; this is the *Xylophylla Roezlii*.

One might spend weeks over the exquisite *Compositæ*, whose examples are incomparable. Here, again, the aid given by the enlarged details is incalculable, and it is delightful to be able to study the infinite variations of the multitudinous florets without the microscope. Let us note the difference of detail shown in three species of a single genus. Here are the three *Encelias* —*farinosa*, *canescens*, and *eriocephala* respectively—California plants with what might be described as starry, yellow flowers, all much alike in the careless eye of the amateur botanist. Each of the three species shows in detail a single floret enlarged from ten to twenty times, and also one of the surrounding ray flowers. In studying these we begin to find in what respects the flowers do *not* resemble each other.

E. canescens shows the receptacle and a chaff scale, varying in form from that of *E. farinosa*, a scale of the involucre with its silvery hairs and the fruit magnified ten times.

In the third species (*E. eriocephala*) the color as well as the form of the floret differs from those of the first-named species—the yellow, tubular floret with its protruding pistil deepening to a warm brown, thus giving to the crowded head of flowers the appearance of a dark, velvety disk amid the surrounding rays of a brilliant yellow.

The foliage, too, of the three species shows a marked distinction in coloring, that of *E. canescens* being of a rich warm green, which in *E. farinosa* changes to a glaucous blue-green, while in *E. eriocephala* both stem and leaves assume a downy texture.

The *Asters* and *Erigerons* are wonderfully perfect, from the young buds showing only the involucral scales or the tips of the closed ray flowers, to the matured flowers in which the discoid florets are fully opened, while the rose or purple rays curve inward as they fade.

Such plants as *Bromelia pinguin* and *Ananassa sativa*, together with the *Cactaceæ*, demonstrate the impossibility of rendering these plants satisfactorily through any other medium than the glass used here. The heavy flowers of the *Opuntias* and the *Cereus*, their fleshy stalks and spiny leaves, are too substantial to be satisfactorily preserved either in alcohol or by drying. In the glass model we seem to see the living plant.

The barbed leaves of the *Bromelia* keep their free outward curve as if to defend from trespassers the strong, club-shaped spike from which spring in spiral ranks the pink-purple flowers, each in turn protected by a flower sheath tipped with fierce scarlet. The whole plant has a martial aspect—it is a warrior, and a dried specimen of it would fail to give any idea of its true character.

The *Orchids* might be dwelt on at great length did space permit, but here, again, all are so exquisite that it is difficult to make a choice. Equally fine are the golden butterfly-plant from Trinidad, the spiderlike, black-barred *Brassias,* the beautiful blue and white *Cattleya crispa* with its crimped edges, and the lustrous rose-tinted *Cattleya amethystina.*

New beauties appear at every step. *Convolvuli* and starry *Ipomeas* fling their light garlands across their cardboard tablets, as if feeling for some trellis to wind about; the pimpernel opens its little red weather-glass of a flower; the dainty sundew catches the light in its tiny diamonds; the Venus's flytrap shows the unwary victim caught in its fatal leaves.

In the gallery overhead are the cryptogams—plants whose nature renders them difficult subjects for illustration. The utmost care has been exercised here in selecting the types which will prove of the greatest use, and there will probably be added from time to time the examples most needed. It is intended to present the lower forms of plant life in a well-chosen series of types from motile protoplasm, fungi, and algæ, through mosses, club mosses, and liverworts to ferns. These models are quite as wonderful in their way as those of the flowering plants, if less interesting to the general public. Among the ferns an *Adiantum* shows in its magnified details the entire process of reproduction, from the tiny spores to the young fern with developed rootlet and frond.

No written description of these models can give an adequate idea of the immense service rendered to science by them; to appreciate this it is necessary to study the collection in all its length and breadth.

Considered in the light of a memorial, we need only say it is worthy of the earnest life it commemorates. The bronze tablet on the wall, beautiful in its simplicity, bears the following inscription:

MDCCCXIV MDCCCLXXXVII

IN MEMORIAM

CAROLI ELIOT WARE

MEDICI

HUJUS UNIVERSITATIS ALUMNI

HASCE IMAGINES

DONAVERUNT

CONJUX ET FILIA SUPERSTITES

RURA FLORES AMICUS EX ANIMO COLUIT

VALDEQUE DILEXIT

Marvelous stories are told, according to Mr. St. George B. Littledale, by the natives of Keria, near Khotan, of the gold and precious stones they dig up from the ruins of cities buried in the sands. They make regular expeditions into the desert to recover the lost treasures, and come back telling of fortified cities guarded by ancient men in quaint Chinese costumes, speaking an unknown tongue.

THE CLIFF-DWELLER'S SANDAL.

A STUDY IN COMPARATIVE TECHNOLOGY.

By OTIS T. MASON.

ONE of the commonest elements in any picture of modern Latin America is the *cargador*, or porter. Upon his back may be seen water, merchandise of every sort, in curious receptacles, supported and held in place by a strap across his forehead or across his breast. His dress also is the quaintest mixture, partly old, partly new, of the primitive aboriginal and of the later European cut and stuffs.

Chasque Runner between Chililaya and Puno, Peru, wearing Single Toe String. (Wiener, *Pérou et Bolivie*, Paris, 1880, p. 593.)

But at present we are concerned with his feet and their gear. Underneath is a sole of hide, harness leather or sole leather as the case may be, cut in the form of the foot and having a hole through the front and gashes through the margin just beneath the ankle. About the foot is the lacing, consisting of a narrow strap knotted at one end, drawn up through the hole in front between the first and the second toe, then carried over the back of the foot through a side gash, where it makes a half hitch, then backward over the heel to the other gash, making another half hitch, thence over the instep, where it is tied into itself to complete the round. There is another style in which the toe string is omitted, a cross lacing over the top of the foot and above the heel like that on a west coast baby frame, holding the sole to the foot. There are many varieties of these types, as may be seen in Wiener's *Pérou et Bolivie,* pages 676–681.

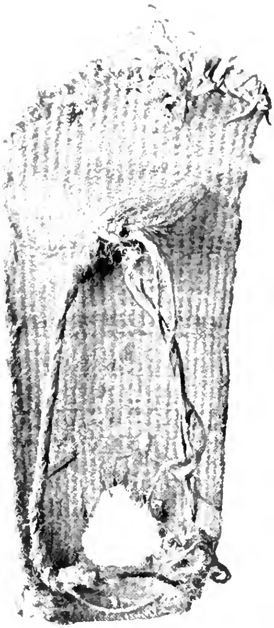
The geographical and chronological distribution of the sandal first named is most suggestive. So far as the National Museum collections teach, this form occurs throughout the Japanese area, but nowhere in Korea or China. By climate it is debarred from Manchuria, Mongolia, and all Siberia, and it is not seen in Tibet.

But both the Japanese type of sandal and the divided mitten-like sock occur again in Kashmir and countries westward and southward. Thence this sandal is found in southern Asia, and has walked all about the Mediterranean for thousands of years. It was the footgear of the Melanochroic Caucasian from very early times. The Mohammedans have scattered it here and there in Africa and thence wore it into Spain. The Latin peoples that conquered middle and South America introduced there for the first time in the history of the Western world this sandal with the single toe string.

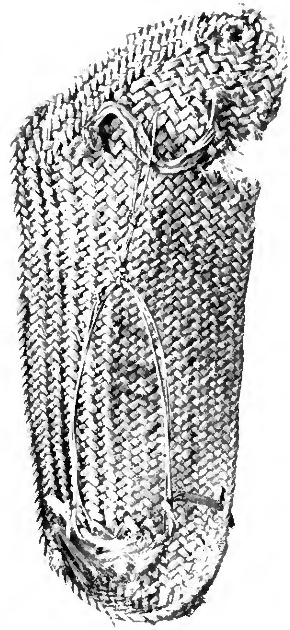
Before that there were in America fur boots in arctic areas, buckskin moccasins down to the borders of the arid region, and thence southward the foot was protected by a sandal, not of raw-hide, for there was none in existence, but of fiber in various kinds of plaiting, and kept on the foot by lacing all round the border and by toe strings and toe loops inclosing toes No. 2 and 3. Fortunately, the meager collections from the cliff dwellings in the United States National Museum are abundantly supplemented by the materials in Cambridge and in the University of Pennsylvania. Through the courtesy of Prof. Putnam and Mr. Stewart Culin I am able to say that the ancient sandal of Arizona and New Mexico never had the single toe string between toes No. 1 and 2. The old types were either of rawhide slashed about the margin, or of fiber with loops about the margin, or of fiber with strip or loop inclosing toes 2 and 3. The examples shown in the plate are from the cliff dwellings of Arizona. Fig. 1 is in the basketry stitch of northern California, "twined work" on a warp of yucca twine in two layers; the weft of *Apocynum* is treated precisely like that of the Ute, Apache, California, and some mound-builder fabrics, by twining two filaments about the warp strands. Decorations are inserted by varying the color and the overlapping of the warp. The lacing is better shown in the next example.

Fig. 2 is of *Yucca angustifolia* fronds not shredded, but plaited diagonally in the manner most widely spread over the Western world. The lacing consists of toe loop, heel loop, and string. The last named commences on the instep and is looped about the toe loop, the heel loop on the right, over the instep and about the heel loop on the left, back to the starting point and knotted.

Fig. 3 is of coarser yucca fiber shredded somewhat, and plaited more coarsely than Fig. 2. The lacing is on the same plan as in



1



2

3

4

Fig. 2, but the knots are all at the toe loop, and the entire lacing is in one piece.

Fig. 4 is quite different from the other three, and is practically woven on four coarse warp strands, by wickerwork, the thick ends of the leaves being left on top and shredded to form a soft bed for the foot. The toe loop is as in Fig. 2. Many sandals of eastern Asia are woven on the same plan, the long ends of the warp being left underneath next to the ground.

INDIA RUBBER AND GUTTA-PERCHA.

By CLARKE DOOLEY.

WAS India rubber known to the ancients? Early writers do not mention it. We need not necessarily conclude, however, that the primitive peoples established on the shores of the Mediterranean were ignorant of the existence of this substance. The game of tennis is one of great antiquity, Herodotus attributing its invention to the Lydians. It is believed they got it from Egypt, which may have received it from Ethiopia. It is known that India-rubber trees are found in Abyssinia to-day. Hence it is reasonable to suppose they were indigenous there in earlier times, and that the inhabitants knew how to prepare resilient balls from their milky product. The Chinese have laid claim to the discovery of rubber, but have so far been unable to prove that they were the first to employ it. Modern Europe had no knowledge of it until the discovery of America. The Spaniards were much surprised to find the Indians playing tennis with balls made of a strange substance which excited their attention, as mentioned by Fernandez de Oviedo at the beginning of the sixteenth century.

This remarkable substance is obtained from the milky juice of certain trees and different varieties of climbers. South America is the principal source of supply—Brazil, of the many states producing it, leading in quantity and quality, and having in its great forests sufficient to meet twice the wants of the world. The best is Pará (fine, medium, and *sernamby*), from the great basin of the Amazon, where more than eighty thousand *seringueiros* (gatherers) are engaged in the dry season in collecting gum. White Pará, "virgin sheets," a new variety in three grades, comes from Matto Grosso. Since its importance first began to be felt, this gum has exerted an increasing influence upon the spread of civilization, especially along the Amazon and Orinoco and their tributaries and the great streams which pour out from the interior of the Dark Continent. Pará, formerly an insignificant village, has grown to be a city of a hundred thousand inhabitants, with modern features, and Manáos, up the river, is fast following it. India rubber is the mainstay of the northern Brazilian states, Bolivia, and eastern Peru. Brazil has a great advantage in its immense waterway; ocean-going steamers run twelve hundred miles up the Amazon, whereas every African river except the Congo has a bar at its mouth and cataracts not far distant from the coast line. It is, besides ivory, about the only commodity produced in the interior of a tropical country that will bear the expense of transportation, often on the heads of natives along tangled man-paths, to the seaboard. So in many places it has been the basis of first commerce. The principal trees in South America are the *Manihot Glaziovii*, the *Ficus gameleira*, and varieties of the *Castilloa*, the *Hevea*, and the *Hancornia*. "The production of Pará rubber," says the Scientific American, December 5, 1896, "increased from 8,243,000 pounds in 1865, to 15,144,000 in 1875, 29,310,000 in 1885, and 46,363,000 pounds in 1895; the great advance in the decade between 1885 and 1895 being the direct result of the increased demand produced by the tire-makers. Last year 37,456,000 pounds were delivered to manufacturers in the United States, against 31,062,000 pounds in 1894 and 35,583,000 pounds in 1893. The highest price paid in this country last year for fine Pará rubber was eighty-one cents and a half in November." The United States has been from the first the largest consumer, and an American syndicate, it is said, is now seeking capital to develop ten million acres in the Orinoco Valley, chiefly with a view to profits from the great virgin rubber forests known to exist there.

Enormous supplies are stored up in Africa and her adjacent islands, where a variety of *Ficus* and great climbing shrubs, the *Landolphia* and *Vahea*, produce it. Stanley alludes to great numbers of these climbers entwining the trees, so as to make passage exceedingly troublesome. Attempts to force the price to unreasonable limits are therefore not likely to meet with permanent success, and we may banish fears of approaching exhaustion. The gum fully thrives, seemingly, nowhere but in the tropics. "It is the one jungle product which society finds indispensable," said The Spectator recently, and, further: "Everybody knows that in the last five years the use of pneumatic tires for cycles and solid rubber tires for horse-vehicles has enormously increased our consumption of this article; but, quite apart from that more obvious fact, India rubber is daily being introduced more and more into all sorts of machinery. Highly competent judges say that if the output could be doubled within a year, so many applications would instantly arise that the price would not fall appreciably." The negroes have no regard for the climbers, and cut them down in order to extract the utmost possible amount of sap.

As a result of this practice collectors have to go farther and farther inland for a supply, so that it often does not pay to transport it to the coast. There is a vast need of better management in collecting and curing the gum, as the African product is of lower grade and brings less than many other sorts in the London market. It seems a certain source of wealth, and is easy of cultivation, so proper steps are almost sure to be taken for its encouragement by the nations engaged in civilizing the continent. Traffic in India rubber is one great incentive for the building of the Congo Railroad.

Asia was the second country to furnish Europe with India rubber. The supply has of late years decreased in importance in consequence of the destruction of the trees. American varieties have been introduced with some success by the Indian Government. The principal native trees are the *Urceola elastica*, the *Ficus elastica* (the well-known window plant) and a species of fig, the *Ficus religiosa*, which is one of the most beautiful trees in the world. Its branches bend down, take root, and form new trunks. The great fig of Narbuddah has three hundred and fifty large and three thousand medium-sized stems, thus constituting in itself a veritable forest. The principal rubbers from India are the Assam and Rangoon. India rubber is also obtained in Oceania, notably in Sumatra, Java, and Borneo, but very little comes from Australia. It was formerly thought that the rubber tree only grew in moist ground, under tropical suns, but explorers have found them in hard soils on high plateaus. A beginning is being made with cultivation of the trees. The Indian Government has a nursery of Pará trees in Assam extending over two hundred square miles, and has shown that they may be productively raised from foreign seed with little care. The cultivation is also attracting attention in Central America and Mexico. According to estimates, it is very profitable. The long waiting of fifteen to twenty years, however, till the tree attains its full vigor, is apt to make individual capital cautious.

France was the cradle of the rubber industry, and French researches permitted the anticipation of many applications of the substance afterward carried out by the English and Americans. La Condamine, who was with the expedition sent to the equator by the French Academy, found the novel article at Quito, where it was known as caoutchouc (from *cahuchu* of the Maïnas Indians), and sent the first accurate knowledge of it to Europe in 1736. The natives called it *hhévé* (hence *hevea*). The Omaguas made water bottles of it, provided with a cannula, which were presented to guests before the repast. They were primitive syringes, and gave the name to the tree in some localities. Hérissant and Macquer, in France, soon attracted attention to the gum by their investigations. Some confusion prevailing in regard to the expression "India rubber," what follows may justify the English name of the substance: In 1765 Aublet announced his discovery of the tree in French Guiana. In 1772 Magellan, descendant of the great navigator (*Le Caoutchouc et la Gutta-Percha*, E. Chapel), proposed caoutchouc, or "*résine élastique de Cayenne*," as a substitute for bread crumb in erasing pencil marks. It was known in France as *peau de nègre*. In England, where the discovery was attributed to the celebrated Priestley, who only propagated a foreign idea, designers soon came to call the article "Indian rubber." It was not known as a product of Asia until 1798. Hence the thought of the time probably connected it with its South American habitat and thus with its Indian gatherers. The appearance of the little cube in the shops about 1775 was the beginning of the great part now played by India rubber in the arts, sciences, and industry. In 1780 Berniard, a Frenchman, experimented in a line with Hérissant and Macquer, and found oil of turpentine to be the best solvent. He also succeeded in imparting various colors to the gum.

By 1791 syringes, sounds, bougies (1779), and elastic bands had been made of caoutchouc. The manufacture of impermeable tissues had been tried in France in 1791 by Besson. The idea was borrowed from the Indians, from whom the early Spaniards had learned to gum their hempen cloaks, which when thus treated were impervious to rain, but degenerated in the sun. Hancock and Mackintosh, in England, were the first to make waterproof garments, later than 1818, the rubber cloth being used as lining (E. Chapel). Hancock devised important processes for treating rubber, and in 1838 invented ink erasers; but it remained for Mackintosh alone, by employing benzene as a solvent, to produce, in 1823, the first successful garments, which at once came into great favor, in spite of their disagreeable odor. At present, three tissues are made: "simple tissues" (having one rubber face), "double-faced tissues" (rubber on both sides), and "double tissues" (two stuffs with one rubber coating between). "Mackintosh" is "double tissue," and the method of manufacturing it is substantially the same as at first, only machinery is used. In the calender machine the fabric is spread with rubber solution, is drawn by a roller under a scraper to remove excess, and passes upon a steam table, where the solvent evaporates, leaving a thin pellicle of rubber on the stuff, which thoroughly dries in passing around a drum and is wound upon a mandrel. It may then be taken to the front of the machine and the process repeated. Ten coats are sometimes applied. The product must afterward be vulcanized, to render it less sensitive to heat and cold.

Many do not understand how much we owe to vulcanization and to the American, Charles Goodyear, its real discoverer, who indefatigably pursued it many years through prosperity and want, encouragement and discouragement, now with friends around him, and, again, lying in a debtor's prison. La Condamine found India-rubber boots among the South American Indians in 1736. Up to 1820 the *seringueiros* had sent rubber to European markets in the form of "pears," or bottles, and rude shoes. They were termed "shoemakers" in consequence, but the appellation has fallen into disuse. The gum did not begin to be known in the United States until 1820. Three years later, five hundred pairs of Brazilian shoes of direct importation had been sold in Boston. Between 1845 and 1850, flat balls, "biscuits," as at present, began to be sent. Rubber threads, making elastic suspenders, garters, etc., possible, were first made, in 1830, in France, and speedily became an important manufacture. About this time the child's ball was doing more to popularize the novelty than anything else. Soon after, the manufacture of rubber became so important in New England that from 1834 to 1836 new factories rose on all sides. But the popularity of the new substance declined when it was found that rubber lost its elasticity at low temperatures and was deteriorated and stuck together at high ones. Then, when many factories in America had closed, and English and French manufacturers were menaced with ruin, Goodyear succeeded in producing rubber unalterable by cold or ordinary heat or solvents, and some of his dark-yellow shoes and bands of perfect elasticity met with a glad reception in Europe in 1841. In 1839, Nathaniel Hayward, an American, had patented a process for powdering the sheets of rubber with sulphur. The discovery was simultaneously made in Germany by Dr. Luedersdorf. But neither thought of applying heat. Goodyear, who had been experimenting with India rubber for four years, bought Hayward's patent, and after long investigation accidentally found, in 1839, that heat caused the sulphur and rubber to combine so as to change the nature of the latter. He afterward conceived the idea of plunging the rubber into a bath of sulphur. The process is called "vulcanization." Goodyear's experiments also laid the basis of hard-rubber manufacture. Hancock, in England, scraped the new article, and was led to make and patent the same discovery in 1843, while Goodyear, through negligence, did not obtain a patent until 1844. Alexander Parkes patented a process in 1846, when molding was invented by Hancock, in which rubber is vulcanized almost instantly by dipping in a mixture of chloride of sulphur and sulphide of carbon; so we now have three processes: "The Goodyear" by steam (improperly), "the Hancock" in the sulphur bath, and "the Parkes" or dipping. They are all reliable and inexpensive. No important discoveries to change the method of treatment have been made since Goodyear, who died in 1860.

The problem of regenerating vulcanized waste (old shoes, etc.) has not yet been satisfactorily solved, no means having been found to remove the sulphur completely, and to restore to the gum its original properties; yet there is an increasing tendency to use partly reclaimed rubber and foreign mixtures. From 1881 to 1883 the waste followed the rise in the price of the gum, and this led to the use of imitations made from linseed oil (first announced about 1846), from arachis, and from colza oil, and they still continue to be considerably employed in the fabrication of cheap articles.

Pure India rubber is whitish. It is rarely used, the vulcanized being preferred. Crude rubber is often mixed with pieces of bark, stone, clay, etc. The lumps are softened in hot water, cut into slices, generally by hand, and passed through washing rollers to remove foreign substances. When dried, they are ready for mixing with sulphur, etc., or for the "masticating machine," which kneads the stuff into a solid mass. The machine gets very hot and has to be cooled with water. The gum is then heated, molded, and cut into sheets by a rapidly moving knife. Balls, etc., which are made of these sheets, have to be cemented. It was not until about 1850 that manufacturers of "balloons" (hollow articles) began to make the endless variety of playthings with which the child of the present is familiar. India rubber grinding stones are made of the waste by an admixture of glass, pumice stone, or emery. Kamptulicon, of English origin, invented about 1843, is a mixture of rubber and pulverized cork applied to coarse cloth and covered with several layers of linseed oil. It is now largely superseded by linoleum (Walton's patent, 1860). Imitation leather and ivory (the latter not with complete success), hevenoide (for billiard balls, piano keys, etc.), baleinite, plastite (for gun rammers, canes, whip handles, etc.), and similar products are also made; even sponges. Stamps were made early in the history of India rubber, and by an American, James Peck, in 1862. They were ruined by the ink, and had to be abandoned until inks with an aniline base came, when they were able to supplant almost all their rivals. Hard-rubber dental plates are said to have been the invention of Dr. Evans, an American dentist in Paris, in 1854. He made several pieces for Goodyear's use in 1855. The latter showed them to Dr. Putnam in this country, who, with the assistance of a chemist and Goodyear, finally succeeded in making an article which has now obtained a high degree of perfection. Street-paving has been tried with success in London and Hanover. It deadens the rolling of vehicles, but the cost bids fair to prevent its general introduction. India-rubber horseshoes, an

American patent, are announced, for special use on asphalt pavements.

It is impossible to mention all the uses to which India rubber is applied, and reference can only be made, in concluding, to two more, very important ones. It is at present finding increasing favor in tires for vehicles, the solid kind being most frequent, though occasionally pneumatic-tired equipages are seen. Hancock claims to have made the solid kind for her Majesty in 1846. The recent tire of American invention with wires running through it is thought, in this country, to be the best, as double the quantity of rubber of better quality is used, which secures greater elasticity, and vastly cheaper, from better rim-construction and because worn spots may be cut out and renewed. The bicycle industry, it is estimated, is turning out, in 1896, in the United States alone, six hundred thousand bicycles and one million and a half pairs of pneumatic tires, which will require about one thousand tons of rubber. The output in England is about the same, that country and the United States producing seventy-five per cent of the wheels manufactured. A writer on this subject (Hawthorne Hill) recently said that probably not more than four per cent of the output of rubber is used in the bicycle trade.

The discovery of gutta-percha, which seems to unite all the advantages of India rubber, excepting elasticity, without its disadvantages, has sometimes been attributed to the traveler Tradescant, who brought it to England, where it was known as mazerwood. It was neglected and soon forgotten. To an Englishman, Dr. Montgomery, is due the merit of having brought the importance of the new article to the attention of the world of science and industry. Hearing of it at Singapore, in 1822, he procured specimens from the natives, who collected it in the neighboring forests, and formed it chiefly into axe handles by malaxation in boiling water. He found it differed materially from elastic gum. Having proved that it retained the shape on cooling, imparted to it in boiling water, while recovering its hardness and primitive tenacity, Dr. Montgomery thought such a substance could serve better than rubber for certain instruments of surgery, and communicated his views to the Medical Board of Calcutta in 1843, which warmly indorsed the idea. He also sent specimens and a study of the product to the London Society of Arts, and received from it a gold medal in recognition of his important discovery. According to Dr. Gützlaff, the celebrated missionary, gutta-percha was known in China long before it appeared in Europe, though certainly not gathered there.

Gutta-percha, like India rubber, is obtained from the juices of certain trees and climbers. The best is produced by a tree, the

Isonandra gutta, of the order *Sapotaceæ*, which formerly abounded at Singapore and in all Malaysia, but which now tends to disappear under the ravages committed by gatherers. *Gutta*, in Malay, signifies gum or lime; *percha* signifies scrap. Incisions are made in the bark, as on rubber trees, and the liquor flows of perfect whiteness, darkening at contact of air. Coagulation takes place spontaneously in a short time. Like rubber, the liquid forms a film on top. This cream is removed, kneaded into a large lump and plumped into boiling water. Under the action of a high temperature it softens and forms the cake usually found in commerce. Other trees in Malaysia and Farther India, in Cambodia and Cochin China, produce good gutta. In Hindustan different grades are mixed by the natives. Chinese merchants, in their depots, mix and manipulate to give a good superficial appearance to the product, as the price is constantly advancing. As the gatherers also do not scruple to add vegetable *débris*, earth, or sand, it has become difficult to secure a pure article. An inferior quality is obtained from trees and climbers in Africa and Madagascar, and, with the development of those countries, more may be expected. For the present, the same ravaging system of gathering seems bound to prevail in these countries as that which the now indispensable gutta-percha and India-rubber growths are suffering in other countries. The valuable discovery of enormous supplies of gutta trees in the vast forests of Guiana was made about 1860. As might be expected, the rich flora of Brazil furnishes many varieties of the tree; one of which, the *Mimusops elata*, exudes a white liquid of an agreeable flavor, which is often used with tea or coffee. Other countries to be mentioned are Venezuela, Costa Rica, and Australia. (For the botany of India rubber and gutta-percha, the reader is referred to E. Chapel's comprehensive work, *Le Caoutchouc et la Gutta-Percha*.) Some growths produce *caoutchouc gutteux*, a substance of inferior quality, having the character of gutta-percha and India rubber.

The largest quantities of gutta-percha come from the Sunda Islands, Cochin China, Cambodia, and Hindustan. At first it was exported exclusively from Singapore, but now some shipments are made direct from the above-mentioned regions, from the island of Celebes and the Philippines; some going to the United States and the ports of Amsterdam and Rotterdam, but the greatest portion to England.

The different varieties in European markets are designated after their place of origin, the best being the Macassar, Java, Sumatra, Borneo, etc. The gutta-percha of the Orient is of various colors. The best grades are white or grayish, slightly rose-tinted, and generally contain very little foreign substance; inferior grades are dark and mixed with impurities. The former are tenacious, the latter often very friable. Macassar and Sarawak, the finest grades of gutta, are light-brown verging on yellow, while Balata is rose-brown.

On being refined and drawn thin, gutta-percha is translucent; drawn very thin, it is transparent; but placed on a white surface, it is rose or gray. At ordinary temperatures it is supple, flexible, and very tenacious and extensible, so that it may be drawn to three times its length, when it retains almost all of the extension. If a dent be made with the finger nail, a trace will remain. It softens above 50° C. and becomes adhesive above 100° C. Two pieces may be permanently joined by applying a hot iron to the surfaces and using light pressure. It is a bad conductor of heat and electricity, but may be electrified by friction; so it is sometimes employed for the disks of electric machines. Exposed to the air, it undergoes, at length, a great change, losing its fibrous structure and becoming granular and friable; more quickly in hot countries. This is a result of the action of oxygen under the influence of light. It is insoluble in water, softens in boiling water and steam; resists alkalies, hydrofluoric acid (being used for a receptacle for this acid), and ordinary dilute acids, but, when strong, they attack it.

The property of gutta-percha of greatest value to mankind is its dielectric or nonconducting property. This is not lessened by atmospheric conditions, nor is it destroyed by plunging under water or burying in the ground or subjection to other deteriorating influences. Hence its fitness for cables, telephone wires, etc. Its power of insulation decreases as the temperature increases. Sea water is a medium in which gutta-percha undergoes no alteration, and the enormous pressure at great depths exerts a favorable action on it by closing up accidental splits. Wrappings are put upon electric cables to protect the insulation from abrasion and the attacks of marine animals, as well as to strengthen the cable. Gutta insulation is preferred for telegraphy, telephony, bell service, etc.; rubber insulation for lighting and power, as intense currents are liable to lead to accidents by fusion of gutta insulation. What the world owes to gutta-percha may be most easily illustrated by more than one hundred and thirty-nine thousand miles of ocean cables, not to speak of the myriads of wires on land, under it, and in buildings for every conceivable purpose.

As soon as this valuable substance became known, industrial enterprise at once sought to make use of it. From the year 1844 the new product received numerous applications and gave rise to many patents. It was used for making stoppers, glues, and wires; then shoes, surgical instruments, and clothing. The most fortunate application was as coating for telegraph cables (patents to

W. H. Barlow and Theodore Forster, April 27, 1848, and to E. W. Siemens, April 23, 1850). Efforts had been made to solve the problem of submarine telegraphy for some years. The Count de Moncel, in his *Traité de Télégraphie Électrique*, gives to Mr. Wheatstone, London, the palm as its inventor, but all do not agree in this. The first mention (The Atlantic Telegraph, W. H. Russell) we are able to find of a current being transmitted a distance under water refers to Sir W. O'Shaughnessy, Superintendent of Electric Telegraphs in India, who hauled an insulated wire across the Hoogly, at Calcutta, and produced electric phenomena on the other side of the river, in 1839. Wheatstone, who is said to have been thinking of binding England and the Continent in electric connection as early as 1837, laid a plan before the House of Commons in 1840 for a cable between Dover and Calais. He seems to have had no definite idea of the kind of insulator to be employed, and, as the insulating quality of gutta-percha was not yet known, his project was not carried out. Morse, in 1842, had succeeded in telegraphing with a copper cable in New York harbor from Castle Garden to Governor's Island, and said, in a letter to the Secretary of the Treasury in 1843, that electric communication "may with certainty be established across the Atlantic Ocean." Three years later Ezra Cornell had successfully employed a cable insulated with rubber in the Hudson at Fort Lee; and in 1846 Colonel Colt, the patentee of the revolver, and Mr. Robinson, of New York, laid a wire across the river from New York to Brooklyn and from Long Island to Coney Island. So this great fact of instantaneous exchange of intelligence with nations beyond seas was in a promising embryonic stage. Yet a satisfactory insulation still was wanting. Then, at the very time when science was earnestly seeking to find a suitable insulating material, Montgomery was studying the properties and supply of gutta-percha. The late distinguished German inventor, E. W. Siemens, recognized the superior insulating power of this substance in 1846, and constructed the first subterranean line in Germany in 1847. Thence to the submarine cable was but a step.

It is now interesting to Americans to note that S. T. Armstrong, of New York (The Story of the Telegraph, by Briggs and Maverick; The Telegraph Manual, by Schaffner), who had been invited to England in 1847 to inspect the products of the new industry, established this industry the same year in Brooklyn (as the president of a company), and made highly favorable experiments across the Hudson in the autumn in 1848. He was so sanguine of the success of gutta-percha insulation that he offered in The Journal of Commerce, the same year, to lay a line across the Atlantic for $3,500,000. (We have been careful to allude to this, as there is usually no reference to Armstrong's experiments in works upon the subject.) Nor was it until January 10, 1849, some months later, that Walker, one of the first *savants* that busied themselves with electricity, and who first experimented with the railway block-system, successfully telegraphed in the harbor of Folkestone on what is generally considered the first submarine cable. It was a gutta-covered cable extending from a boat two miles to the shore. The favorable results at Folkestone encouraged John W. Brett, who is known in England as the father of submarine telegraphy, to construct the first long line from Dover to Calais, with the encouragement of the French Government, in 1850, when the successful application of gutta-percha to real submarine telegraphy was demonstrated and Wheatstone's hopes were completely realized. Brett labored with great energy for the success of long-distance submarine communication, and his faith and advice, as well as capital, were of the very greatest value to Field and his fellow-promoters of the first Atlantic cables. In 1851 the fire-hose at the exposition in London was of this substance, and on the last voyage in search of Franklin a light and portable gutta-percha boat did good service, showing that the material was suitable for the sheathing of boats. Advantageous use was also made of it in making molds for reproducing delicate impressions in the galvanoplastic process. But, except in telegraphy and galvanoplasty, its employment soon diminished. Shoes of gutta-percha softened before the fire and stuck; clothing made of it in turn fell into ill favor. Vulcanizing and mixing with rubber were thought of, but still satisfactory products were not obtained. They were hard and were soon abandoned.

The failure of gutta-percha for some purposes is owing to its greater suppleness at a slightly elevated temperature. It may be vulcanized by adding sulphur and heating to 135° to 150° C., but this process, owing to inconvenient results obtained, is now very rarely employed. Its resistance to acids led to its being put to use for vessels and tubes in factories of chemical products and laboratories, while medical science, as seemed promised at its coming, has found in it a valuable auxiliary.

The gutta-percha of commerce contains impurities—wood, earth, sand, etc.—which must be eliminated. It may be dissolved in sulphide of carbon or benzene. Then decant and allow to evaporate. A cheaper and preferred method is by mechanical means. The cakes are cut into chips, which are plunged into a hot-water vat and stirred by an agitator; the heavy substances go to the bottom, the gutta and wood remaining on top. A series of rasps removes the wood, and the gutta is taken and dried. The process is often accomplished by still other machinery for removing the foreign substances, care being taken to squeeze out all the air bubbles. The gutta is now pure, but may be mixed with other substances to harden it or diminish the price. *Caoutchouc gutteux* is sometimes added to make it more supple, and a certain degree of elasticity may be imparted to it by adding India rubber of good quality. With the perfect machinery now employed it is made into sheets of almost any desired thickness. Many articles are molded and the seams are finished with a hot iron. Cords and tubes are made by a machine employed for similar articles in the manufacture of India rubber, and which is on the principle of one used in making macaroni. Belting is made for use in moist air or where acid vapors are given off. Such belts have less resistance than those made of rubber or leather, and are only used for small powers. According to Meyer's Lexikon, there is a transparent gutta-percha varnish which can be used for covering documents. It does not change the paper; the document is perfectly protected against water, acids, and alkalies; and the writing can not be erased. Gutta-percha is also used in dentistry.

At the International Congress of Electricity at Paris, in 1881, the alarm was sounded in regard to the decreasing supply of this substance, and England, France, and Holland caused investigations to be made with a view to gutta-percha planting, but they do not seem to have led, as yet, to any specially practical results. Land of volcanic origin has been observed to be favorable, and heat and light and constant humidity the conditions essential for the growth of the tree. There are vast regions in Cochin China and Cambodia where, it is said, the *Isonandra* could be grown at slight expense; while all Malaysia, and probably other regions where it grows native, would be found to lend themselves to the same purpose. As the tree requires thirty years to reach maturity, little can be expected from private enterprise, and national aid should be extended. Meanwhile, the increasing demands of submarine telegraphy, etc., and the ruthlessness of gatherers are making it scarcer, and manufacturers must speculate with very variable prices.

In his presidential address before the Royal Geographical Society Sir Clements R. Markham cites the execution of the Periyar Canal, in the Madras Presidency, India, as a most striking example of the power of man to alter permanently the physical geography of a region. The Periyar flows northward between the ridges of the western Ghauts Mountains, breaks through them, and reaches the coast on the western side, in a region abundantly supplied with water, while Madura, on the east side, is an arid plain, constantly parched. The canal has been completed, with a tunnel through the mountains, and the river has been turned to the western side, making the effectual irrigation of Madura practicable. As opposed to the too many instances in which man has injured the countries some of whose geographical conditions he has changed, we have one here in which by careful calculations and high engineering skill he has conferred great and lasting benefit upon a region.

SKETCH OF JOHN GUNDLACH.

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THE words by which Sir William Jardine characterized Alexander Wilson may be equally well applied, with a slight change, to Gundlach, the Cuban naturalist. He "was the first who truly studied the birds of *Cuba* in their natural abodes from real observation; and his work will always remain an ever-to-be-admired testimony of enthusiasm and perseverance." Gundlach studied with equal completeness all the land and river fauna of Cuba and that of the sea, except the fishes, on which Poey was engaged.

John Christopher Gundlach was born July 17, 1810, at the University of Marburg, Hesse Cassel, where his father, Dr. John Gundlach, was Professor of Mathematics and Natural Philosophy. When the father died he left his five children a good name and a noble example; and the mother received a pension.

These resources, however, were not sufficient for so numerous a family. Great sacrifices were necessary if so many children were to be fittingly educated. The young students were compelled to devote their leisure moments to work, instead of the exercises of pleasure and recreation which were the privilege of their fellows. Henry became a doctor of medicine; Conrad, a Protestant minister; William, a guardian of the forests; and John accustomed himself, to use his own words, to "accept destiny in whatever shape it might present itself," and to do much while he spent little. He was in his ninth year when his elder brother returned from Cassel with a ready and practical knowledge of taxidermy. He used to watch the brother's work, closely and quietly following all the processes of his preparations. The boy was an industrious collector of insects all the while; and in the study and classification of his collections enjoyed the counsel and assistance of naturalists, who were glad to give him their encouragement. Those fruitful collecting excursions were the pastime of his youth. About this time the young man suffered a serious disaster from the accidental discharge of a shotgun, by which his nose was shattered, and he was permanently deprived of the sense of smell. The misfortune, however, had one comforting compensation, in that the student was thereby enabled to deal with subjects in extreme stages of decomposition as easily as if they had been entirely fresh. He gained an extensive reputation as a taxidermist, a practical demonstration of which was the fact that a captain residing in Marburg intrusted him with the preparation and mounting of his valuable collection of birds.

Gundlach's mother sought vainly to guide his steps through the mazes of theological studies; and although he at one time, in deference to her wishes, began a course, he was not destined to complete it. Dr. Maurice Herold, Professor of Zoölogy, offered him employment in the university as conservator and preparator —a position in which he had advantageous opportunities for prosecuting the embryological work in insects which he had undertaken. Enjoying as the son of a professor the privilege of gratuitous instruction, he was enabled, while assisting Dr. Herold and serving as his substitute, to take three successive courses in zoölogy. He obtained, in 1837, the degree of Doctor of Philosophy and Master of the Liberal Arts; while he had also been elected to the Society of Natural History of Cassel.

Gundlach was invited by Dr. Julius Hill, a Dutch physician, to visit Surinam, where a company had been organized for making collections; and by the Cuban, Carlos Booth, who had completed his studies at London and Cassel, to go with him to Cuba. He accepted the latter invitation, and, sailing from Hamburg early in November, 1838, landed at Havana, January 5, 1839.

He at once made a favorable impression in Cuba. He might have speculated in the results of his researches, but refused to do so, giving as the reason, when asked by the writer of this sketch, "Booth having incorporated me into his family, I had no expenses and could send these objects gratuitously to Cassel."

The venerable Simón de Cárdenas wrote of him at the time that "of a modesty equaled by none, he ever ignores the price of his works. Tolerant with all, he never criticises. He only knows how to give good advice. His amiable character is invariably the same. . . . That science fills his soul and heart is a fact that needs no demonstration. The impetuosity of violent passions is something entirely unknown to his nature, and for him there is nothing in the world but study and friendship."

Juan Clemente Zenea, in his *Revista Habanera* (1861), spoke of Gundlach's zeal and devotion to science, his modesty and unselfishness, in terms of the highest eulogy, saying, among other things: "For the last twenty years our richest planters have been disputing among themselves for the right and pleasure of giving him hospitality and attending to his needs, which are few, and he only cares for the study of science. . . . He is a naturalist as others are soldiers. . . . He is entirely unconscious of his distinction. He unassumingly communicates his vast knowledge to whoever may feel inclined to hear him, like a prophet inspired by a superior will."

He established himself with Booth at Cardenas, in 1841. During one of his excursions he shot a hummingbird, which he found to be of a new species and designated it after Mrs. Booth.

Up to that moment he had never collected for himself. He now decided, on the suggestion imparted to him by the study of that rare specimen, to form a Cuban collection. Removing, in 1846, to the "Refugio" farm, one mile from Cardenas, he deposited there his collections, which had acquired great value, and freely exhibited them to the numerous visitors who were attracted to the spot. Six weeks of the year 1850 were spent at San Juan de los Perros, on the coast of Cardenas, in collecting vertebrates, articulates, and mollusks, while the fishes were left to Poey.

At this period Gundlach formed a number of valuable scientific acquaintances and friendships. Señor Blas du Bouchet, assessor of Cardenas, made several visits to the Refugio, and a close association was formed between the two. Going to reside in Havana, thirteen years after his arrival in Cuba, Gundlach for the first time met Felipe Poey, whom Dr. Manuel Presas styles the true inaugurator of the new era of Cuban science, and whom he had before known only by correspondence. The greeting between the two was a warm one—"*Animæ pars*" (Part of my soul), exclaimed Gundlach; "*Dimidia meæ*" (Half of mine), responded Poey—and was the beginning of an intimacy which was cordial and lasting. In Havana he found, too, Juan Lembeye, the ornithologist, author of a little treatise on the birds of the island of Cuba,* whom he had known since 1846; Ramon Forns, Principal of the "Santa Teresa" School, another ornithologist; Antonio Fabre, Francisco A. Sanvalle, and Dr. Manuel Gandul; and a very pleasant circle of naturalists was formed for profitable intercourse. Very fruitful expeditions were made in 1855 to the mountain called the Pan of Guajaibón; and the encouragement of this success was an important factor in the development of a plan for exploring the Island of Pines. Dr. Nicolás Gutierez, Patricio Paz, and Poey found the means to carry out the idea, it being agreed that they should pay all the expenses and share with Gundlach the scientific harvest. The riches thus acquired stimulated desire, and the project of a new expedition to the east of Cuba was formed, with a view to the collection of mollusks, and particularly of the *Helix imperator*.

Gundlach started on his journey alone in June, 1856, and prosecuted it with an earnestness that nothing could dampen, and a determination that overcame every obstacle of bad roads, dense thickets and foliage, mountain ranges, the burning heat of the day and the cold of the night, tropical showers, high waters, and mud up to the neck, with all the hardships they could inflict

* A continuation of, or rather a supplement to, the Physical, Political, and Natural History of the Island of Cuba, published by Ramon de la Sagra, in which the part allotted to ornithology is edited by Alcides d'Orbigny.

upon him. He went overland from Havana to Cienéga de Zapata (Zapata Swamp), thence to Caimanera and Cienfuegos. In September he passed through Trinidad, San Juan de Letran, Güinia de Soto, Araca with its great marsh, and other places, all of which were closely and attentively examined.

On the 22d of February of the following year he started from Casilda toward Manzanillo, thence to Bayamo, where he was entertained with true Cuban hospitality. Drawn by an irresistible desire to acquire more specimens of a very interesting mammal known locally as *tejón*, called *almiqui* by Poey and his successors, and scientifically named *Solenodon cubanus* (Peters), he traversed the Sierra Maestra. Another mammal, the *Jutia andaráz* (*Capromys melanurus*, Poey), of which he had obtained specimens from Dr. Yero, also attracted him thither. Besides having specimens of these species, he desired to trace them to their homes and follow them to their burrows, but his success was prevented by natural obstacles which he could not overcome. With the Yero brothers he went to Guisa, where he found in one of the caverns the interesting bat *Monophyllus Redmanni*, and many specimens of mollusks. Reaching Santiago de Cuba in December, 1857, he closely investigated its vicinity. He revisited Cabo de Cruz in April, 1858, in search of the tropical bird *Phaëthon flavirostrus*—called in Cuba *rabijunco*, from the two median rectrices that gracefully prolong its tail—which disappears from the place in the latter part of August or beginning of September and returns in February, and obtained very good specimens of it. In June of the same year he visited Caimanera, in the harbor of Guantánamo, for mollusks. At Zateras, in 1859, he met the botanist Charles Wright, of Connecticut, who had already collected a number of plants for Harvard University and had returned for new finds. The two explored in company, mutually aiding each other; and Wright acquired snails and insects and bird skins for the Smithsonian Institution, in return for which Gundlach had seeds and specimens of plants to send to Havana. He returned to Santiago de Cuba; visited Baracoa in May, where he went to the "Marianna" estate to see the famous branching palm; ascended the mountain called *Yunque de Baracoa* (Baracoa Anvil), where he discovered a number of insects and new species of mollusks; and went on by way of Gibara to Nuevitas, whence he passed to Puerto Principe, and finally arrived in Havana in August, 1859, three years and three months after his departure on the expedition.

Established again in the Cuban capital, Gundlach occupied himself with the systematic compilation of his collections. He described and published three new species of birds; sent the reptiles to Dr. Peters, of Berlin, for classification, and the land

and river mollusks—which he had already himself partly named —to Dr. Pfeiffer, of Hesse Cassel; while he reserved the insects for German and North American specialists.

After other journeys to Vuelta Abajo, Gundlach decided to gather all his collections under one roof. He furnished for that purpose a room on the upper floor of the infirmary of the sugar estate "Fermina" (Bemba), where the valuable Cuban Museum of Natural History was installed during the holy week of 1864.* There all the zoölogical species, especially birds, were represented by specimens of both sexes, young and old, their eggs and nests, with cases of albinism and melanism and anomalous features, especially of the bill. In 1866 Gundlach prepared—arranging and packing—the specimens for the Cuban exhibit in the Paris Exposition of 1867. The exhibit included a collection of land and river mollusks, a Cuban herbarium, and a collection, no less valuable, of woods and textile plants; geological and mineralogical collections; sections of fossils; and other specimens of the products of the island. In it the collection of the Academy of Sciences of Havana was added to Gundlach's own.

The breaking out of the Cuban insurrection in 1868 made the continued exploration of the island impracticable, and Gundlach turned his eyes to Porto Rico. He visited that island in 1873, and traversed, investigated, and studied to great advantage the surroundings of Mayagüez, Aguadilla, Quebradillas, Arecibo, Guanica, Utuado, and Lares. The six months work done here did not, however, satisfy him, and he returned in 1875, when he also explored Jayuya, Vegabaja, and Bayamon. Receiving news of the burning by the rebels of some estates near the "Fermina" sugar plantation, he at once abandoned everything to go to the rescue of the museum, his only treasure.

In 1884 he started anew in the direction of Santiago de Cuba and Guantanamo in search of certain birds and butterflies. Although he did not find the immediate object of his quest, his labor was rewarded by the acquisition of other specimens which speedily found their way to the university, the Institute of Havana, and other scientific centers. He returned in 1885, having with him, among other trophies of his enterprise, several good specimens of the ivory-billed woodpecker, a species which, thanks to the careless destructiveness of hunters, is becoming quite rare, and of the *Papilio Gundlachianus*. "Every trip to the mouth of the Aguadores River," he wrote to the author of this

* The Gundlach Cuban Museum is certainly worthy of special attention. A more detailed account of the treasures it contains is in preparation. The collections are now deposited in a private hall of the Institute de Segunda Enseñanza of Havana. In April, 1890, it held 4,135 species.

sketch, "had to be begun at half past five in the morning. It was there that the *Papilio Gundlachianus* flew. I had to walk two leagues, stand three hours, and then walk back two leagues more. The heat was unbearable." This *Papilio* is highly valued by students of Lepidoptera, and the specimens command a high price. It is not so large as the *Papilio antimachus* of Sierra Leone, but it enjoys the distinction of being the prettiest butterfly in America. A goodly number of swifts and large swallows were also in the collection. Gundlach made other journeys to the eastern province in 1885 and 1887, always collecting, always active and untiring, as if his seventy-six years, in spite of the arduous nature of his enterprises, had dealt lightly with him.

His unrivaled Cuban Museum established in the Havana Institute, still claimed and received his attention to the last moment of his working life. A hearty octogenarian, he continued to devote himself, as with his old-time energy, to improving it as far as possible. Assisted by kind friends, he went up daily to his place of work, first assiduously laboring and then recreating himself with his only treasure. Finally, in 1896, the end came. He was taken from the institute to his deathbed.

Gundlach's researches in Cuban fauna are so numerous that it would be extremely difficult to record them all in a brief summary. He first published Contributions to Cuban Ornithology, 1854–1857. Then followed, in quick succession, *Index generum Coleopterum*, 1854; *Molluscorum species Novæ*, 1858; A Synoptic Conspectus of all the Birds observed in Cuba, published in the *Journal für Ornithologie*, 1861; A Review and Catalogue of the Cuban Birds, 1865; A Review and Catalogue of the Cuban Reptiles, 1867; New Contributions to Cuban Ornithology, in the *Journal für Ornithologie*, 1871, 1872, 1874, 1875; Contribution to Cuban Ornithology, 1871, 1876; Contribution to the Ornithology of Porto Rico, 1874; Contribution to Cuban Mammalogy, 1877, 1878; Notes on the Fauna of Porto Rico, 1878; New Contributions to the Ornithology of Porto Rico, 1878; Contributions to Cuban Herpetology, 1880; Contributions to Cuban Entomology, 1881; Land and River Mollusks, 1883; Sea Mollusks, 1883; besides descriptions of new species of mammals, birds, reptiles, and insects, published in journals, organs of learned societies, etc. Gundlach was also distinguished by his skill, grace, and delicacy as a taxidermist, the wonderful patience with which he performed every branch of that work, and the gift of genius by which he was able to give a startlingly natural pose to the specimens he mounted.

The list of honors which Gundlach received from institutions and learned societies is a long one. In 1853 he was made a corresponding member of the Natural History Society of Montreal, and in May of the same year was honored in like manner by the Natural History Society of Weterau. In 1861 the Academy of Sciences of Havana signified the high esteem in which it held him by conferring on him the title of Member of Merit. In January, 1864, he was made a corresponding member of the Entomological Society of Philadelphia; in July of the same year an honorary member of the Society of Naturalists of Berlin; and in the following year a member of the scientific department of the Matanzas Lyceum, and a member of the *Sociedad Economica de Amigos del Pais* of Havana. In 1867 he was elected a corresponding member of the Academy of Natural Sciences of Philadelphia. In 1872 the distinction was conferred upon him of election to membership in the Spanish Society of Natural History, Madrid. In 1878 the Farmers' Circle of the Island of Cuba (*Círculo de Hacendados*) made him a Member of Merit.

Besides his untiring devotion to science, which has been evident in nearly every line of this sketch, Gundlach was distinguished by unaffected modesty and plainness and a charming geniality in his companionship. Simon de Cardenas says, in the tribute from which we have already quoted: "He sympathizes with all persons he sees, and when one has had an hour with him it is a pain to part from him. He is an entertaining converser, no matter what the subject may be. He can soar in the heights of science, talk of history, literature, and philosophy, or engage in the private, intimate, and affectionate conversation of the family circle. If we were required to point out among his many virtues others equally conspicuous, we should certainly mention his honesty and disinterestedness." Juan Clemente Zena said that "in speaking of him we must needs pay him homage or not mention him at all. His face is like a transparent crystal, in which all moral perfections are reflected."

In their investigations of the electrical and magnetic properties of matter at very low temperatures, Profs. Dewar and Fleming have, according to a summary given in the London Times, completed an examination of the electrical conductivity of many pure metals, notably bismuth and mercury, and shown that their electrical resistance vanishes as the temperature approaches the absolute zero; also that at very low temperatures the electrical resistance of bismuth may be increased many hundred times by transverse magnetism. They have analyzed the effect of low temperature on magnets, and studied the magnetic qualities of iron and steel at the temperature of liquid air. They have measured the magnetic permeability of liquid oxygen and its dielectric constant, and shown that this complies with Maxwell's law. They have proved that liquid oxygen is extremely magnetizable, while its insulating and dielectric powers give it a unique position among known liquids and salts.

Correspondence.

RACE PSYCHOLOGY.

Editor Popular Science Monthly:

SIR: The article entitled A Study in Race Psychology, published in the January number of the Popular Science Monthly, has called forth several letters which show that the particular case there presented is far from being an isolated one. It is interesting to note also that the question of educational adaptation raised by the article is working in many minds, and has prompted experiments in many quarters. Before referring to these I would note that objection has been taken in one instance to discussions based upon a single case. It is in order to apply here the doctrine of Le Play, who believed that to understand society it is necessary to know its unit, the family. This, however, he declared did not necessitate the study of all families, but simply of typical families. Now, the unit of the school is the pupil, and to know the problem of the school it is necessary to study its typical unit. The study in question was a tentative experiment of this kind.

But to return to the correspondence. City and country are about equally represented in it, with the higher measure of appreciation for the study and its purport in the former. It would seem, indeed, that the problem presented is one well recognized in cities with large colored populations. The question raised in almost every case is how to adapt the dav school to individuals or to a class of whom Isaiah is the type. I should answer that possibly the school is not the place in which the adaptation can be made. The school must treat the child primarily as part of a social whole. This is one of the chief benefits that it renders the community. It accustoms the young to act in concert and in obedience to a general law. On the other hand, it must approach the child also as an individual, but for obvious reasons it addresses itself to an average or normal individual. This is the underlying principle of grading which in some form or other obtains in schools of every order. Experience has shown, however, that society suffers if even a few individuals below the normal fail of development. In several foreign cities, notably Berlin and London, this has been as clearly recognized as the need of guarding against general illiteracy, and special schools for dull or abnormal children have been established at public expense. There are peculiar difficulties in the way of sifting out the colored population of a city like Washington, for example, on any such plan. Nor can we hope at present for a system of continuation schools such as is provided in Germany and Switzerland by which American youth, white or black, who leave school with the barest knowledge of the elements, might have their intellectual training prolonged, while at the same time they should be initiated into some art or trade. The only feasible plan at present is to supplement the school by auxiliary agencies, private or church. It is interesting to note that this is an expedient which is being attempted by leading colored men in the interests of the poorer and most backward of their race. Two notable efforts of this kind have been reported to me from Washington. One of these is of the nature of a veritable "settlement" in a forlorn purlieu of the city, the other is an industrial school in connection with a leading colored church. These efforts, however, are directed chiefly to girls, and they emphasize anew the extreme difficulty of adapting any agency of the kind to the needs of colored boys. The discussion of such adaptation has been promoted by the article in question. Inadequate as are these isolated experiments, they are the only resource while we wait the slow increase of pressure which, like the military and industrial stress of European countries, will yet force us to make larger provision and more varied adjustments for the education of the masses.

From the study of one hundred thousand school children of England Dr. Francis Warner is led to the conclusion that about fifteen in a thousand require particular training, and he urges that the expense of teaching this proportion in a special classroom and by special methods would be an efficient means of lessening crime, pauperism, and social failure. Discounting all hereditary differences between the black and the white races, the argument is nevertheless peculiarly applicable to the lower class of blacks on account of their well known social and family disabilities. ANNA TOLMAN SMITH.

WASHINGTON, *January* 25, 1897.

Editor's Table.

AID FOR THE STATE EDUCATIONAL MACHINE.

MORE than once have we hinted in these columns that the only thing which can render State education successful, and enable it to accomplish the ends which a system of education ought to accomplish, is the earnest co-operation of the more intelligent portion of the public. The trouble is that the public do not in general see the matter in this light. They not unnaturally think that one of the advantages of State education is that all responsibility in connection with the matter is taken off their shoulders. When the government of a country establishes a postal service the individual citizen does not feel called upon to devote his time or his ingenuity to the task of perfecting it. Of course, if he is a reformer born, and his thoughts happen to run in that direction, be will favor the Post-Office Department from time to time with suggestions which may or may not be of value ; but in general the feeling is that such volunteer assistance is not needed. Somewhat similar—very similar indeed—is the feeling which the average citizen entertains in regard to the educational system of his State. It is something he need not interfere with : he pays his taxes, and he has a right to have his children educated ; and there the matter ends.

What the average citizen must wake up to some day is the perception that there the matter must not end. It is one thing to ask the State to arrange for the conveyance of letters or parcels ; it is quite another to intrust it with the education of youth. For the former purpose a few business arrangements, such as are within the compass of ordinary practical intelligence, fully suffice ; for the latter something more is wanted than any government, as such, has it in its power to supply. What, for example. is education without an ideal ? Can the State supply an ideal ? Individual teachers—the more conscientious ones—may have their ideals ; but do they derive these from their contact with or relations to the State ? Or is their position as State employees precisely the thing which makes it hard for them to have or maintain ideals ?

Let us, however, make it quite clear what we mean when we speak of the importance of an ideal in education, and of the utter incompleteness of education without an ideal. By an ideal we simply mean a conception of life worthy of a moral and rational being—such a conception of life as shall develop and strengthen, not weaken and wither, his or her moral and intellectual powers. The first lesson which should be taught to the child is the lesson of its actual, and yet more its potential, worth. "If," says the heathen philosopher Epictetus, "a man should be able to assent to this doctrine as he ought. that we are all sprung from God, I suppose that he would never have any ignoble or mean thoughts about himself." Now, education without an ideal is an education in which a child is never taught to think nobly of himself, and in which, by inevitable consequence, he is almost precluded from having any noble thoughts about anybody or anything. It is consequently an education without any large or worthy aim, an education in which the child is treated simply as a piece of mechanism which has to be put in order for certain definite and servile ends. The idea which dominates State education is the idea of the struggle for life, human being pitted against human being in the scramble for material goods. We do not blame the State for this, for we do not hold it to be capable of organizing education on any higher plane. It can keep an intellectual machine shop, but it can not in any systematic manner provide for the higher needs of growing souls. It may go so far as to enunciate bald moral precepts; but it can not pronounce the master words which speak to the conscience and dominate the life.

So, as we have said, when the citizen pays his taxes and packs his children off to the public school, all is not done. If the citizen thinks the education of his children has been sufficiently provided for, there is a large chance that he will before very long be rudely awakened to a sense of his error. He will find that character is something the proper formation of which demands more care and pains than either he or the public school had thought of bestowing, and that for want of the necessary attention in this direction his children are showing a serious lack of any power of self guidance or self-control. Thousands of parents are to-day precisely in this position, with children on their hands to whose moral cultivation no proper attention has been paid either at school or at home, and who consequently show alarming signs of making shipwreck of life. The parents thought—so far as they thought about it at all—that the schools would see to the matter, and the schools threw back the responsibility on the parents: between the two stools the children have come to the ground. What parents should be made to understand once for all is that if they leave the moral interests of their children wholly in the hands of the public school, those interests will not and can not be adequately provided for. Teachers may individually do their best, but the public school as an institution can not strike the note that is necessary for complete education. It can not strike the note that Epictetus struck in the sentence above quoted; and yet, as we have said, unless the child can be taught self reverence, he will never learn to reverence anything, and his whole life, aimless in any noble sense, will drift among the shoals of circumstance.

Deeply interested as we are in this view of the question, it was with great pleasure that we read a few weeks ago a letter in The Nation from Mrs. Elizabeth Burt Gamble, President of the Detroit Educational Union, describing what had been done in that city toward supplementing the work and influence of the schools by the concerted efforts of the mothers of the pupils. The problem, as Mrs. Gamble expresses it, is to carry more of the home into the school and more of the school into the home. The plan of action was to invite the mothers of each school district, "regardless of creed, color, nationality, or environment," to meet periodically—once a month—for the discussion of "topics best suited to aid in the proper development of the child." The co-operation of the teachers of each district was invoked, and the meetings were as a rule held in the schoolhouse after the regular school work for the day was over. Each district league conducted its proceedings in view of the needs and peculiarities of the particular neighborhood, but the central union prepared a syllabus of work for general use. In this syllabus were suggested such topics as the following: "Proper food and clothing for children; care of the body, cleanliness, the way to prevent the formation of injurious habits; the rights of children; proper reading in the home; how to teach the children self-control and to have a proper regard for the rights of others; the duties of true citizenship; and various other subjects to be taken up by the mothers in the home."

Now, nothing could be better than this, except that we do not see why the movement should have been confined to the *mothers*. Why were the fathers not thought worthy to take a share in the good work? Mrs. Gamble states that in Detroit the movement has received a check. "At the very outset it was observed," so she tells us, "that petty jealousies and a fear of the growing influence of women would make it difficult for the work to continue." We do not see why there should be any dread of the growing influence of women so long as the latter are working judiciously toward good ends. We can imagine, however, that an exclusively feminine movement might perhaps be conducted upon lines or might become committed to positions that would excite not wholly unreasonable opposition. Zeal for reform is a noble thing, but to be successful it requires to be tempered by tact and a sense for the practicable. The matter is not one in which women solely are interested, and if the best results are to be achieved there must be a co-operation of the sexes. If the ideas of men lag behind those of women in some particulars, compensation may be found in the assistance which the former are able to lend in carrying certain limited reforms into actual practice and so preparing the way for further advance.

Mrs. Gamble raises a serious question when she asks, "Has society reached that stage where such results (those, namely, contemplated by the Educational Union) are desired?" There is, unfortunately, room to doubt whether some parents really desire the best training for their children. A parent, for example, who has no worthy ideal in life would not care to have his child indoctrinated with the idea that worldly success is not everything. Such teaching is looked upon as harmless in the pulpit; but many parents, if we are not mistaken, would be disposed to object if their children were taught anything like this at school. It is very desirable that we should know just where as a community we stand in regard to this matter. If all parents do not desire the best moral teaching for their children, all the greater need is there for an educative campaign that shall embrace parents as well as children. Certain it is that the children have a right to the best teaching—the most rational, the most humane, the most inspiring teaching—that can be given them, and no effort should be spared that could in any way tend to put the instruction given in our public schools on a right level or to supplement it by suitable home influence. The subject is one upon which too much public attention can not be concentrated, and we are glad to find from Mrs. Gamble's letter that she and her fellow-workers have no intention, despite some discouragements, to intermit their efforts. It is satisfactory to think that whatever may be done with right motives in the direction indicated must have *some* good effect. To interest even one mother or one father in what—using the words not quite in their usual sense, but in a sense more important than the usual one—may be called the higher education of their children is so far a gain; but to interest, as by proper measures might easily be done, hundreds and thousands of parents throughout the country would be to initiate perhaps the most important reform movement that our century has witnessed.

A CRITIC CRITICISED.

A few months ago there appeared in France a French translation of Mr. Balfour's work on The Foundations of Belief, with an introduction by the well-known editor of the *Revue des Deux Mondes*, M. Ferdinand Brunetière. In this introduction M. Brunetière took occasion to repeat many of the arguments already used by him in his article of a year or so ago on The Bankruptcy of Science. He was greatly pleased to think that Mr. Balfour had shown that science could not lay claim to any greater certainty than theology, and he quoted with much satisfaction Mr. Benjamin Kidd's disparagements of the reasoning faculty and exaltation of the irrational or suprarational as the source of everything good and excellent in human society and in the history of the race. It is a little wonderful that men of the general intelligence of M. Brunetière and Mr. Kidd do not recognize the futility of such intellectual exercitations as those in which they indulge; but the former of these gentlemen can at least see how his attitude strikes a common-sense observer in a very sprightly article published in *La Nouvelle Revue* of the 15th of January last.

The writer, M. Gustave Téry, begins by observing that M. Brunetière only a few years ago was one of the most severely scientific writers of the time. In physical science he was an evolutionist and in literary criticism as rigid and inflexible as Sarah Battle over her game of whist. One fine day he turned round on evolution, and shortly afterward he declared war on science. Now there is no knowing where to find him. He is here, there, and everywhere, showing different colors at different angles, and taking pride in nothing so much as an infinite flexibility of mind and conviction. His present condition seems traceable in the main to an interview he had a couple of years ago with the Pope, who showed him all the kingdoms of the world in a moment of time, and, if he did not convert him outright to Catholic orthodoxy, filled him with a holy zeal for persuading the world that science is the one thing least worthy of trust. In pursuance of this mission he has charged science with having undertaken to "explain the universe" and with having egregiously and shamefully failed to do so. But, as M. Téry says in the article before us: "What *savant* ever claimed to explain Nature in the ontological sense —that is to say, to reveal the nature of Being? All that science undertakes is to connect phenomena with one another, to relate them to their causes and formulate their laws." If, he further observes, M. Brunetière will only make this elementary distinction, he will not be so scandalized as he appears to be at the reply attributed to Laplace when some one —the pious Napoleon Bonaparte, was it not?—asked him what place God occupied in his speculations. The reply was that he did not need that hypothesis, by which he meant that a speculation as to a *first* cause had no place in a series of inquiries relating to *secondary* causes.

One of the amiable remarks of M. Brunetière apropos of reason is that while it is easy enough to see the ruins it has wrought, it is by no means so easy to see what it has constructed. This in face of the fact that day by day all the solid and enduring work in the world is done by the aid of reason and in accordance with its rules. Do we employ lunatics as architects, as engineers, as analysts? Do we ask them to plead cases in court, to write books of science, to manage business affairs? Or, passing over lunatics, do we seek out persons of confessedly mean intelligence for these purposes? Is not all work good precisely in proportion to the amount of correct and rational thought that is embodied in it? If a bridge breaks down, or a house collapses, or a ship is lost at sea, or a railway disaster happens, or a fire sweeps through a town, or an epidemic gains headway, do we ever say that an excess of *reason* was chargeable with the calamity? Or do we, as we investigate the causes, say that here or here there was some defect of knowledge, thought, attention, vigilance, common sense—some defect of reason, in short? The question does not call for an answer, seeing that every one knows that what we need to get into human affairs is more and more reason, more and more intelligence, more and more of the spirit of science. But if, M. Téry says, we are in spite of everything to trust to the irrational or Mr. Kidd's supra-rational, who is to interpret it for us? There are many brands of the irrational, and doubtless just as many of the supra-rational. Who is to pick out the particular one that suits our circumstances and needs? Surely, reason is not to be called upon to decide in what direction we are to forsake its guidance and what precise species of unreason we are to surrender ourselves to. We should be able to look to the gentlemen who tell us how unsafe a guide reason is; but there is nothing they so pointedly decline to do as to give us any practical help whatever. The conclusion of the matter seems to be that of all the fads of the present day the weakest and silliest is that which prompts men otherwise intelligent to disparage reason and its realized outcome, science. A fitting punishment, were it possible, would be to confine such persons for a certain period to an exclusive diet of the irrational and the supra-rational. If their wits survived the ordeal, they would return to ordinary conditions with a devouter thankfulness for the gift of reason, and for all the works of reason, than they probably ever experienced in their lives before.

Scientific Literature.

SPECIAL BOOKS.

THE completion of Herbert Spencer's Synthetic Philosophy * is the most noteworthy recent event in the field of scientific literature. More than forty years have elapsed since Mr. Spencer enunciated the doctrine of evolution in the first edition of the Principles of Psychology, preceding by several years the great work of Darwin on the Origin of Species. Nearly thirty-seven years have gone by since the plan of the Synthetic Philosophy was definitely formulated, soon followed by the publication of First Principles. The accomplishment of the Herculean task then outlined is hardly less marvelous than was its projection at a time when, as Mr. Spencer ex-

* The Principles of Sociology, vol. iii. By Herbert Spencer. New York: D. Appleton & Co., 1897. Pp. 645.

plains in the preface to the present volume, his circumstances of health and fortune were most discouraging.

Though approaching the completion of his seventy-seventh year, neither Mr. Spencer's age nor his long struggle with infirmity has dimmed the vigor of his thought or the lucidity of his diction. The closing chapters of the present volume exhibit the strength of a mind unimpaired and of a conviction undaunted by the apparent drift of events in a direction contrary to that in which he sees the salvation of society. No pessimistic reflections have obliterated his early vision of an ideal man in a relatively perfect social state. "Long studies," he affirms at the conclusion of his work, ". . . have not caused me to recede from the belief expressed nearly fifty years ago that 'the ultimate man will be one whose private requirements coincide with public ones. He will be that manner of man who, in spontaneously fulfilling his own nature, incidentally performs the functions of a social unit.'"

The volume now before us includes the discussion of Ecclesiastical, Professional, and Industrial Institutions. The consideration of the two latter topics, not contemplated at the outset, has displaced the general survey of progress which was to have completed the Principles of Sociology. The finished structure is not marred; the change has enhanced the practical value of the work. In this adaptation to the requirements of added experience and maturer reflection the Synthetic Philosophy is seen to be itself a product of evolution, a vital expression of progressive thought, rather than a mechanically constructed system. That its final form is so near to the original plan is a remarkable testimony to the profound scientific prescience of the author.

The first two sections of the present volume have already received notice in these pages. The concluding section, on Industrial Institutions, is the latest product of Mr. Spencer's thought, and treats of the problems now uppermost in the minds of men. The discussion, therefore, has more than a merely theoretical value. It presents the mature judgment of the greatest thinker of our time on questions of immediate practical import. It therefore challenges the thoughtful attention of all to whom the perfection of individual character and of the societary forms best adapted to assure the progress of the race is a matter of supreme interest.

Reviewing the different stages of industrial progress, Mr. Spencer optimistically concludes that advancement has been more rapid in the century now closing than in all the past of man's career upon the earth—a conclusion seemingly justified by the facts which he skillfully marshals in its support. This progress has been characterized by an increasing specialization of functions and division of labor, thus illustrating the universal law of evolution. The chief incentives to early industrial effort grew out of the steady increase of population, the militant structure of society, and the love of ornament common to primitive peoples. Further industrial progress, however, is seen to be dependent on the decline of the military spirit. Peace alone answers the conditions requisite to continuous effort, promotes economy, and encourages better methods. Hostilities between tribes and nations prevent free interchange and competition, and so favor adulteration in materials and the survival of inefficient methods. "Thus in all ways increase of population by its actions and reactions develops a social organism which becomes more heterogeneous as it becomes larger, while the immediate cause for the improvement in quantity and quality of productions is competition."

Mr. Spencer regards the development of a sound and convenient medium of exchange as a condition essential to that integration of industries which has everywhere accompanied the differentiation of industrial functions. The idea that each local community must be autonomous and self-supporting, peculiar to early societies and in harmony with their prevailing militancy, must give way as production increases and the means of distribution are developed. These advances are dependent on an acceptable medium of exchange. "With a good monetary system the resistance to exchange disappears; relative values of things can be measured; current prices can be recognized; and thus arises competition, with all the cheapenings, stimulations, and improvements resulting from it." A debased currency tends to limit exchanges to the community which employs it; witness the innumerable disastrous experiments with irredeemable paper money. "A developed and differentiated currency furthers production and raises the rate of distribution," thus aiding in the integration of society. Mr. Spencer's conclusions confirm the teachings of political economists, and will commend themselves to all who believe in sound and progressive financial methods.

All these processes of industrial evolution tend to raise man out of the static independence of the savage state into that higher realm of interdependence and mutual service which is his noble prerogative as a social being. By them labor is organized and regulated. Its early regulation implies either actual or potential coercion, at first effected by combined religious, governmental, and industrial control. These functions are gradually differentiated as social evolution proceeds. Emancipation from coercion is conditioned upon the higher development of character in the worker. Patriarchal regulation, communal regulation, and slavery were necessary steps in industrial progress, leading to the modern system of free labor under contract.

The place of the craft-guilds in industrial evolution is treated most suggestively. Their universal prevalence, their normal development in a militant society as substitutes for the original family groups, their important bearing on the evolution of the political franchise, are admirably expounded. It is shown, however, that the "free man" of the industrial guild was free only in a qualified sense. He was subject to many restrictions imposed both by the guild and by the government of the country. The modern trade union, while not a lineal descendant of the craft-guild, is the product of similar social conditions, and is akin to it in nature; militant in its structure and often tyrannical in its oppression of the individual worker. The fruitlessness of the attempt to benefit the worker by artificial efforts to raise the rate of wages is clearly shown. Natural law is stronger than artificial regulations. "Protected industries do not prosper." Yet Mr. Spencer recognizes the fact that trade organizations are natural to the passing stage of social evolution, and may have beneficial functions under existing conditions. Employers are more ready to raise wages when trade is flourishing than they would be without the menace of combined labor. They treat the laborer with more respect. They are led to study the convenience of the men, and look after their health and comfort. The discipline of the organization also helps to prepare the men for the higher social and industrial conditions which will probably arise.

The economic utility of the various modes of compounding capital exemplified in our modern industrial life is clearly recognized by Mr. Spencer. By the use of these methods stagnant capital has almost disappeared. Liberty of combination is asserted, subject to due responsibility of the individual shareholder. No sympathy is expressed with the prevalent indiscriminate denunciation of corporations and trusts. Possibly Mr. Spencer does not fully realize the extent to which such combinations may become a menace to the liberty of the small tradesman, the purity of legislation, and the just requirements of public service. He doubtless thinks that such evils would be self-corrective, as in the case of the various "bubble enterprises" which have been fostered under capitalistic auspices. He sees the utility of such combinations in promoting serviceable industrial enterprises, and affirms their superiority to state action in the advancement of the common weal.

The greatest interest of the reader will probably center in the closing chapters on co-operation, socialism, and the probable trend of industrial evolution in the near future. Mr. Spencer's general attitude toward these questions is well known; but he has never stated his convictions more lucidly nor with equal calmness and poise of judgment. Nor has he before presented so clearly the ripe fruit of his own mature reflection as to the ideal relation of the laborer to the product of his industry.

"Social life in its entirety is carried on by co-operation," Mr. Spencer declares. The earliest modes of conscious industrial co-operation are closely allied to similar united action for militant purposes. All modes of industrial alliance which are enforced by the state must partake strongly of the militant spirit, inhibit individual freedom, and restrain true progress along normal lines of social evolution.

The word "co-operation" is now commonly used in a restricted sense to distinguish a special form of social and industrial life. In those methods of adjusting the interests of capital and labor generally known as "profit-sharing," Mr. Spencer sees some advantages joined with serious defects. He regards them as unnecessarily complicated, difficult of comprehension by employees, and therefore not likely to prove ultimately satisfactory to them. They are based on the system of wage-labor, and this is defective in that it does not proportion the reward of services to their quality and amount. "So long as the worker remains a wage-earner the marks of *status* do not wholly disappear. For so many hours daily he makes over his faculties to a master. . . . He is temporarily in the position of a slave, and his overlooker stands in the position of a slave-driver." An ideal system will assure rewards proportionate to activities and a direct interest of the worker in the enterprise which he is developing. Socialism, whether voluntary or compulsory, violates the first of these conditions, tends to undermine family life, and is essentially militant in its social ideal. "People who, in their corporative capacity, abolish the natural relation between merits and benefits, will presently be abolished themselves."

All co-operative enterprises involving wage-service imply the defects inherent in the wage system, and can only partially remedy its inequities. A self-governing body of workers paid according to the piece-work system, and sharing profits or losses in a like ratio, constitutes the ideal of future industrial evolution. The practicability of such a system depends wholly on character: "The best industrial institutions are possible only with the best men." Such an ideal adjustment can not become speedily prevalent; but a few successful efforts "might be the germs of a spreading organization. Admission to them would be the goal of working-class ambition. They would tend continually to absorb the superior, leaving outside the inferior to work as wage-earners; and the first would slowly grow at the expense of the last. Obviously, too, the growth would become increasingly rapid; since the master-and-workman type could not withstand competition with this co-operative type, so much more productive and costing so much less in superintendence."

For the present, Mr. Spencer sees the rhythmic principle exemplified in all evolutionary processes carrying us inevitably toward a *régime* of socialistic experimentation. Militantism is reviving in Europe and America. Equality is the ideal of the modern statesman, economist, and politician, rather than liberty. "There is small objection to coercion if all are equally coerced." This process can only be arrested by a great spread of co-operative production, which is not probable. Nations may perish, civilizations may decay, under this downward tendency. How long it will last and what will ultimately check it we can not now foresee. The processes of evolution will go on, however, gradually ultimating in that complete adaptation of human nature to the social state which is its ideal end and aim. This end will be proximated and preceded by a federation of nations whereby wars will be prevented and "the rebarbarization which is continually undoing civilization" will come to an end. Peace is the essential condition to that equilibrium between inner faculties and outer requirements, between man and society, which will constitute the final stage of human evolution. By a faith in eternal principles as constant and exalted as that of the religious saint, Mr. Spencer sees beyond the reversion implied in present downward tendencies the vision of man finally triumphant over false theories and the delusions of ignorance, at last completely fulfilling the demands of his higher nature in the organization of a society which may well be likened to the kingdom of heaven foretold by the founder of Christianity. May we not hope that the treaty of arbitration between Great Britain and the United States will constitute an initial step in the direction of this better day?

GENERAL NOTICES.

We have received a couple of attractively got up books, one on *Angling* and one on *Hunting*,* which are apparently the first two of a new series, to be called the "Out-of-door Library." The books are made up of short papers by different writers, all of which have appeared in Scribner's Magazine. The stories are for the most part accounts of trips to special regions famed for some particular game. The first chapter in Angling is a discourse on fly fishing. The Land of the Winanische is the account of a fishing trip to Lake St. John and its surroundings, where, it seems, the winanische or ouinaniche is localized. Nepigon River fishing, striped and black sea bass, and tarpon fishing in Florida are accounts of similar excursions. A chapter on American game fishes, and finally one on Izaak Walton, which describes his home and fishing grounds in Dovedale, complete the volume on angling. Hunting contains eight chapters. The first one, entitled Hunting American Big Game, is an account of the game conditions in Wyoming some fifteen or twenty years ago. Camping and Hunting in the Shoshone gives a general description of the Rocky Mountain scenery in this district, and describes exciting incidents from a number of hunting trips which the

* The Out-of-door Library. Angling, pp. 305, $1.50. Hunting, pp. 327, $1.50. New York: Charles Scribner's Sons.

author, W. S. Rainsford, has made to this region. A few pages are next given to climbing for white goats. Sport in an Untouched American Wilderness describes the region east of the State of Maine, between the Atlantic Ocean on the south and the Gulf of St. Lawrence on the north. A Kangaroo Hunt recounts several hunting excursions in the Australian bush. The Last of the Buffalo is a brief historical sketch of this now almost extinct animal, winding up with the description of a Montana buffalo hunt of the days when this game was still plentiful. At St. Mary's and Hunting Musk Ox with the Dog-Ribs complete the volume. Both books are well illustrated, and, while not particularly scientific or instructive, some of the descriptions are interesting simply as stories, and all of them will hold the attention of the sportsman.

Prof. *L. H. Bailey* has made a collection of his addresses to horticultural societies and similar essays, all bearing upon the process of evolution as observed in domestic plants.* Having had the plan for such a collection in mind for some time, he has been treating from time to time subjects which would together make up a somewhat systematic whole. He has grouped his papers as essays touching the fact and philosophy of evolution, those expounding the fact and causes of variation, and those tracing the evolution of particular types of plants. The last of these divisions is the most popular and practical, and therefore the most interesting to the horticulturist who is not a biologist. In one of these he discusses the question, Whence came the cultivated strawberry? or rather, Whence came the pine, its ancestor? Of the three possible origins—a hybrid, a direct development of the Chilian strawberry, or a modified form of our big wild strawberry—his examination leads him to decide on the second. In a similar manner he discusses the development of American plums, grapes, and carnations; of the petunia and the garden tomato. Much interesting horticultural history is used as evidence in these discussions. The opening essays of the volume are addressed more especially to the biologist. "It is only in the first two essays," he says, "that I have ventured to state any general convictions respecting the bolder problems of organic evolution; but I count these of much less merit than the statements of many plain and simple facts of observation and experiment which are made in the humbler essays. If the author has been fortunate enough to make any contribution to positive science in these pages, it is probably that associated with the vexed question of bud variation, which is chiefly presented in the third essay; but even this is novel only in its treatment." The first two essays deal with the survival of the unlike and the transmission of acquired characters. Prof. Bailey holds that unlikenesses are the greatest facts in the organic creation; that they survive because they are unlike, and thereby enter fields of least competition. He believes that acquired characters useful to the species tend to be perpetuated, and the more surely the longer the transforming environments are present. Intermediate in character as in position between the former and latter groups of essays are those dealing with the fact and with the causes of variation. In one of these he combats the idea that improvement in the quality of fruits is always at the expense of some other desirable quality of the plant. In others he discusses the distribution of cultivated varieties with reference to climatal and geographical conditions, the longevity of varieties, the relation of seed-bearing to cultivation, and similar topics.

Problems in Elementary Physics, by *E. Dana Pierce*, is the title of a little volume intended to be used as an auxiliary to the ordinary text-book or laboratory manual on physics. It consists of a series of selected problems for illustrating and also for testing the student's knowledge of the general physical laws. The introductory sections review the portions of arithmetic most needed in physical computations. A good working knowledge of algebra and plane geometry is assumed. A separate chapter is given to simple applications of the graphic method. (Holt, 60 cents.)

A seventh and revised edition of Dr. *Newell Martin's* useful handbook of physiology, *The Human Body*, has come to hand. A considerable amount of new matter has

* The Survival of the Unlike. By L. H. Bailey. New York: The Macmillan Co. Pp. 515, 12mo. Price $2.

been added, especially in connection with the physiology of the cardiac and general vascular nerves and of the brain. As Dr. Martin says, "Physiology has not finished its course," and while this volume contains all the more important facts at present known about the working of our bodies, it also makes it plain that very much is yet to be discovered. (Holt, $2.20.)

The first and most needed reform in methods of instruction called for in the educational revival begun by Horace Mann was the substitution of something better for text-book memorizing. Objects were chosen instead of words, and "things before words" became the motto. *James Johonnot's Principles and Practice of Teaching*, in the International Education Series, of which a new edition lies before us, was a potent factor in bringing about the above reform. He advocated the new education as based on the methods of Pestalozzi. The work of revision for the present volume has been done by Sarah Evans Johonnot. In a few instances the phraseology has been modernized, and a brief sketch of the pioneer work in manual training has been added, to show Mr. Johonnot's influence and close connection with the earliest experiments in this country. (Appletons, $1.50.)

The thirty-fourth annual *Report of the Michigan State Board of Agriculture*, as do all these reports, contains a large amount of interesting information, which is, however, as is also usually the case, so presented as to be rather difficult of access. There are nine hundred pages, and the topics range from the "management of swamps" to "climbing cutworms" and "five-banded bees." The volume contains a portrait and sketch of T. T. Lyon, Superintendent of the Michigan Experiment Station.

The *Transactions of the American Climatological Association* for 1896 have just reached us. Among the papers of special interest may be mentioned: Some of the Difficulties of Climato-therapy, by J. B. Walker; A Plea for Moderation in our Statements regarding the Contagiousness of Pulmonary Consumption, by V. Y. Bowditch; The Climate of Arizona, by M. A. Rodgers; The Sanitarium or Closed Treatment in Phthisis, by E. O. Otis; and A Study of Highly Mineralized Thermal Waters in the Treatment of Disease, by H. H. Schroeder. The object of the association is thus stated in its constitution: "The study of climatology and hydrology, and of diseases of the respiratory and circulatory organs."

General Principles of Zoölogy, by *R. Hertwig* (translated by George W. Field), comprises the first or general part of the author's *Lehrbuch der Zoologie*. When the latter volume first appeared there was no intention of a separate publication of the general part; but it is now thought that a book simply covering the "larger generalizations of the subject" will be of service and within the reach of many who would not purchase the larger work. The contents are well described by the title; it is a manual of zoölogy; there are paragraph headings in larger type, and the general arrangement of the text is such as to facilitate its use as a text-book, if desired. (Holt, $1.60.)

The *Elements of Physics*, of Profs. *Edward L. Nichols* and *William S. Franklin* (Macmillan, $1.50), has been prepared with a view to producing a text-book which shall correspond with the increasing strength of the mathematical teaching in university classes. While some text-books assume that the student's mathematical knowledge does not reach to the calculus, and others presume so much upon the mathematical training that they are unreadable for nearly all undergraduates, this one is intended for those who possess an elementary knowledge of the calculus. It is planned to be used in connection with illustrated lectures. It meets all difficulties, simplifying them as much as possible, but not evading them. The first volume, on mechanics and heat, has already been published. The present volume, the second, concerns electricity and magnetism, and a third volume is to follow.

The second title of Mr. *William Mathews's Nugæ Litterariæ* (or Literary Trifles) —Brief Essays on Literary, Social, and other Themes—well describes the character of the book. It is a collection, without special arrangement, of paragraphs and short essays on all kinds of subjects—ever bright and pungent and consequently interesting, always containing at least one good thought, often witty and more frequently suggestive, and good to take up at any time of the day and to read steadily or in five to fifteen minute intervals. Six of the papers first appeared in the North American Review (Roberts Brothers, $1.50).

The second volume of *The Cambridge Natural History* (Macmillan, $3.50) contains a connected and comprehensive history of the flatworms and mesozoa, nemertines, threadworms and sagitta, rotifers, polychæt worms, earthworms and leeches, gephyrea and phoronis, and polyzoa. These various subdivisions are dealt with by special students and zoölogists. The chapters on polychæt worms, gephyrea and phoronis, and polyzoa are particularly acceptable as bringing together much information that has heretofore been locked up in special memoirs. In the chapter on rotifera, Prof. Hartog presents for the first time his views on the zoölogical affinities of the group. He says: "I have been induced to take a view of the structure of the rotifers that brings it into close relationship with the lower platyhelminthes and with the more primitive larva of the nemertines termed *pilidium*." He therefore changes the orientation of the rotifer, and places it, like the cuttlefish, mouth downward. For anterior and posterior he substitutes oral and apical; for dorsal and ventral he uses anterior and posterior. As in the volume on insecta, the name of the author of the first chapter only stands conspicuously on the cover. The volume and the whole series, in fact, is in a way so encyclopedic in its character that it seems as much out of place to have an author's name on the cover as it would be to see a single author's name on an encyclopædia. The volume is an indispensable adjunct to the library of a naturalist. The beautiful illustrations, the matter, well up to the latest researches on the subject, and the fact that specialists in each department have contributed to its material, bringing in their own original work, make the series unique and invaluable.

The United States Weather Bureau has issued a folio pamphlet on *Surface Currents of the Great Lakes*, deduced from the courses taken by floating bottles put into the waters of the lakes in 1892, 1893, and 1894. Of the five thousand bottles set afloat by the Bureau, six hundred and seventy two had been recovered up to the preparation of this report. The text is accompanied by a chart of each lake, showing the courses taken by the bottles each season, and the movements of the waters which these courses indicate.

The *Report of the Commissioner of Education for the Year 1893–'94* makes two volumes of the familiar form containing over a thousand pages each. The usual statistics are accompanied by a large number of essays on educational topics. The reports of the "Committee of Fifteen" on training of teachers, on correlation of studies, and on city school systems, which have aroused widespread interest, are here printed; Rev. A. D. Mayo contributes a history of public schools during the colonial and revolutionary periods. A digest of school laws in the several States and of sanitary laws affecting schools occupies about three hundred pages. Other features are A Preliminary List of American Learned and Educational Societies, giving the officers, objects, and publications of each, and Some Recent Educational Bibliographies. There was an increase of over four hundred thousand pupils in the public schools of the country during the year, against an average of less than three hundred thousand for the preceding ten years.

A useful contribution to the current discussion of the money question is afforded in No. 74 of the Old South Leaflets, *Hamilton's Report on the Coinage*. All the important phases of the currency problem are discussed calmly and thoroughly in this masterly report of the first Secretary of the Treasury, and it is highly instructive to see how an able financier, unaffected by any of the prejudices of the present day, looked at matters that are now in hot dispute. The report makes a pamphlet of thirty-two pages. (Directors of the Old South Work, Boston, 5 cents a copy, $3 a hundred.)

Describing his book, *The Perfect Whole* (Ellis, $1.50), in its preface, *Horatio W. Dresser* says: "Thus, broadly defined, the purpose of this book is threefold—psychological, metaphysical, and practical. As a psychological analysis, it is especially concerned with the higher or spiritual nature of man. As a philosophical discussion, it aims to develop a generally sound view of reality by a consideration of materialism, agnosticism, and mysticism in the light of their shortcomings when compared with the demands both of reason and the spiritual sense. It points out many important distinctions essential to a just view of life, and indicates the dangers of pantheism and of all one-sided conceptions of the universe. In its practical aspect it urges the same need of breadth and discrimination which it finds essential to a sound doctrine of reality. It is an urgent appeal to life, a plea for the realization of ethics and the application of spiritual law in every moment of existence." Mr. Dresser is also author of a book entitled The Power of Silence.

The fourth volume, completing the edition of *The Writings of Thomas Paine*, which *Moncure Daniel Conway* has collected and edited, is almost wholly devoted to Paine's religious writings. About half of it is occupied by The Age of Reason, to which we called attention when it was issued separately. This is followed by several essays arguing against the reality of divine inspiration in the Bible, and in support of a simple Deism and a pure morality. To appendixes are relegated a number of shorter writings—autobiographical, political, and technological—including a few pieces of verse and his will. In closing his labors on the history and the writings of Thomas Paine, whom he calls "the Great Commoner of mankind," Mr. Conway says: "Personally I place a very high value on Paine's writings in themselves, and not simply for their prophetic genius, their humane spirit, and their vigorous style. While his type of Deism is not to me satisfactory, his religious spirit at times attains sublime heights; and while his republican formulas are at times impaired by his eagerness to adapt them to existing conditions, I do not find any writer at all, not even the most modern, who has equally worked out a scheme for harmonizing the inevitable rule of the majority with individual freedom and rights." As to the historical value of Paine's political writings Mr. Conway adds, "He was literally the only man who came out with the whole truth, regardless of persons." (Putnams, $2.50 a volume.)

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Fragments of Science.

The Davy-Faraday Research Laboratory.—The Davy-Faraday Research Laboratory, established and equipped by Dr. Ludwig Mond, and presented by him to the British nation, was opened by the Prince of Wales, December 22d. From a review of the history of the idea of founding the institution, given by Dr. Mond in his presentation address, we learn that a movement was set on foot fifty years ago, under the auspices of Prince Albert, to establish an institute for the pursuit of pure chemistry, where practical and systematic instruction could be given to students, and a place provided where original research could be conducted by fully qualified investigators. At first it was proposed to attach this institute to the Royal Institution; but this plan had to be abandoned, on account of the inadequacy of the Royal Institution to provide accommodations for the scheme. The teaching part of the plan was, however, provided for a few years afterward by the foundation of the Royal College of Chemistry, which under the direction of Hofmann soon became one of the most successful institutions of that science in the world, while the provision of a place for original research still had to wait. Even before he knew of these facts, Dr. Mond had determined to found in London a laboratory of research in purely scientific chemistry and in physical chemistry—whence the greatest results in the knowledge of the real nature of things might be expected—and had become convinced that such a laboratory would derive the greatest advantage if it could be associated with the Royal Institution. He had therefore improved an opportunity that offered to procure a suitable property immediately adjoining the Royal Institution and prepare it, in co-operation with suitable advisers, for its special work. As it stood, he believed that it would compare favorably with any other laboratory in or out of England, in the completeness of its appliances, and was unique of its kind, being the only public laboratory in the world solely devoted to research in pure science. The laboratory contains: On the basement, rooms for thermochemical, for pyrochemical research, and for electrical work, a battery of twenty-six accumulators, constant temperature vaults, and boiler rooms and storerooms; on the ground floor, rooms for research in organic and in inorganic chemistry, a fireproof room for experiments in sealed tubes, a balance room, and entrance hall and cloak room; on the first floor, the honorary secretary's room, a large double library connected with the library of the Royal Institution; on the second floor, a museum of apparatus; on the third floor, seven rooms for research in physical chemistry; on the fourth floor, rooms for organic and for inorganic preparations, a photographic room, and four rooms for research in physical chemistry; and on the roof an asphalted flat, with table, gas, and water. All the floors are connected by a hydraulic passenger lift. Dr. Mond has further furnished the laboratory with an endowment of £100,000, or $500,000—£38,-000 sunk in the building and its equipment, and £62,000 for the endowment proper; and he has intrusted it to the Royal Institution, so as to insure its being open to men and women of all schools and of all views on scientific questions. Lord Rayleigh and Prof. Dewar have been appointed the present directors. The qualification for admittance to the privileges of the laboratory is to have already done original scientific work, or to be judged by the Laboratory Committee qualified to undertake original scientific research in pure or physical chemistry; but no person shall be excluded on account of nationality or sex. Admission to all the privileges is free, with responsibility for damage done.

Characteristics of Reformatory Prisoners.—The Twentieth Yearbook of the New York State Reformatory supplements the usual items of the formal report with some observations on the anthropometric characteristics of the inmates of the institution, which, while they are far from exhaustive, may cast considerable light upon the condition of the persons who find their way to such places. Exercise in the gymnasium was prescribed to the men of more marked physical defects, and general muscular increment in volume and power resulted from it. Comparing the five hundred and twenty-nine men of the reformatory with Amherst College students of nearly corresponding age, the reformatory man appears to be below the Amherst student's average ten pounds in weight, three inches and three tenths in height, fifty-six cubic inches in lung capacity, thirty pounds in strength of chest, thirty-two pounds in strength of back, and two dips in strength of arms, but reaches him in strength of legs. He is within one pound in weight and falls short an inch and seven tenths of the Wellesley College girl in height, and is only a little stronger than she in lung capacity and strength of chest, while he is superior in strength of back and legs. A large percentage of the heads are marked and scarred, as the result of street brawls and conflicts with the police, although the men's first explanation generally is a fall. Defects in the eyes are pretended in a large proportion of cases, but many of them are real. If near-sightedness, etc., are so much the result of civilization, school pressure, and close study as many physicians suppose, the class of men found in this institution should be practically exempt from it. "But the opposite are the exact conditions found." The physical make-up of the adolescent criminal appears to be reflected "as well in his visual organs as in other portions of his body, and the predisposition to eye trouble is inaugurated at both. The environment, personal habits, and mode of living only serve to act as exciting causes upon an already predisposed organism." Many of the prisoners in the reformatory are possessed of a defective inhibitory power or control, rendering it difficult and distasteful for them to apply themselves continuously to any one trade or calling. As boys, they are truants or shirks; and later on they constitute the class of men never able to retain a situation for any length of time. Others become thieves, to be able to indulge their propensities for dissipation. Within the last few years there has been a marked increase in the number of those committed whose nervous and mental condition is unsatisfactory.

The Grass Garden of the Department of Agriculture.—In the grass garden of the United States Department of Agriculture double beds, or plats, are arranged on each side of the greater length for the growth of native plants to be allowed to come into flower. Inside of these bands is a narrow range of plats in which are grown various fodder plants—clovers, vetches, lupines, etc.—which do not belong to the grass family. Extending lengthwise through the center is a series of larger beds in which are cultivated those grasses that are known or supposed to be good formers of turf. An opportunity is afforded by such an arrangement for the comparison of one kind of grass or forage plant with another, and for noting their relative merits for special purposes. In it may be grown, too, for the use and information of the botanist, the grasses of all countries, arranged according to their natural tribes and subdivisions. Opportunities for study and experiment may thus be given the botanist and the economist such as can be got in no other way. Native plants should always have a prominent position here, in order that we may become familiar with them, and because they may exhibit under cultivation qualities of usefulness which can not be detected in them in their native stations. Mr. F. Lawson Scribner, Agrostologist of the United States Department of Agriculture, says, in the Yearbook of that department, that "we have better grasses and a greater variety of them native to our soil than we can ever get from Europe, and it will not be necessary to grow them ten or twenty years or more in order that they may be acclimated. . . . There are sixty native species of clovers found in the United States; there are more than sixty kinds of blue grass—distinct botanical species; there are twenty or more good grazing grasses related to the buffalo grass; there are fourscore or more of native lupines and twoscore vetches which have yet to be tried in our agriculture; and then there are broom grasses, and meadow grasses, and pasture grasses, and hay grasses, almost numberless, suitable to every kind of soil and rock formation and climate. And of all this wealth of kinds, the natural heritage of our country, hardly more than a dozen have been brought into cultivation."

Oral Schools for the Deaf and Dumb.—The first oral schools for the deaf and dumb were established in 1867, when the sign system of instruction had been in full sway for fifty years, and they had to dispute for progress with a method which seemed firmly established. In 1868, 38 out of the 304 deaf pupils in the New England States, or a little more than 12 per cent of the whole number, were taught in oral schools. The Horace Mann School was established in Boston the next year, and since then the percentage has steadily increased till, toward the end of 1893, 351 out of a total of 524 pupils, or 67 per cent, were found exclusively in oral schools. Outside of the New England States, besides the special schools in which it is exclusively used, the oral method has been admitted into many of the other schools, and both systems are taught in them—a fact which is expressed by the words "combined system." Statistics of the use of the oral method in the whole United States show very clearly that the oral method is extending with great rapinity. Prof. A. Graham Bell, in the address from which we quote these facts, adduces as an argument for the excellence of the oral system that the little schools in which it is taught, springing up by private enterprise, are able to compete successfully with the State sign schools until the latter introduce the oral system and become "combined" schools, while the little schools still live. In Germany the oral method has encroached upon the sign method till that has given way to a combined system. At the International Convention of Teachers of the Deaf, held in Milan in 1880, all the delegates from continental Europe voted for the preference of the pure oral method, while all the votes cast against the resolution were those of an Englishman and three Americans. This decision has been accepted as final by all subsequent conventions. In 1881–'82, 81 per cent of the 280 schools for the deaf on the Continent of Europe were pure oral schools, 4 per cent were sign schools, and 15 per cent pursued a combined system. Prof. Bell traces the origin of his invention of the telephone to his observation of the ability of the pupils in the Horace Mann School to understand what was said to them by reading the movements of the lips. He was finally convinced of the fact, and was led to study the subject; then to devise machines and contrivances to help the children, the ultimate outcome of which was the telephone.

"Geological Myths."—As "geological myths," Prof. B. K. Emerson, in his chairman's address before the Geological Section of the American Association, characterized "the Chimæra, or the poetry of Petroleum; the Niobe, or the tragic side of calcareous tufa; Lot's wife, or the indirect religious effects of cliff erosion; and Noah's flood, or the possibilities of the cyclone and the earthquake wave working in harmony." Regarding a myth as meaning "a history, treasured and hallowed in the literary and religious archives of an ancient folk, of some startling or impressive event that, in the stimulating environment of poetry and personification, has completed a long evolution which disguises entirely its original," the author sought the origin of these stories in traits of the natural features with which they were associated. The Chimæra was described by the Greek poets as a monster having the tail of a dragon, the body of a goat, and the head of a lion, or the three heads of lion, goat, and serpent, vomiting fire and ravaging the mountains of Lycia. By comparing the references in various authors with the observations of Admiral Beaufort at the end of the last century, the examination of the spot by Spratt and Forbes in 1842, and the accounts of other modern travelers, the origin of the fable is traced to a mountain called the Yanar-dagh, formerly Chimæra (both names meaning burning mountain), from a crevice of which issues a stream of burning gas. The Greek word χαμαίρα means goat. Hence the origin of the basis of the myth, the goat's body, to which, it really vomiting flames, imagination added the heads and the tail. Niobe, who wept herself into a stone over the death of her twelve children slain and petrified, is, as the American scholar Van Lennep has shown, a prehistoric statue of a woman, cut in the rock of Mount Sipylus, in Lydia, over which the water trickles from the rocks above. Below the figure lie in the talus rocks fallen from the cliffs, out of which imagination may construct the children turned to stone. The name Niobe is associated in sound with Greek words signifying the pouring of water and the falling of snow. Lot's wife is representative of a common phenomenon of the salt ridge of Kushum Usdum, or Sodom, on the Dead Sea, where one pillar is formed out of the mass as its predecessor is eaten away. The story of the Flood may well stand as a graphic description of the combined action of a cyclone and an earthquake with tidal wave, affecting the region of the Persian Gulf.

The Circulation in Plants.—The discussion in the Botanical Section of the British Association on the circulation of water in plants was participated in by Francis Darwin, Prof. Marshall Ward, Prof. Fitzgerald, and Dr. Joly, of Dublin. Mr. Darwin considered the path of the ascending current in trees and the force that produces the ascent of the water. Attention was called to the necessity of a complete study of the minute structure of wood in relation to the modern theories. Prof. Vines referred to an account he had published of a number of experiments on the suction force of branches. He had been under the impression that the results obtained were independent of the action of atmospheric pressure—that they were solely indications of tensile stress exerted by the transpiring branch upon the water in the apparatus; but now he had reason to believe that they were, as a matter of fact, affected by the atmospheric pressure. Hence these results are not different in kind from those of other observers, but are compatible with them. The observations brought out the two important facts that a high suction force can be developed by branches which have been deprived of their leaves, and that this suction force is not dependent on the life of the branch. Prof. Vines then proceeded to give an account of subsequent observations made with dead hazel branches (pea sticks), which had been found to develop considerable suction force, amounting in one case to nineteen inches and a half of mercury with a stick eighteen inches long. He concluded by expressing the opinion that in recent attempts to explain the mechanism of the transpiration current, the part played by the "imbibition" of the cell walls had been underestimated, and urged that what is especially requisite for a further advance is a more complete investigation of the properties of a dead stick.

Chinese Cheap Money.—The Chinese, as all the world may know, have cheap money, their standard of value being a copper coin about the size of a quarter of a dollar, with a square hole in the middle by which it may be strung, which is commonly called cash—in Chinese, *tsien*. They are strung by hundreds, with a knot to mark each hundred, and when large sums are to be used, strings enough to make out the amount are hung upon the shoulders of the carrier. Mr. Carles, a traveler in Korea, relates that he had to hire a special pony on one of his excursions to carry his cash, and that at one time he met two ponies carrying twenty-four thousand cash, or thirty dollars, to pay the workmen at a certain mine. The Chinese money-tellers become very expert in counting these cash and detecting false ones, for even these copper pieces, representing as little value as money can be made to do, are falsified. Emblems manufactured out of iron or of sand and gluten are often put upon the strings in place of the real bronze coin; in fact, a certain number of these spurious pieces are nearly always found. They are detected and separated from the genuine by boiling the pile or string. The sand and gluten cash are dissolved, and the iron are exposed. The accountant weighs what is left; or, if the sum represents millions, he boils a few thousand and makes an average from the result which he applies to the whole.

The Smoke Nuisance.—A recent English inquiry into the smoke nuisance and the possibility of its abatement is noticed in Industries and Iron. The commission's report contains much interesting information, and sums up as follows: In presenting their report the committee express their conviction that in the great majority of cases the black smoke thrown into the air during the combustion of coal is preventable, either by hand or mechanical firing, and without great cost to the consumer. Often the prevention of smoke is accompanied with saving of expense, in that an increase of heat is developed by a more perfect combustion of the fuel; and where live fire bars are adopted—that is, where the bars have an automatic reciprocating motion — an inferior and cheaper quality of coal can be used, and thus a further saving of expense effected. The consumption of fuel was found to be lower in boilers fired by machine than in those fired by hand. In short, they say a manufacturing district may be free from manufacturing smoke—at least from the steam boilers, with which alone the committee have concerned themselves—and they give ample information as to the means by which it may be so freed. As the discharge of black smoke from factory chimneys was made a criminal offense in England by the Public Health Act of 1875, all that is necessary now to abate the nuisance is a call by public opinion for the application of the law.

The Earliest Animal Life.—The president of the Geological Section of the British Association, J. E. Marr, opened his presidential address, on stratigraphical geology, with a reference to the points in geological history of which we are ignorant. Specially prominent among these is that of the animal life of the earth during the vast length of time previous to the Cambrian period. The extraordinary complexity of the earliest known Cambrian fauna has long been a matter of surprise, and the recent discoveries in connection with the *Olenellus* fauna do not diminish the feeling. We may look forward with confidence to the discovery of many faunas older than those of which we now possess certain knowledge, but until these are discovered the paleontological record must be acknowledged to be in a remarkably incomplete condition. Valuable work has recently been done in proving the existence of important groups of stratified rocks deposited previously to the beds containing the earliest known Cambrian fossils. With our present views, however, we can hardly suppose that organisms acquired hard parts at a very early period of their existence, and fauna after fauna may have occupied the globe and disappeared, leaving no trace of their having lived. In such case we are not likely ever to obtain from fossils definite knowledge of the character of the earliest faunas; and the biologist must not look to the geologist for direct information concerning the dawn of life upon the earth. The importance of detailed work may be inferred from a consideration of the great increase of our knowledge of the Permo-Carboniferous faunas as the result of recent labors in remote regions. It is specially desirable that the ancient faunas and floras of tropical regions should be more fully made known, as a study of these will probably throw considerable light upon the influence of climate on the geographical distribution of organisms in past times.

A Lobster's Motions.—The adult lobster, as appears from Dr. F. H. Herrick's study in the Bulletin of the United States Fish Commission, lives and feeds exclusively upon the sea bottom, which it never leaves of its own accord in any considerable degree. In traveling over the bottom in search of its prey, the lobster walks nimbly upon the tips of its slender legs. The large claws are extended in front of the head, a position which offers the least resistance to the water, while the two hinder pairs of walking legs, which end in hard, spurlike joints, serve as picks to steady the movements of the animal. In thus getting about, it has the constant aid of the delicate swimmerets, attached vertically to the under surface of the "tail," each of which consists of a short stalk and two very flexible blades. By the movements of the swimmerets the lobster is impelled slowly forward without the aid of the walking legs. The branches of the swimming feet are garnished with long, chitinous *setæ* or hairs, to which the eggs of the female are attached. When taken out of the water the lobster can only crawl in its vain attempts to walk, owing to the heavy body and claws, which the slender walking legs are unable to sustain. In exploring its feeding grounds, where an enemy is likely to be encountered, the legs which carry the long claws are extended forward in front of the head or carried somewhat obliquely, their tips resting on the bottom, and the long, sensitive "feelers" are waved constantly back and forth to give warning of any foe or other objects which the eye may fail to detect. These are exclusively organs of touch. If the anticipated enemy makes his appearance, or if the animal is surprised, as when it is suddenly touched with the blade of an oar or cornered, it will immediately strike an attitude of defense. It now raises itself on the tips of its walking legs, lifts its powerful claws over the head after the manner of a boxer, and strikes with one of its claws at the offending object, trying to crush it or tear it to pieces. By far the most powerful organ of locomotion in the lobster is the tail, by the flexion of which it can scull itself through the water with astonishing rapidity. The lobster, though less active and keen-witted than the higher crabs, can not be regarded as a sluggish animal in any sense. In the water its movements are graceful; it is wary, resourceful, pugnacious, capable of defending itself against enemies which are often larger than itself, and, if the occasion requires it, of running about with the greatest agility and speed. When a lobster is surprised it seems to disappear with a single leap or bound, as a locust or grasshopper might do. It never, however, rises more than a few inches or at least a few feet above the bottom, and it is evident that swimming at the surface would be impossible, on account of the great weight of the body.

Jack Rabbits.—The jack rabbits, which occur almost everywhere in the Great Plains and desert regions of the United States, are so called—also "jackass hares" and "jacks," "narrow-gauge mules," and "small mules" —from the resemblance of their large ears to those of the jackass. They may be seen abroad, Dr. T. S. Palmer says in his account of them, at almost any hour of the day. Living as they do on the open plain, where they are compelled to rely for safety on quickness of hearing and on speed, their ears and hind legs are developed to an extraordinary degree. This gives them a somewhat grotesque appearance, but in reality few animals are more graceful than they as they bound along when once thoroughly alarmed. A closer acquaintance with their habits will reveal many points of interest, and will arouse admiration for the way in which they seem to overcome every adverse condition of life. Unlike the cotton-tails or the common rabbit of Europe, these hares do not live in burrows, but make "forms" under bushes or in patches of weeds, where they find protection from the weather and bring forth their young. Where there are no bushes they seek the protection of any object that can shield them from the sun—even the shadows of the telegraph poles along the railroads. Extremes of climate do not appear to affect them. They feed on the bark and leaves of shrubs and on herbage. They live on the grasses of the plains, the bark of willows, greasewood, cactus, shrubs which other animals seldom touch. Sometimes it is hard to see where they can get food enough; but lack of water and of green herbage serves only to reduce their numbers, and rarely causes their complete absence from any region. Among the greasewood on the alkali flat northwest of Great Salt Lake and on the cactus-covered deserts of Arizona the jack rabbits are almost as fat and sleek as when feeding in the alfalfa patches and vineyards of southern California. If necessary, they can travel long distances for food; but, as they seldom drink, scarcity of water causes them little inconvenience, and the juicy cactus pads or ordinary desert herbage furnish all the moisture necessary to slake their thirst. They are very destructive to gardens and orchards, and, as they multiply rapidly, they often become great pests, and would be in danger of overrunning the country if not kept down. Where new land is cultivated or irrigated they seem to swarm in from the surrounding country, and flourish where civilized conditions prevail. The damage done by them in Tulare County, California, in a single year has been estimated at six hundred thousand dollars, and a single county in Idaho has spent more than thirty thousand dollars in bounties on them. Fortunately, they can be used for coursing, for their skins, and for food. As they outrun all but the swiftest hounds, coursing for them is rare sport. The consumption of them for food amounts to about six hundred thousand a year, and is gradually increasing. Under the energetic measures that have been taken against them their numbers are gradually diminishing.

Women in Business.—A London trades paper has extracted from an official report on bankruptcy the fact that comparatively few failures occur among women engaged in business. This, says the Spectator, remarking upon the subject, we would expect to be told; "and in this case, at any rate, the statistics correspond with the general impression of the world, that women in business are more careful than men—less liable to run into excess and to ruin themselves by too adventurous a spirit." Another fact parallel with this, but which has not found its way into the statistical reports, may be accepted as generally if not universally true, that women in business do not accumulate large fortunes. It follows, from the same reason, that enterprises that bring great returns also almost necessarily involve great risks; and avoidance of the risk carries with it avoidance of the accompanying chance of making a fortune. "To put the matter in a nutshell, a woman conducts her business on the cardinal principle of making as few losses as possible; a man, on the cardinal principle of making as many profits as possible."

W. F. Ainsworth.—W. F. Ainsworth, who died in London, November 27th, in his ninetieth year, was a veteran in science, the recollection of whom may have passed from the minds of most of the present generation. He took a surgeon's degree at Edinburgh in 1827, and, having gone to the School of Mines in Paris, made a vacation walking tour in the Pyrenees and volcanic districts of Auvergne. He afterward started and conducted the Edinburgh Journal of Natural and Geographical Science; walked to London in a geological study of the country, and became a member of the Royal Geographical Society. In 1831 he made a study of the cholera, was appointed surgeon to a cholera hospital in London, and was sent, when the disease broke out in Ireland, to the affected towns and districts. Results of these experiences and attendant adventures were many papers published on cholera, and a monograph, in 1834, on the Caves of Ballybunnion, which is described as "a remarkable production in respect of its date and the subsequent development of geology." In 1833 he was appointed surgeon and geologist to the Euphrates Expedition under Chesney; and, after returning from this was placed in charge of another expedition, sent out by the Royal Geographical and the Propagation of Christian Knowledge Societies, to the Christians in Chaldea. Two books made known the scientific and other observations he made in these expeditions, to be followed, in 1844, by a geographical and descriptive account of the expedition of Cyrus and the retreat of the Ten Thousand with which Xenophon made the world acquainted. He returned to England in 1841; conducted the Syro-Egyptian Society; labored for the adoption of the route to India *via* the Euphrates and Tigris Valleys; was founder and honorary treasurer of the West London Hospital; and published new geographical books. A bibliography of his contributions to knowledge, the Athenæum says, "would itself fill a volume." He was a corresponding member of the Geographical Society of Paris, the German Oriental Society, and the Moldavian Natural History Society.

MINOR PARAGRAPHS.

General Francis A. Walker, President of the Massachusetts Institute of Technology, died very suddenly of apoplexy, January 5th. He was a man of great versatility, filled many important public positions, and contributed much to knowledge through the results of his economical studies. He was born in 1840; was graduated from Amherst College in 1860; adopted the profession of law; went into the war and rose to be a brigadier-general; after the war began to teach; did editorial work on the Springfield Republican; was appointed chief of the National Bureau of Statistics in 1869. As superintendent of the ninth and tenth censuses he made great improvements in methods. From 1873 to 1881 he was Professor of Political Economy and History in the Sheffield Scientific School, while he also lectured at Johns Hopkins and Harvard Universities. In 1881 he became President of the Massachusetts Institute of Technology. He was also chief of the Bureau of Awards at the Centennial Exhibition; a United States Commissioner to the International Monetary Conference at Paris in 1878; President of the American Statistical Association in 1882; and President of the American Economic Association in 1886. He was author of a large number of books and papers, chiefly on economical subjects, which are much consulted.

The Tsimpshian Indians, living around Port Simpson, British Columbia, were described by Prof. B. Adler in the British Association as being the most intelligent, progressive, and best-built natives he had seen in any country. Of the various customs of these and the other tribes of the region, the author described the potlatch as a solemn ceremony whereby on a chieftain's death his successor, who curiously is the late chief's eldest sister's eldest son, is invested with the chieftaincy in the presence of the whole tribe, taking the late chief's flute as a sacred symbol of office. The Indians were represented as having a marvelous adaptability to song, eloquent speaking, and building. The Tsimpshians were the most wonderful linguists the author had ever met, and their facility for acquiring other languages than their own was almost an instinct. Their own language is very complete, well inflected, and aided by auxiliaries.

The Royal Society medals for 1896 were distributed as follows: The Copley medal to Carl Gegenbauer, Professor of Anatomy in Heidelberg, in recognition of his pre-eminence in the science of comparative anatomy or animal morphology; the Royal medals, one to Sir Archibald Geikie as the most distinguished British geologist, the other to Prof. C. V. Boys, who has given to physical research a method of measuring minute forces far exceeding in exactness any hitherto used; the Rumford medal to Prof. Philipp Leonard and Prof. W. C. Röntgen; the Davy medal to Prof. Henri Moissan; and the Darwin medal to Prof. Giovanni Battista Grassi.

The first indications of gold in Nova Scotia were observed, according to Sir James Grant's paper in the British Association, in

1860, and new discoveries were made in 1862, giving additional stimulus to the industry. In 1865, by the utilization of appliances for removing gold from low grades of ore, the mines became extremely lucrative. The average yield per ton for thirty-three years was thirteen dollars, and it was estimated in 1895 that Nova Scotia had produced gold to the value of $11,500,000. In the province of Quebec, gold was first discovered in 1847. Prof. Hardman made an examination in that province in 1895, when, after running a tunnel six hundred feet long, he struck the bed of an old river, and in three weeks removed enough gold to pay the entire expense of his operations. There was, consequently, feverish excitement in the province.

NOTES.

Mr. W. Baxter, Jr., writing in Cassier's Magazine, gives the total amount of capital invested in electric lighting in the United States as $500,000,000, and the number of plants, public and private, as more than 10,000. About 500,000 motors are in use, and they are valued at $100,000,000. The electrical apparatus used in mining is estimated to be worth $100,000,000. The value of the electric elevator industry is supposed to be about $15,000,000. The electric railways are believed to represent a capital of more than $700,000,000, and the aggregate of capital invested in electric railways and lighting, exclusive of the value of the establishments that manufacture the machinery and apparatus, is about $1,500,000,000.

A new railway between the Russian Asiatic towns of Nertchinsk and Vladivostock, crossing Manchuria to unite the two branches of the Trans-Siberian Railway, is to be constructed with French capital and by French engineers, under the control and with the guarantee of the Russian Government—to be, nevertheless, a Chinese line, administered by Chinese.

A Swiss society of popular traditions has been formed at Zurich for the collection of anthropological and ethnological notes relative to the several cantons, documents on the manners, dwellings, costumes, festivals, working tools, musical instruments, industrial arts, family celebrations, religious solemnities, weather lore, popular literature, games, names of places and persons, and other items in folklore. A special review will be published, to embody the results of the inquiries made under the society's auspices.

Mr. H. Harries has shown, in the Royal Meteorological Society, that hail and thunderstorms are not, as has been supposed, extremely rare in the arctic regions. He has examined one hundred logs of vessels which have visited those quarters, and seventy-five of them gave records of hail having been encountered at some time or other. Thunderstorms were not so frequently mentioned as hail, but they were observed in seven months out of the twelve, most frequently in August.

Leo Brenner, of the Manora Observatory, Istria, has acknowledged a gift of $1,650 from Miss Catherine W. Bruce, of New York, for the use of the observatory and additions to its equipment. Herr Brenner is engaged in the study of Mars, and reports the discovery of several interesting features, including twenty new canals, "very broad, and consequently probably double," and a new "oasis" or "lake."

An American locomotive works is in course of erection at Nijni Novgorod, Russia, to have capacity for turning out one hundred and fifty locomotives a year, and employ about one thousand men.

Proof regarded by him as abundantly satisfactory has been collected by Mr. N. T. Bonner, of Cincinnati, from study of Pompeiian boilers, that the principle of the water-tube boiler was fully understood and appreciated by the people of Pompeii two thousand years ago. The Pompeiian boilers, being used principally for heating water and wine, the shells and covers were only such as would offer a slight resistance to the escape of the steam.

Formalin, a solution of formic aldehyde, has been recommended to the London Entomological Society as a preventive of mold. An object once sprayed with it never becomes moldy afterward. It is much used in the color industry, and is therefore produced on a large scale.

Besides the common early belief in spirits of the forest, sea, and mountain usually needing propitiation, Mr. Henry Ling Roth finds among the natives of Sarawak and British North Borneo a conception of a well-disposed beneficent *Petara*. A system of omens exists for the regulation of life, and with it is combined a sort of worship of the birds with whose movements the omens are associated. The medicine men or medicine women pretend to extract disease in the form of bits of stick or stones, and rags are hung on bushes by the roadside to turn away or carry off disease. Cairns are built up by passers-by, each adding a stone, and *tabu* prevails, as in the Pacific Islands.

Messrs. Petermann and Graftian, of the Belgian Academy of Sciences, find that hoarfrost is peculiarly rich in nitrogenous compounds, and therefore plays an important part in increasing nitrogenous matter in the forest and in purifying the air.

STEPHEN J. PERRY.

APPLETONS' POPULAR SCIENCE MONTHLY.

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HOW CAN THE FEDERAL GOVERNMENT BEST RAISE ITS REVENUES?

By DAVID A. WELLS,
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THE President of the United States, in one of his recent speeches, was reported as saying: "*I can imagine nothing more important than a revenue system that will provide money enough to run the Government. We have not had enough money to run this Government for the past three years, under a false system of political economy. So the question is, How shall we raise that money? Do you want to raise it by direct taxation, by taxing the property and lands or the incomes and wages of the people?* [*Cries of* '*No.*'] *Well, then, the other way to raise it is by taxing the products that come here from Europe in competition with American products.*"

Assuming the above authoritative utterance as in the nature of a text from which deductions are both warranted and desirable for the purpose of popular instruction, the following points ought to commend themselves at the outset to the American people for consideration: *First.* Notwithstanding the great and urgent necessity of currency reform, the need of providing a speedy, certain, adequate, and proper revenue for the Federal Government is of immediate importance. *Second.* No nation exists, or ever has existed, which has such great resources and facilities for obtaining an ample and certain revenue with so little of friction and annoyance to its people and with such a minimum of expense. The amount of our national debt is not alarming, and ought not to be a source of anxiety. As a matter of fact, the United States, notwithstanding its present fiscal disturbance, is in a better financial condition than any of the other great nations of the world, with the exception of Great Britain and Germany. The United States, Great Britain, and Germany are the only governments that within the last twenty years have notably reduced their national debts; all the other nations have notably increased their indebtedness—France, Russia, and Italy taking the greatest relative lead. In every instance the recent increase in the indebtedness of nations is mainly referable to prospective war expenditure, a contingency from which the United States ought to be entirely exempt; for it is as certain as anything in the future can be, that the United States will never enter into war with any foreign country unless unnecessarily provoked. But this is not the opinion of military men, who as a rule rarely look beyond their profession, and of others who desire war with anybody and on any account by reason of prospective personal agrandizement, or increased opportunities for money gain that war would bring to them, conjointly with increased fiscal burdens upon the masses of the people. From March, 1885, the beginning of Mr. Cleveland's first administration, to March, 1889, the public debt was reduced $341,448,449.20, while Mr. Harrison's administration paid off $236,527,666.10. Circumstances, however, for which the second administration of Mr. Cleveland was not responsible, namely, the advocacy of the so-called "silver policy," which impaired national credit, and a Federal Congress which authorized great and unnecessary expenditures, have caused an increase in the bonded or interest-bearing public debt during the three years from 1894 to 1897 of $262,000,000. But this, in view of the resources of the nation, is not a matter for national disquietude; more especially when it is remembered that the uncovered demand (non-redeemable) debt of the nation was at the same time greatly lessened by the accumulation of redeemable instrumentalities in the national Treasury.

Third. Notwithstanding such favoring fiscal conditions, the Federal Government is now and has been for some time past in default of sufficient revenue to defray its current expenditures. For the fiscal year 1890, with an average rate of taxation of $4.74 *per capita*, its revenues were $105,344,000 in excess of expenditures. In 1895, with an increase in population over 1890 of about 8,000,000 and an average *per capita* rate of taxation of $6.21, the receipts of national revenue fell short of defraying national expenditures to the extent of $42,805,000.

Fourth. Taxes levied for protection—i. e., for the purpose of reducing imports or narrowing the basis on which customs taxes are levied—can not be rightfully regarded as taxes for revenue. No one will deny that to get revenue from customs we must have imports of dutiable goods. And yet, while admitting this as a general principle, the majority of the men who appear before the "Ways and Means" Committee of Congress generally ask for *prohibitory* duties on the importation of articles that compete with their own products. To the extent that protection is made absolute, to just that extent the customs revenue will be destroyed.* Taxes levied on the importation of commodities that the country does not produce accrue entirely to the benefit of the national Treasury. Taxes levied on the importation of commodities which compete with domestic products are paid by the people, but benefit the Treasury to a very limited extent or not at all. For example, when in 1869 a tax of five cents per pound was imposed on the import of crude or unmanufactured copper, the customs revenue that accrued to the Government in one year (1879) was only five cents; but the taxes levied on the American people through the increase in the price of domestic copper, and effected mainly through the agency of a gigantic monopoly, aggregated millions during the same period.

One almost insuperable obstacle in the way of formulating and instituting a correct system of revenue which pertains to the Federal Government of the United States, does not find a parallel in the administration of the government of any other country in which its people are allowed to participate. As a rule, in such other countries political antagonisms, however bitter they may be on the part of legislators, do not embrace or extend to the business of raising the revenues which are considered essential for the support of the state, although no system of revenue has ever been devised, or probably ever can be, that will not to a greater or less degree be made the subject of popular complaint. In this connection the methods adopted as the result of long experience by the British Parliament for raising revenue and authorizing expenditure in anticipation of the necessities of each succeeding year, are most pertinent, and substantially as follows:

The British fiscal year commences on the 1st of April. In the course of the preceding six months the estimates of expenditures for the ensuing year are prepared with great detail by the heads of the different departments of the Government and submitted to the Chancellor of the Exchequer, who corresponds to the United

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* "Mr. Lawrence, of Ohio, who for years has been most earnest in advocating prohibitory duties on wool, when recently confronted with the fact that his policy would lead to the loss of revenue, said: 'Why should you want any?' When the laugh that followed had subsided, he explained that he meant why should we want any revenue from wool, adding that there were many other commodities from which revenue could be derived. He did not stop to consider that the producers of those other articles wanted duties that would shut out foreign competition as badly as he desired it in his own interest. Moreover, his was a particularly flagrant case, as he represented a commodity of which the country produces only about half as much as we consume."

States Secretary of the Treasury. This official, who is always a member of Parliament, after giving the subject careful study and deliberation, communicates the result to the full Cabinet; and then, with its concurrence, which is regarded as an assumption of responsibility on the part of the existing Government, makes what is called a "Budget" speech in the House of Commons, giving his estimates of the prospective receipts of revenue for the ensuing year, and proposing such changes both in respect to revenue and expenditure as the Government may think advisable. The House of Commons next, and at an early day, resolving itself into a Committee of the Whole under the name of "The Ways and Means," discusses generally the proposed estimates and changes, and at a subsequent period, resolving itself into what is called "The Committee of Supply," decides what services shall be undertaken. In this committee the Secretary of State for War and the First Lord of the Admiralty generally move the adoption of the estimates for the army and navy which the Government has submitted, and preface their motions with a statement of the general condition of their respective departments. The conclusions arrived at in committee, are next reported to the House of Commons, and embodied in a bill known as the "Inland Revenue and Customs Bill;" which, after passing both Houses of Parliament and receiving the "royal assent," becomes the act regulating the collection of revenues for the ensuing fiscal year. Most of the British taxes are levied under the authority of permanent acts. Some, however, as the duty on tea and the income tax, are only granted for limited periods. Certain expenditures, also, are sanctioned by legislation once and for all, and are not revoted every year; such as the interest on the public debt, the "dotation" of the Crown, the salaries of the judges, ambassadors, and other high officials, pensions, and compensations to which the public faith has been pledged. Should any unforeseen demands for large expenditures arise subsequent to the passage of the general revenue bill, supplementary estimates are presented to Parliament by the ministry. This, however, only happens when the deficiency is large. When the deficiency is small—as, for example, if the war office finds it necessary to incur certain expenditures in its branch of the service not provided for in the general estimates and bill—it must apply to the Treasury, stating the circumstances, for leave to meet the expenditures by drawing on any surplus that may accrue in other departments of the Government, with the exception that the navy appropriation can not be applied to meet army expenditures, and *vice versa*. Such permissions, if granted, are only temporary. They are reported to Parliament at the earliest opportunity, and a vote sanctioning its proceedings is asked by the Treasury. When any tax or duty is changed by act of Parliament, the Treasury authorizes the Inland Revenue and Customs officials to levy the modified rates in a manner that seems to them most expedient.

Any surplus of income over expenditure for any year is devoted to the diminution of the public debt, but so carefully and with such system is the business of collecting and of its expending revenue conducted by the British Government, that except under very unusual conditions, the two accounts, separately aggregating at present about $450,000,000 per annum, balance each other with almost marvelous closeness. Thus, for the fiscal year 1893–'94, a period of great fiscal disturbance and trade depression, the revenue collected and expended was within one half of one per cent, in a total of $450,000,000, of the budget estimate, while the amount of revenue paid out to meet expenditures was about one quarter of one per cent less than the estimates; the whole constituting a most striking testimonial, first, of the solidity of the British financial system, and, secondly, of the great sagacity and experience of the able permanent officials on whom the financial administration of the greatest empire and government of the world mainly depends.

Recognizing also that a rigorous supervision of the governmental estimates and warrant for expenditures by the House of Commons is not possible under the circumstances of parliamentary life, an audit department of the civil service has been created, whose business it is to examine the accounts and vouchers of the expenditures in every branch of the public service; and in addition to this, the House of Commons at every session appoints a public accounts committee of its members, consisting of experienced business men, whose duty is to supervise the work of the audit department. Under such a system extravagance, not to speak of peculations, in respect to the public funds is impossible; and general recognition of this fact goes far to explain why the House, irrespective of any political differences of its members, readily grants the sums of money asked by the existing ministry.

There is another feature of the parliamentary government of Great Britain which is well worthy of serious attention on the part of the American public and its representative law makers; and that is, that by a standing order of the House of Commons no member of the House, unless he is charged with the administration of a department, and therefore with the duty of framing the fiscal estimates of such department, can, however eminent, influential, and capable he may be, on his own authority propose in Parliament to grant any sum of public money, however small, to any object, however deserving. The theory of this is, that the Government, which is the ministry in power, is entirely responsible for all public expenditures involving taxation during the term that it is in office; and that to permit private members or political opponents to propose expenditure of the public moneys would not only transfer responsibility from those who ought to bear it, but would lead to great financial disorder and vast and inexpedient expenditures. The great mass of the civil servants of the British Government are also strictly excluded from seats in Parliament, and until recently were debarred from voting for members; the reason for such provisions being that those who have personal interest in taxation because they have improvable property or incomes from taxes, ought to have no voice, direct or indirect, in the imposition of taxes, on the same principle that judges are considered disqualified for trying cases in which they may have or are presumed to have any personal interest. On the other hand, in the Federal Congress, where lavish and unexpected grants of public money are constantly made on motions of members not connected with any finance committee, and acting avowedly in behalf of private or local, rather than public, interests; and where the authorization of expenditures is divided among a number of committees so that no group of men is responsible for the aggregate appropriations; it is obviously not within the power of the executive department of the Government to present and adhere to any previously well-considered scheme of annual taxation and expenditure, or what in most other countries is known as an annual budget.

The following record of recent experiences, which probably could not happen in the legislature of any other civilized country, strikingly illustrates the senseless and costly way in which the fiscal policy of the United States is not infrequently determined. During a comparatively recent fiscal debate in the United States Senate, a Senator advocated certain proposed appropriations of the public money, which were opposed on the ground that they were in the nature of extravagances, by saying that they could not be grievous to the people, "since they would not amount to more than *three* cents per day *per capita*." But three cents per day would amount to nearly eleven dollars per head per annum, or over fifty-five dollars for every family of five persons, and there are millions of men and millions of families in the United States whose income is not a dollar a day. Again, how many of the American people are aware that a bill proposing to grant pensions to seventy thousand ex-slaves, on the ground that they were chiefly instrumental in developing the wealth of the country, is reported to be now pending in the United States Senate? Such a bill, if once passed, would establish the principle of pensions for civil service, and by swelling the existing pension list to an inordinate amount would almost justify the assumption, that the main object of a government by the people is the payment of pensions rather than the protection of life and property.

The Prospective Revenue Requirements of the Federal Government.—The aggregate revenues of the Government for the fiscal year 1897–'98 are estimated, on the basis of existing laws, by the Secretary of the Treasury (Report on the State of the Finances, 1896) at $421,227,000; and the estimates of appropriations, exclusive of sinking fund, required for the same period, are $466,946,000; leaving a prospective national deficit of revenue for the next fiscal year of $45,719,000. The total appropriations of the two sessions of the past (fifty-fourth) Congress aggregate $1,043,437,019. Under such circumstances a provision for an annual revenue of more than $500,000,000 is therefore most expedient, and the question at issue of first importance is, How can this sum be raised with the greatest certainty, regularity, and minimum cost to the Government, and with the least inconvenience and friction on the part of the people who will have to provide it? For the Government never has any money—by which alone the expenses of the state can be defrayed—except what the people—citizens or subjects—give or concede to it by voluntary or involuntary action; while the people, as a whole and in turn, never have any to give except what comes to them as a result of their work, or from an exchange of the products of their work. And such being the case, we are confronted with a homely truth, generally overlooked by writers and legislators on taxation, that what the Government really wants of its people, when it calls upon them for taxes, is work, and that the methods of taxation are only methods for collecting and using the products of work. Furthermore, it ought also to be borne in mind that for every dollar the Government at present expends, the average American citizen must work for at least half a day, or furnish a value equivalent for such an amount of work.*

Another matter of almost equal importance for consideration in this connection is the desirability of initiating an adequate revenue system for the national Government, the elements of which shall be rendered in a high degree permanent, by exemption from influences contingent on changes in the political administration, and on temporary commercial and industrial conditions of the country. In fact, it would be difficult to name an influence more certain to be conducive to national prosperity than the realization of such an agency.

* "Taxation means work, of the head, or the hand, or of the machine, or all combined. And the method of taxation is only a method of distributing the products of work. It is measured, when in the process of distribution, in terms of money, but the money itself stands for work, or is derived from work."—*The Industrial Progress of the Nation, Edward Atkinson; G. P. Putnam & Sons, New York, 1890.*

To obtain a clear understanding of these subjects, the most rational, and indeed the only correct way, is to take up and submit to analysis the most available sources of national revenue, commencing with those that are beyond question the most important. But, preliminary to so doing, attention should be given to the fact that in all civilized nations at the present time the production and consumption of spirits, fermented liquors, and tobacco are recognized as the most legitimate and productive sources from which revenue can be obtained with the minimum of expenes and industrial disturbance. The factors determinative of the productiveness and continued increase of revenue from these sources are mainly two—namely, continued increase of population and continued or increasing ability on the part of the masses to consume. These factors are more influential at the present time in the United States than in any other nation. We are increasing in population in a greater annual ratio than any other country. Our ability to consume, owing to the rapid accumulation and distribution of wealth among the masses, is far greater than that of any other nation. Commercial disturbances and business depressions, which are potent in all other countries in reducing the consumption of luxuries, appear to have comparatively little effect in the United States, and are not of long continuance.

Thus, of the commodities in general use in the United States, the two that have not notably declined in consumption during the almost universal depression of industry in recent years are fermented liquors and manufactured tobacco, more especially in the form of cigarettes.

The single source from which the largest amount of revenue is collected by the Federal Government is distilled spirits, and the experience of the United States in respect to it, although exceedingly curious and interesting, has been but little instructive to either the people or their legislators. From the first imposition of taxes on this commodity under the present revenue system in 1862, unwarranted sentiment, rather than intelligence and regard for the fiscal interest, of the nation, have characterized its treatment. There has been, in the *first* instance, a comparatively small number of people—132,871 voting for prohibition in 1895 out of an aggregate of 13,790,572 other voters—who take the position that it is the moral duty of the state to absolutely prevent the manufacture, sale, or use of all alcoholic liquors; a result not possible of attainment except through a radical change in human nature. The results of experience under this head may be briefly summed up as follows: In small communities, where there is a general union of sentiment in favor of extreme temperance, a high degree of prohibition may be temporarily brought about. But, on the other hand, the evidence of the only reliable data available, namely, the tabulated returns of the Internal Revenue Department, which takes cognizance of every gallon of distilled spirits—other than illicit products—manufactured and sold for consumption in the United States, indisputably show, that for the whole country the efforts of the extreme temperance advocates have never exerted any general influence in restraining their manufacture and use; and that, eliminating the temporary influence of hard times and business depressions, the average annual increase in the production and inferential consumption of such spirits, is at a rate equal to or in excess of the average annual increase of population. Thus, during the decade from 1880 to 1889 the aggregate increase in the population of the country and its consumption of tax-paid spirits was nearly concurrent; but from 1888 to 1893 the increase in the production and *per capita* consumption of spirits was in a ratio much greater than any concurrent increase of population; the whole culminating for the fiscal year 1893 in a tax-paid product of 99,145,000 gallons, and an average *per capita* consumption of 1·48 gallons, as compared with a *per capita* of 1·25 in 1889.

Secondly. We have a general sentiment among both people and legislators, that distilled spirits and alcoholic preparations generally are commodities that can advantageously be made subject to any degree of taxation. If under a given rate the revenue increases, an increase in the rate is held to be desirable; if the revenue falls off, the decrease is attributed to decreased consumption, whereby any loss of revenue is correspondingly compensated by moral advantages. But there is in the enactment of any and every tax a certain rate which, if exceeded, invariably impairs the maximum possible revenue obtainable from it; and any government that disregards what may be termed the line of wise expediency in fixing such rates, invariably cheats itself and promotes popular immorality. One would think that the experience of the United States had been sufficiently instructive in this matter. But such is not the case. The class of people whom the proverb says "go to the school of experience" have all been there and have paid "high tuition"; they have also exemplified the remainder of the proverb as expressed by Franklin, to wit, that the number of scholars that learn anything in such school "is small, for it is true that we may give advice but can not give conduct." Under such circumstances the following brief notice of some of the lessons that have been taught in this school may be profitable. Thus during the fiscal year 1868, with a tax of two dollars per proof gallon on distilled spirits, the Internal Revenue Bureau in full operation and an annual consumption of the country of at least 60,000,000 gollons, the Government was only able to collect a tax on less than 7,000,000 gallons, leaving to the credit of corruption from the sale of the balance of concurrent annual product, at market rates, of from $80,000,000 to $100,000,000. But with a reduction of the tax to fifty cents per proof gallon the annual revenue, including all taxes on the process of manufacture and sales, increased the first year to $45,000,000, and the second to $55,-606,000.

By the Act of August 28, 1894, the rate of tax on distilled spirits, which had been in force for fifteen years and was working satisfactorily, was prospectively advanced from ninety cents to a dollar and ten cents per proof gallon. Note the result. For the first six months of 1894 the average monthly revenue which accrued from the lesser tax was about $8,000,000. Then the prospective profits from the increase of the tax were anticipated to such an extent by speculators, that the revenue increased during the month of July and for the first twenty-seven days of August to $19,064,000 and $21,470,000 respectively, representing an aggregate gift to the speculative interest of about $24,000,000. The increased rate of tax having become operative, the revenue for the month of September declined to the comparatively small sum of $510,696. Stated generally, the total receipts from the *direct* tax of ninety cents per proof gallon during the fiscal year 1893 was $89,231,000; for 1894, with increased rate for part of the year, it was $79,862,000; for 1895, $74,741,000; for 1896, $75,327,897. That a considerable part of this recent decline has been due to a contemporaneous depression of the business of the country is beyond question; but what is to be inferred from the following official statement as to the manner in which the decreased production of spirits in the United States distributed itself during the year 1895: *decrease* in the production of alcohol, neutral or cologne spirits, 16,065,000 gallons; increase in the production of Bourbon whisky, rye and miscellaneous liquors, 6,924,773 gallons? These figures do not include illicit production, which is certainly very considerable; and one effect of the increase of tax in stimulating this business may be inferred from the fact that the number of illicit stills seized and destroyed increased from 1,016 in 1894 to 1,874 in 1895.

Another point of interest in connection with the increase of the rate of taxation on distilled spirits in 1894, and to a certain extent contingent on such increase, is, that the business of manufacturing whisky has been so stimulated, with a resulting overproduction, that the average market price of this commodity, exclusive of taxes, has been reported as below the cost of manufacture, and in accordance with this view of the situation nearly all the large distillers of the country have united in suspending operations.

Under a former rate of duty of ten per cent on the importation of diamonds, $100,000 on duties representing a value of $1,000,000 was reported as collected at the single port of New York. With an increase of duty to twenty-five per cent, little or no revenue is derived from that source.

The best and most reliable data for estimating the maximum revenue resulting from the taxation of distilled spirits is to be found in the experience of the Internal Revenue Department for the fiscal years from 1887 to 1893 inclusive. During these years, under a uniform and stable rate of taxation, a good and efficient administration of the law, and a fairly prosperous condition of the country, the average increase in revenue was nearly $5,000,000 ($4,910,000) per annum; the whole culminating in the fiscal year 1893 in a revenue of $89,231,000. In a report made by the writer to the Secretary of the Treasury in July, 1893, the sequel of any increase in the then existing rate of tax (ninety cents), which was at that time to some extent advocated, was foreshadowed in the following language: "It will favor a recurrence of the disgraceful and disastrous results that characterized the period of experimental taxation in the years immediately succeeding the termination of the war. Certain it is also that an anticipation of participation in an increase of the tax would lead to such a production of spirits as to postpone for one or two years any increase in revenue to the Government." It is needless to say that every prediction thus made has been fully verified, and, encouraged by such success, the following anticipations may be warranted: If our legislators in Congress assembled, agreeing to limit all consideration of the subject to the one point of revenue, will reduce the present rate of tax per proof gallon of distilled spirits from $1.10 (about 825 per cent) to the former rate of ninety cents (690 per cent), with no exemptions, and the industry of the country again become fairly prosperous, the average *per capita* consumption of 1892 and 1893 may be fairly taken as the basis of future estimates from the greatest and most reliable single source of national revenue. Or, in other words, an annual revenue, under such conditions, approximating one hundred millions may be anticipated in 1899, with a certain regular increase contingent on a normal increase in population of from three to four millions additional per annum.

THE ALCOHOL EXEMPTION PROPOSITION.—A brief notice of a proposition to essentially impair the revenue from distilled spirits by exempting alcohol used in comparatively few manufacturing industries and in the preparation of "medicinal and other like compounds" from taxation is here pertinent. The history of this movement constitutes an extraordinary feature in American fiscal experience, and in brief is as follows: When "an act to reduce taxation, to provide revenue for the Government, and for other purposes" (passed August 28, 1894) was under consideration by the United States Senate, and pending a proposition to increase the revenue by increasing a tax of about 680 per cent on the average prime cost of distilled spirits to a rate of nearly 825 per cent, a Senator, apparently utterly oblivious that the subject involved had years before been thoroughly considered by the United States Treasury Department and declared to be impracticable, submitted a motion permitting the use of alcohol in the arts, or in medicinal or other like compounds, without the payment of any internal revenue tax. The motion in question, after a very brief consideration, was accepted and incorporated in the laws of the United States. The result was that the Secretary of the Treasury reported that in default of any appropriation to defray the expenses of administering the act, and an unsuccessful attempt to frame regulations which would protect the Government, the Treasury Department was constrained to abandon the effort and await further action by Congress. It was also estimated that the expense to the Government of attempting to administer the act would probably be not less than one million dollars per annum; that the loss of revenue contingent on its enforcement would be about ten million dollars yearly, and that the loss of revenue from an increased opportunity for illicit and fraudulent practice would also be very considerable.

Under such circumstances Congress, in 1895, repealed the act of exemption, but subsequently a strenuous effort has been made to re-enact it. The main argument adduced in its favor is that the present cost of alcohol would be largely reduced, whereby certain industries which use it as a raw material would be greatly benefited. That such a result would be in accordance with a general economic principle can not be disputed, and, such being the case, the question is pertinent. Why limit the exemption to the one material, alcohol? Why not equally grant exemption to manufacturers who use wool, coal, the various ores and metals, crude tobacco and the like, as raw materials?

As already pointed out, the taxation of distilled spirits constitutes the largest single source of national revenue, and as such, its consideration by legislators, more especially in view of the present fiscal necessities of the Government, ought to be strictly limited to the one point of ascertaining its greatest availability for revenue. The existing tax of 800 per cent on proof spirits and more than 1,200 per cent on its derivative, alcohol, constitutes a temptation to evade payments which human nature as ordinarily constituted can not withstand. Illicit distillation is admitted to be on the increase in the country, and American ingenuity has been active in facilitating it. It is now proposed to further increase temptation by offering an approximate profit of two dollars for every gallon of alcohol that can evade taxation. The annual loss of revenue consequent upon the proposed exemption of alcohol will not be less than $10,000,000 and probably more, all of which, under present revenue necessities, will have to be made good by an equivalent increase of taxation on other commodities.

The circumstance that some of the countries of Europe, especially Great Britain, allow alcohol mixed exclusively with naphtha (methyl), and in very large stipulated quantities, to be exempt from taxation, but the use of which, from the nauseous smell and taste thereby imparted, is exceedingly limited, has no bearing on the situation in the United States. In Europe the process of methylation is conducted under the close supervision of revenue officials, as it must be in the United States. In the former countries the number of grain distilleries, with bonded warehouses attached, where the process must be mainly conducted, is comparatively small. In the United States it is comparatively large; the number operated in the single State of North Carolina in 1895 being largely in excess of the number in the whole of Great Britain. If, in addition to the number of inspectors and gaugers required at the distilleries for an honest administration of the exemption, the number of druggists who use alcohol in medicinal preparations (which has been officially estimated as at least 32,000) and manufacturers of patent medicines are taken into account, the problem confronting the administration of the Internal Revenue Department of the Government might be well characterized as "appalling." In short, if the exact truth in respect to this proposed modification of the taxes on distilled spirits were known, it would probably appear that the people most interested in securing this exemption are the patent-medicine manufacturers, who see a great extension of their business in manufacturing cheap intoxicants without the compulsory use of methyl, under the name of medicinal preparations, and selling them by the bottle from the apothecary's shelf, rather than from the bars of hotels and restaurants. And this assumption finds much of confirmation in the circumstance that in respect to the applications filed in the Treasury for rebates, or damages for the non-execution of the exemption law, which are very considerable, estimated at from $10,000,000 to $19,000,000, the Internal Revenue reports that a large proportion of the claimants are manufacturers of patent medicines, and also to some extent the manufacturers of "mince pies" and candy. Recent investigations instituted and reported by the Massachusetts State Board of Health also show that many of the most noted patent medicines, especially the so-called "blood purifiers," "nerve tonics," and other remedies of like character, contain very large percentages of alcohol by volume—not infrequently from seventeen to twenty-six per cent—which probably accounts in a high degree for their great popularity, and for the wonderful curative results contingent on their use. Country druggists also report a special demand and consumption of these medicinal preparations in towns that have voted "no license," and in which a sentiment in favor of total abstinence predominates.*

Again, if the legislative department of the state decides that it would be expedient to establish or stimulate the manufacture of certain commodities, no one under a free Government would venture openly to justify such action, except on the ground that public welfare would be thereby promoted. Suppose, with this purpose in view, it is decided to stimulate the manufacturers of a comparatively few articles by exempting them from certain forms of taxation, would it not be expedient, and the part of a wise fiscal policy, that the state, by proper rules and investigation, should ascertain the rightful amount that would accrue to each claimant from such exemption, and then raise the money to pay it in the same manner as it raises money to defray its other expenses, and not allow private interests to exercise the great sovereign power of taxation by practically determining what the state shall levy and what the people in general shall pay?

Fermented Liquors.—The internal revenue tax on fermented liquors (beer) has been practically uniform since its first authorization in 1863, nominally one dollar per barrel of thirty-one gallons. As, however, a deduction of seven and a half per cent is allowed to brewers on the purchase of stamps, which is assumed to represent the difference between the theoretical barrel unit of thirty-one gallons and the quantity contained in the commercial or trade supply barrel, which, owing to redriving of hoops and re-pitching, averages from twenty-eight to twenty-eight and a half gallons, the net tax is, accordingly, ninety-two and a half cents, which is made payable in stamps, one of which, "denoting the amount of the tax, shall be affixed upon the spigot hole or tap (of which there shall be but one) in such a way that the stamp shall be destroyed upon the withdrawal of the liquor from the barrel or other receptacle." There is also a special tax, in the nature of a license on brewers, which yielded the Government—in 1896, $163,779—relatively a small matter. A tax of one dollar per thirty-one gallons is equivalent to 3·225 cents per gallon. On a basis of $5.25 per barrel, the price at which beer of good quality could recently be bought in quantity, or at wholesale, in the city of New York or vicinity, the present tax is about twenty per cent

* For more specific information on this subject, reference is made to an official bulletin of the State Board of Health of Massachusetts for March 14, 1896.

ad valorem. One barrel of thirty-one gallons equals 248 pints or 496 half pints. The present tax on this basis is, therefore, one fifth of a cent per half pint, or per glass as usually sold in saloons for five cents; or two fifths of a cent per pint.

In recent years some of the large industrial establishments of the country have made a practice of furnishing their employees with beer of a good quality at a price but little in excess of the cost of production. In such cases the beer is sold by weight, a pint being regarded as equal to a pound, and a pound as equal to two glasses such as are usually sold in the saloons. From twenty-six to thirty tickets, each representing one pound of beer, are usually sold for one dollar, which makes the average cost to the local consumers of from one and two thirds to one and three fourths cents for a full glass or half pound of beer, and which charge is represented by those competent to express an opinion as sufficient to cover the wholesale price and entire cost of distribution—labor, ice, rent, and light—and leave a fair profit.

The points of interest worthy of special attention in connection with this subject are as follows:

1. The regular and great increase in the quantity of fermented liquors annually made subject to internal revenue taxation—i. e., from 62,205,375 gallons in 1863 to 1,110,609,000 in 1896; an increase in popular consumption very far in excess of the rate of increase in the population of the country—i. e., from 1·86 gallon per head in 1863 to about sixteen gallons in 1896, the latter representing an average consumption of about 100,000 barrels daily.

2. The concurrent regular increase in revenue from this source has been from $1,558,000 in 1863 to $33,784,255 in 1896.

3. As large and costly plants are essential for the manufacture of fermented liquors on a large scale and at the lowest cost, illicit production is thereby rendered difficult, if not impossible; and whatever of fraud upon the revenue exists in this business is undoubtedly due to the non-use or non-cancellation of the stamps which represent prepayment as a condition of sale and consumption.

4. The variations in the product of fermented liquors which the Government has been able to annually subject to taxation since 1863 have been inconsiderable and in remarkable contrast to those occurring in the case of distilled spirits. The average increase in the receipts of internal revenue from this source for the ten years from 1883 to 1892 was about $1,617,000 per annum; the *per capita* consumption during the same period increasing from 10·25 gallons to 15·05 gallons. Comparing 1894 with 1893, there was a remarkable decrease in revenue in the former year of $1,134,195. Comparing 1895 with 1894, there was a recuperation in receipts to the extent of $225,829; which augmentation in 1896—

a year of continued great depression in the industry of the country—rose to the large figure of $2,143,617. That this latter ratio of annual increase under the present rate of tax is likely to indefinitely continue is almost demonstrated by the fact that the popularity of fermented or "malt" liquors as beverages among the American people is unquestionably increasing; and also that large, seemingly, as is their present average *per capita* consumption—namely, sixteen gallons—the present *per capita* consumption of the people of several other nationalities is much greater—that of the United Kingdom being estimated at thirty gallons; of England and Wales, thirty-six; of Belgium, thirty-two; of the whole of the German Empire, thirty-three; of Bavaria, sixty-two.

An important fact pertinent to the prospective consumption of beer and its permanent value as a source of national revenue is, that the cost of the materials used in its manufacture has decreased in comparatively recent years, in the United States, Great Britain, and probably in other countries characterized by its large consumption, to the extent of at least forty per cent;* and the advantage from this change which has accrued to British brewers was stated by the British Chancellor of the Exchequer, in May, 1895, to have been upward of £2,000,000 ($10,000,000) per annum.

From this decline in prices, and consequent reduction in the cost of production, the consumer has not been permitted to gain any advantage, the retail price of beer remaining substantially what it was.

All the resulting gains have been intercepted by those connected with the trade, and how well they have fared, some statistics recently given by the British Chancellor of the Exchequer, and which are probably equally applicable to the United States, sufficiently show. "In 1884-'85," he said, "the number of assessments to income tax from brewers was 2,446, and the whole of their profits assessed amounted to £6,316,000. Ten years later the number of brewers assessed for income tax was 2,274—show-

* In the United States the decrease in this branch of prices has been much greater, as shown by the following table of comparative prices in 1877 and 1897:

	1877.	1897.	Decrease, per cent.
	Cents.	Cents.	
Sugar (brown) ....lb.	9·5	2·81	70·4
Rice, Carolina........................lb.	6·5	4·0	38·5
Hops (import price)...................lb.	51·5	22·0	57·2
Barley (import price) ....bush.	76·2	37·8	50·4
Oats..................................bush.	44·0	21·0	52·2
Maize.................................bush.	60·0	28·5	52·5
Molasses (prime) ....gal.	54·0	24·0	55·5

ing that the smaller brewers were being more and more absorbed by the great concerns—while the amount of assessed profits was £10,177,000, showing an increase of sixty per cent in the profits of the brewing trade during those ten years."

If it is desirable at the present time for the Federal Government to increase its annual revenue by additional taxation, it is certain that such a result can not be attained more certainly and with so little of expense, effort, or industrial friction, as by a moderate increase of the tax on fermented liquors. The existing tax (twenty per cent ad valorem) is lower than upon almost any other industrial product entering largely into domestic consumption—spirits paying, for example, eight hundred and forty per cent; tobacco, one hundred and nine; wool, manufactured, fifty-six; iron and steel, forty-eight; breadstuffs, twenty-five; glass, fifty-two, and the like. The business of brewing malt liquors is acknowledged to be one of the most successful of domestic industries, and financial participation in it has in recent years been so attractive to foreign capitalists that it is generally believed that the ownership of a large proportion of the brewing business in the United States has passed into their hands. It is also reasonably certain that in the distribution of industrial products for consumption there is no branch of business that returns a larger profit on the labor and capital employed than the retailing of malt liquors; a small retail store often supporting a large family, besides paying high Federal and State licenses. The data already submitted, which are believed to be reliable, show that beer can be retailed at a profit for one and three quarter cents per glass of a half pint, on which the present tax is one fifth of a cent, yielding a present revenue of about $34,000,000 ($33,784,000) per annum. An increase of the present rate of tax—i. e., from one dollar to two dollars per barrel of thirty-one gallons, or from one fifth to two fifths of a cent to a half-pint glass—might be reasonably expected to at once yield at least $30,000,000 additional per annum, bringing up the present annual revenue from this source to $64,000,000, with a prospective annual increase of $3,000,000; and this without increasing the cost of his beer to the individual consumer or materially diminishing the profits of the brewer or the wholesale or retail dealer.

It remains to briefly notice the reasons that have been popularly urged against any increase in the taxation of fermented liquors. It is said that the brewers already pay a fair share of the expenses of the Government, and "to make them pay more looks like a discrimination against a particular industry." But as the case now stands, the discrimination in respect to taxation is not adverse to the brewing interest but greatly in its favor; and the proposed increase in rate would impose a smaller burden, as has been above shown, than is borne by many other domestic industrial products. Again, it is said that "beer is the poor man's bread," and therefore it ought not to be taxed. But if beer is exempted from making a fair contribution to the revenue necessities of the state, the deficiency will be made good by increased taxes on other commodities of general popular consumption, the ultimate incidence of which, if indirect, as they are likely to be, will fall heaviest on the consumer who, by reason of his poverty, is forced to buy in small quantities. The most potent source of opposition, however, to an increased tax on beer is undoubtedly to be found in the popular assumption that "no political party will commit itself to an additional tax of a dollar a barrel on beer, because it is feared that it would involve the loss of too many votes. It somehow happens that beer has a great many friends, and, whether correctly or not, it is apprehended that doubling the tax on it would be resented by a large number of voters." And if partisan politics is to become the essential feature of the revenue system of every popular form of government, as the experience of the United States and of France seems to indicate it will be, nothing further need be said on this subject.

Tobacco.—The present consumption of tobacco in all its forms by the people of the United States will probably average about four pounds per head per annum. The aggregate quantity which the Internal Revenue took cognizance of for taxation in 1896 was 266,215,736 pounds, a gain of 18,136,846 pounds over the aggregate for 1894. The number of cigars and cheroots subjected to taxation preliminary to consumption in 1896, was over four billions (4,237,755,943), an increase over the number assessed in the preceding fiscal year of 73,983,503. As a basis for estimating the revenue prospectively available from this source, the comparative *per capita* consumption of tobacco in other countries is especially worthy of attention in this connection. For the United Kingdom the amount for 1891, officially reported, was 1·61 pound; France (estimated), $1\frac{4}{5}$ pound; for the population of the city of Paris, $3\frac{1}{2}$ pounds; Germany, $4\frac{1}{2}$ pounds; Belgium and Holland, $3\frac{1}{2}$ pounds. The annual consumption of tobacco in the United States is therefore certainly much greater than in most other countries, and is equaled in not more than one or two. This result may be referred to several agencies: to the greater cheapness of the taxed commodity; to greater ability on the part of the masses to consume it, and to a larger use of tobacco for chewing,* the quantity manufactured for this purpose in 1895 being

* In France the sales of tobacco in 1885 were returned at 700,000 kilogrammes for "chewing" and at 15,400,000 for smoking.

returned at 181,494,000 pounds, as compared with 83,346,000 manufactured for smoking.

From 1863 (when the tax was first imposed on this commodity) to 1869 the variations in the annual internal revenue receipts from tobacco (always in the way of increase) were very great and, as it were, spasmodic, and were due mainly to frequent changes in the rate of tax on the different forms of tobacco. During this same period occurred one of the most remarkable illustrations to be found in fiscal history of the influence of a tax reduction in increasing the consumption of a comparatively cheap commodity in general use. Thus, in 1866, with a uniform tax of ten dollars per thousand on cigars, only 347,443,894 were returned by manufacturers for taxation, while in 1869, under a uniform tax of five dollars per thousand, 991,335,934 were returned, or nearly three times the quantity.

From 1870 to 1882 the ratio of annual increase in the taxed product of domestic tobacco was greater on the average than the corresponding ratio of increase in the population of the country; and in the latter year the annual internal revenue collected from this source attained the large and unprecedented aggregate of $47,391,989.

In 1883 the rates of tax on all forms of domestic tobacco and the special taxes on dealers and manufacturers of the same were reduced fully fifty per cent. This reduction of tax caused an immediate reduction of revenue, comparing the receipts of 1882 with those of 1884, the first full year of reduced rates, to the extent of $21,329,589. In 1886 the tax on cigars was further reduced fifty per cent, and in 1890 the taxes on snuff, chewing and smoking tobacco, twenty-five per cent. At this latter date all special taxes relating to tobacco—i. e., licenses to manufacturers, dealers, etc.—were also entirely repealed. The annual reduction in revenue in consequence of these last abatements, comparing the receipts for 1890 with those for 1892, was near $3,000,000, notwithstanding an increase in population during the same period of 2,897,750. The internal revenue from tobacco for the fiscal year 1896 was $30,-711,629, an increase of $1,006,721 over the receipts for 1895, and a decrease of $3,277,372 as compared with the receipts of 1890. Had the taxes on tobacco existing in 1882 been allowed to remain unchanged, the annual revenue from this source (the increase of population being taken into account) for the fiscal year 1897 would probably have approximated $70,000,000.

The United States internal revenue taxes on tobacco are smaller than those imposed by any other country that seeks to make this commodity a leading source of revenue. In the year 1895 they amounted to about forty cents *per capita*. The duties collected on imports of tobacco for 1895 were $14,916,000, and the total customs and internal revenue yielded by tobacco during the fiscal year 1895 was about $44,000,000, or sixty-eight cents *per capita.*

In the United Kingdom the taxes on tobacco, mainly on imports and through the customs, are about $1.30 *per capita,* and yield an annual revenue of about $50,000,000.

In France the taxes on tobacco are reported at $1.71 *per capita,* yielding an annual revenue of about $65,000,000. In other European countries the *per capita* taxes on tobacco are reported as follows: Austria, $1.31; Germany, $1.30; Italy, 94 cents; Hungary, 79 cents.

Were the same ratio of taxation on tobacco as exists to-day in the United Kingdom established in the United States, the annual revenue accruing to the Federal Treasury at the present time would be in excess of $90,000,000. If the rates existing in France were adopted, the annual revenue from this source would be $126,000,000.

Whatever may have been the considerations that prompted in recent years the abatement of this important source of national revenue in the United States, it is certain that they were not based on any sound financial policy, or on any lesson of past experience in respect to the best methods of raising revenue. Taxes on tobacco are taxes on a typical luxury. Their payment is not obligatory, as are the taxes on the essentials of living, on any citizen, but are in the nature of a voluntary assessment on the part of the consumer, on whom the entire burden of the tax ultimately rests, and which payments may be properly regarded as representing his surplus income. They are not obstructive to the development of any other industrial product, and there is no evidence that the highest rate ever assessed under the internal revenue has ever been productive of general discontent on the part of the masses of the American people.

The popular argument that a low rate of tax should be imposed on tobacco, because the burden of it falls mainly and disproportionately upon the poorer classes, has no foundation in fact. If the exact facts could be known, it would probably be found that by far the greater portion of the tax is paid by the well-to-do part of the community, who consume the high grades of tobacco. Again, the revenues of the Federal Government are almost exclusively derived from taxes on commodities which are paid by their consumers; and when any deficiency of needed revenue is occasioned by the reduction or entire abatement of the taxes on any one commodity or class of commodities, the deficiency must be made good by new or increased taxes on other commodities, the consumption of which is often more essential to the poorer classes than the article exempted. Thus, for example, the consumer of any class can better afford to pay taxes on his tobacco—in the form of chewing, snuff, smoking, cigars, and cheroots—than he can on foods, fabrics, and the raw materials of his industry. Another point generally overlooked in this discussion, is that when a tax which is direct, as is the tax on tobacco and spirits, is shifted to a supplementary tax which is indirect, the consumer may feel certain that his burden of tax will be augmented very considerably, often to the extent of twenty-five and even fifty per cent, by payment of profits to merchants and other middle men.

STAMPS AS SOURCES OF REVENUE.—The instrumentality of stamps as a means of obtaining revenue, although attended with less friction and expense than almost any other methods, and which was advantageously incorporated in the war system of taxation, can hardly be said to have had a place in recent years in the internal revenue system of the Federal Government; the stamps used in connection with the taxation of distilled spirits, fermented liquors, and tobacco—which are peculiar to the United States and not in use for like purposes in any other country—being rather in the nature of instrumentalities for facilitating the collection of taxes than independent sources of revenue. In fact, the only strictly revenue-producing stamp tax now existing is the tax of two cents per pack on playing-cards, the receipts from which declined from $382,402 in 1895 (the first year of its imposition) to $259,853 in 1896—a result that certainly warrants the modified application of an old proverb that, "under a free government, the rulers may propose taxes, but the people will dispose of them."

Under the fiscal system of the British Government (United Kingdom) the revenue which accrued in 1893–'94 from stamps was £12,799,000 ($62,244,000). The sources from which this aggregate of stamp revenue was obtained are numerous and of a character that are not in the main applicable to the fiscal system and Government of the United States, and for the most part are classified as follows: Probate duties; legacy duties; duties on estates, real and personal; succession duties; capital duties on companies; receipts; records; patent medicines; marine insurances, etc.* In fact, it is said that you can do nothing of any consequence in Great Britain without a stamp of some kind.

A system of taxation through the instrumentality of stamps can, however, be devised and made a permanent feature of the

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* Under the British system foreign bonds, whether issued by a state, a municipal body, a corporation, or a company, are chargeable with stamp duty if made or issued in the United Kingdom; or if offered for subscription and given or delivered to a subscriber in the United Kingdom, though originally issued abroad; or if assigned, transferred, or in any manner negotiated in the United Kingdom, provided the interest is payable in that country.

internal revenue of the United States, which, in respect to facility, economy of administration,* and productiveness of revenues, ought to have much to commend itself. A system formulated by discarding, if thought expedient, all stamp taxes on drafts, checks, promissory notes, receipts, releases, matches, etc., as vexatious rather than valuable, and making their fixation and cancellation obligatory on every deed, mortgage, or certificate of stock at the time of their transfer of ownership, by sale or otherwise, at the rate of fifty cents per every thousand dollars of their face value, and every fractional part thereof, would be highly productive of revenue and have much otherwise to recommend it. A man that sells or transfers a farm or mortgage, or a certificate of stock, for $10,000, would not think a stamp of five dollars very burdensome. In its applicability to the purchase and sale of real estate it would have the characteristics of a land tax, the incidence of which, although always and necessarily equitable, proportionate, and free from anything like discrimination, would be the lightest on lands uncultivated or devoted to agriculture, and heaviest on lands at the great centers of population and trade, for the purchase of which its surface must be, as it were, always covered with gold.† It probably would not be agreeable to speculators in stocks, to the creators of fictitious "trusts," or to the directors of swindling railroad, mine, and other like organizations, who, if not benefited in respect of their profits, might be to some extent as to their morals. Such a tax, moreover, would be as readily and economically collected as that of the postage stamp, and, like the latter, would have to be paid for before using. How much revenue would annually accrue to the national Treasury from such a system of taxation through stamps is not easy to estimate, but undoubtedly it would be very considerable. In the way of information helping to form an opinion on this subject the listing of stocks and bonds on the New York Stock Exchange during the year 1896, exclusively to replace old securities, is reported as amounting to nearly $1,175,000,000. During the recent years of business depression an average yearly sale of 56,000,000 shares of stock in New York city is reported; but during what are re-

* The cost to the Government in 1868 of revenue stamps for checks, drafts, receipts, and other like instruments, was twelve and a half cents per thousand. The cost of collecting the entire receipts of the internal revenue in 1894 was 2·70 per cent.

† "A million dollars and half a million more were recently paid for five lots on Broadway, New York, opposite Bowling Green. This was the value of the land alone, as the old buildings it bore were at once to be torn down. A year or two ago the corner of Liberty Street and Nassau, measuring seventy-nine feet along the one and one hundred and twelve along the other, and about one hundred feet in depth, brought $1,250,000, and this, again, for the sake of the land alone."—*Places in New York*, *Mrs. Van Rensselaer*, *Century Magazine*.

garded as prosperous times the yearly aggregate of sales not infrequently exceeds 100,000,000 shares.

PETROLEUM AND ITS DERIVATIVES.—Another source of revenue readily and largely available to the Federal Government, which since 1868 has almost entirely escaped attention, is petroleum and its derivatives. The present annual production of these commodities is probably about 54,000,000 barrels, and of this product the present annual domestic consumption is estimated at 28,000,000 barrels of forty-two gallons each, or 1,176,000,000 gallons. Of the balance of product, in either a crude or refined state, 931,785,000 gallons were exported in 1896, and therefore exempt from taxation. A tax of two cents per gallon, or eighty-four cents per barrel, on domestic consumption, which could be as readily collected through the agency of stamps as the taxes on distilled spirits, fermented liquors, and tobacco, might yield an approximate annual revenue of $24,000,000. An interesting circumstance in this connection, and one strikingly illustrative of the remarkable change in the industrial and fiscal relations of this product in the last thirty years, is to be found in the fact that when refined petroleum was previously taxed by the Government the rate was fifteen cents per gallon in 1866 and ten cents in 1867; the amount brought to charge during the latter year being 24,999,000 gallons, as compared with over 1,000,000,000 gallons accessible at the present time.

Inasmuch as the Federal revenue, customs and internal, is derived on principle almost entirely from the taxation of commodities of common and popular consumption, especially from distilled spirits, fermented liquors, tobacco, and sugar, there is no good reason why, if a present additional and prospective increase of revenue is needed, a commodity properly belonging to the natural resources of the country, and which has proved a source of immense wealth to those concerned in its distribution, should not also contribute to the expenses of its Government, more especially when fully one half of the domestic product, by reason of its being exported, would not be subject to any form of taxation. That a tax of two cents per gallon would probably be entirely transferred by an additional price to the consumer is almost certain; and yet that there would be no necessity for such action would seem to be proved by the circumstance, that in recent years the market price of refined petroleum for considerable periods has varied more than the proposed rate of tax without any recognized restriction of supply on the part of the trust that controls its product.

TEA AND COFFEE AS SOURCES OF NATIONAL REVENUES.—The policy of making the consumption of tea and coffee sources of national revenue through customs taxation on the imports of these commodities has much to recommend it. The present annual consumption of tea in the United States is about 94,000,000 pounds, and of coffee about 600,000,000 pounds; the importation of these two commodities in 1895 having been, however, considerably greater—namely, of tea, 97,168,866 pounds, and of coffee, 655,-564,000 pounds. A levy of three cents a pound on tea and three cents a pound on coffee would yield a present annual revenue in excess of $20,000,000, and represent an *ad-valorem* rate of about twenty per cent on both commodities—rates that would probably not interfere with their popular consumption in the least degree. If sugar, a commodity of more indispensible popular use, is regarded as not overburdened by a tax of forty per cent *ad valorem*, tea and coffee could easily stand a like duty. This would make the tax on each article six cents a pound, with an accruing revenue at the present rate of consumption of more than $40,000,000 per annum. Under the revenue system existing in 1870, coffee was taxed five cents a pound and tea twenty five cents, and the aggregate revenue from both commodities was $22,881,000. The arguments in opposition to imposing a duty on imports of tea and coffee are, mainly, two: First, that it is inexpedient to antagonize a free breakfast table; second, that customs taxes ought not to be imposed on the imports of commodities not produced in the United States.

Now the popular phrase "a free breakfast table" is a mere sentimental expression, and in relation to fiscal matters an absurdity, even if its authorship be attributed to as high authority as Mr. Gladstone. A free breakfast table, in the sense of the complete exemption of all its constituents from taxation, is utterly impossible in a civilized country where taxation is essential to the support of a government; and the only place where an approximate result could be attained would be some tropical isle where a native obtains his breakfast by pulling a banana from a tree, extracting a yam from the ground, or catching something which the sea supplies gratuitously. Think of the nature of a statute which, in order to meet the requirements of a free breakfast table in the United States, would exempt from taxation everything generally used in connection therewith—china, crockery, earthenware, glass, hardware, fish, flesh, cereals, fruits, and vegetables—and make the same subject to taxation to meet the requirements for revenue when otherwise utilized. The *second* antagonizing argument is equally unwarranted and absurd. Customs taxes on the importation of articles not produced in this country are the only taxes on imports in respect to which the people can have an assurance that, apart from the small cost of assessing and collecting, the Government will certainly receive all that they pay; and any man who argues to the contrary does not know what he is talking about, or has the idea that taxes on imports should be levied, not merely for revenue and the support of the state, but also in furtherance of some individual interests.

SUGAR.—Next in importance to the domestic consumption of distilled spirits as an easily available source of national revenue is the consumption of imported sugars. In the twenty-four years from 1867 to 1890, when imported sugars paid duties, the lowest sum received in any one year was $31,000,000 (in 1872), and the highest $58,000,000 (in 1887). After 1885 to 1890 inclusive at least $50,000,000 annually could be counted upon from this one item of imports, and the duty, estimated on an *ad-valorem* basis, varied from sixty-two to seventy-eight per cent, according to the fluctuations in the price of sugar. Such a long average degree of taxation made but little change in the consumption of the country, distributed itself very evenly over the whole population, and averaged less than seventy cents *per capita* of a population ranging from fifty to sixty millions. After April, 1891, duties on sugars were abolished, except half a cent a pound on sugar above No. 16 (continued with a view of protecting the refining interests of the United States), on confectionery, and small discriminating duties on sugars coming from countries which are believed to pay a bounty on exported sugars. The results of this extraordinary policy, which has been not inaptly characterized as one of the most disgraceful pieces of fiscal legislation ever perpetrated in a free country, was that the duty on imported sugars, which amounted to over $50,000,000 in 1891, ran down to $176,795 in 1892, and $163,956 in 1894. The Government, moreover, with a practical repeal of all duties on raw sugars, began the disbursement of money for bounties on domestic sugar, which amounted in round numbers since 1892 to about $35,000,000. Increased importations brought up the revenue from sugar to $15,599,342 in 1895, and $29,897,000 in 1896, the latter representing an import of 3,666,-842,395 pounds, which, if subjected to a duty of one cent per pound, would have yielded a revenue of $36,666,000.

With the absolute necessity for increased revenue to meet increased expenditures, there is no good reason why the duties on the import of sugars should not be so adjusted as to insure a permanent annual revenue of at least $50,000,000, which amount, with a consuming population smaller by at least ten millions, was exceeded in 1885. During the month of January, 1897, the import price of sugar was two cents per pound for cane and one and nine tenths for beet. If on this basis of import prices the average rate of duty under the present tariff—namely, forty per cent—were levied, only four fifths of a cent a pound duty would be collected.

A question of importance which next presents itself, and about which there is a great difference of opinion, is, the form in which the duty on the imports of sugar shall be assessed—*specific* or *ad valorem?* To help to the formation of a correct opinion on this subject, attention is asked to the following exhibit of the nature and practical workings of these two forms of taxation. The *ad valorem* system, proportions duties to the worth of the goods at the place of shipment at so much per cent of their market value. Its chief merit is its justice and equity. It adjusts itself automatically to differences of valuation or of commercial qualities, so that the tax collected from the consumer varies in proportion to his ability to pay—at least so far as this may be determined by his ability to buy goods of greater or less cost.

The chief demerit commonly ascribed to it is the temptation which it is said to offer to fraudulent undervaluation. Since the duty to be paid depends upon the foreign value, if this can be made to appear less than it really is, some part of the tax is evaded, and the cost of the goods to the importer diminished. The difficulty of evading a customs revenue under a good and intelligent administration through undervaluation is illustrated by the circumstance that, in order to secure a saving of as much as six per cent on the landed cost of goods, the dishonest importer in the case of a forty-per-cent duty would have to swear an undervaluation of more than twenty per cent. On the other hand, the great advantage of a simple specific duty is the care and certainty with which it may be applied. If, for instance, the duty upon a class of textile fabrics should be fixed at forty cents a pound, including all accessories involved in packing, the weight of the contents of a case would show, by simple multiplication, the exact amount of duty to be paid. No expensive process of examination need be entered upon. Disputes can hardly arise, and false swearing is out of the question. Such duties have been found most useful when imposed upon simple articles not produced in widely varying grades of greatly differing commercial values.

The injustice and inexpediency of specific duties are, that they bear so much less heavily upon the high-priced than upon the low-priced qualities of goods, that the poorer classes of the community are taxed at a much higher rate than the richer. Neither do they adjust themselves to ups and downs of market values; and a rate of duty reasonable enough when enacted is often transformed by a fall of price into an onerous and prohibitory tax restricting imports and diminishing revenue. It is not, therefore, surprising that the attempt had been made to unite, if possible, the certainty and inevitableness of the specific system with the justice and equity of the *ad-valorem* principle. Two methods of combination of specific and *ad-valorem* rates have therefore heretofore been adopted.

Viewed from the standpoint of equity and expediency, the proposition to assess all the varieties of imported sugars at one and the same rate of duty is something extraordinary. The United States, for the attainment of its fullest material development as a nation, must have foreign commerce. It desires to attract all nations to its markets; and, except when it is itself made the subject of discrimination, it must, for the attainment of this end, admit to equal privileges the people of all nations desiring commercial intercourse. Were the proposition soberly made to discriminate specially and by name, in our commercial laws, against any one, two, or more unoffending nations, the proponent would be speedily hooted into silence. But the proposition to assess raw sugars at one rate embodies this very thing. Thus, to illustrate, the sugars produced in countries of low civilization, like Brazil, Central America, the East Indies, and the like, *constitute the bulk of the sugar product of the world,* and are low in grade and price, and necessarily so because these countries lack intelligence and capital. Such sugars are, however, capable of purification without difficulty, and afford the largest basis in so doing for the profitable employment of domestic labor and capital. The producers, furthermore, must sell them in our markets if they in return are to buy any of the products of our skill and machinery, for they have little or nothing else to buy with. Such raw sugars naturally command the lowest prices in the world's markets. On the other hand, the raw sugars produced in Cuba and Demerara are much further advanced in manufacture, and are largely known as "centrifugals," from having been subjected to a purely mechanical (rotary) process of refining. Such raw sugars command the highest prices, and are worth on the average at least fifty per cent more than the sugar products of countries of a low civilization. A uniform duty on all raw sugars of one cent per pound would, therefore, be equivalent to an *ad-valorem* tax, or tax on market value, of about fifty per cent on the cheaper grades, and about twenty-five per cent on the highest grades; or, in other words, if the Government, under a uniform rate of one cent, were to collect its (customs) taxes in kind on sugar, it would take one half the importations of low-grade sugars, while only one fourth of the importation of high grades would be taken for the same purpose. All the machinery of the Government is now adapted to the *ad-valorem* system of taxing sugars, and in the opinion of the Treasury officials it can be and is honestly administered.

It is difficult to see why, with an impending deficiency of national revenue, sugar grown in the Hawaiian Islands, and the importation of which into the United States in 1895 exceeded 280,000,000 pounds, should be admitted free of duty. Is it not clear that such an exemption constitutes another and indirect form of taxation incumbent on the American people?

What the National Revenue was in 1896, and what might be anticipated in the Immediate Future from Certain Modifications of the Existing Tax System.—The revenues of the Government from all sources—exclusive of the postal service, in which the receipts and expenditures closely balance—for the fiscal year 1896 were $326,976,200, of which $146,762,864 accrued from internal-revenue taxes, and $160,021,751 from customs.

Contingent on the modifications of the internal-revenue system above proposed, the annual receipts from this department, considered in reference to the special sources pertaining to it, would, without much doubt, be approximately as follows:

From distilled spirits, provided there is no exemption of any part of its product from taxation for any purpose, $100,000,000: a result more likely to be attained if the present ratio of tax, $1.10 per proof gallon, be reduced to its former rate of ninety cents.

From fermented liquors, with an increased tax to the extent of $1 per barrel, $60,000,000.

From tobacco, on the assumption that political and popular sentiment will not permit any increase of rates, $35,000,000; although, if a fiscal policy in furtherance of the best interests of the Government were alone considered, the annual accruing revenue from this source would be at least double.

From petroleum and its derivatives, $24,000,000.

From stamps, $30,000,000, which can be readily increased to $50,000,000.

From tea and coffee, under a twenty-per-cent duty, $20,000,000; under a duty of forty per cent, $40,000,000.

From sugar, such a rate of duty on its import as will insure an annual revenue of at least $50,000,000.

Total, $319,000,000, leaving a deficit, on an estimated annual expenditure of $500,000,000, of $189,000,000. To meet this requirement, the entire revenue from customs, other than from the imports of sugar (already considered), and incidental revenues to the extent of $15,000,000, are available.

Doubtless, to many the proposal to increase the existing number of special sources of national revenue, with modifications of existing rates, will seem inexpedient and unnecessary; but, with a constant tendency to increase national expenditures, it is only a question of time when such changes will have to be made; and the future record of the new administration and the new Congress, for good or for ill, will be largely determined by the manner they answer this question: Shall money be saved by new economies or provided by new and increased taxes? And if the latter policy is favored, its advocates will do well to remember, that any taxes that tend to obstruct the export of the surplus products of the country will not long be tolerated.*

THE STABILITY OF TRUTH.†

By DAVID STARR JORDAN,
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[*Concluded.*]

THE primal motive of science is to regulate the conduct of life. This is in a sense its ultimate end, for it is the first and the last function of the senses and the intellect. If science has any message to man, it is expressed in these words of Huxley: "There can be no alleviation of the sufferings of mankind except in absolute veracity of thought and action and a resolute facing of the world as it is, with all the garment of make-believe thrown off."

"Still, men and nations reap as they have strewn." The history of human thought is filled with the rise of philosophic doctrines, laws, and generalizations not drawn from human experience and not sanctioned by science. The attempt to use these ideas as a basis of human action has been one of the most fruitful sources of human misery. It is true that wrong information may sometimes become the basis of right action, as falsehood may secure obedience to a natural law which might otherwise be violated. But in the long run men and nations pay dearly for every illusion they cherish. For every sick man healed at Denver or Lourdes, ten well men will be made sick. Faith cures and patent medicines feed on the same victims. For every Schlatter who is worshiped as a saint, some equally harmless lunatic will be burned as a witch.

And now a word as to the positive side of scientific belief.

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* Touching the question of national revenue and its present yearly deficiency, the following opinion, expressed by the late Secretary of the Treasury, in his annual report on the finances of the country for 1896, has an important bearing on this problem, and ought not to fail of popular consideration: "Hereafter," he says, "it will not be possible to sacrifice revenue to protection without seriously embarrassing the fiscal affairs of the Government by depriving it of an income sufficient to defray its necessary expenditures. If the usual proportion of this income is hereafter to be derived from taxes on imported goods, the protective theory must be abandoned as the basis of our legislation upon the subject, and a well-considered and consistent revenue system must be substituted in its place; and, in my opinion, this can be done without material injury to any trade or industry now existing in this country."

† President's address, California Science Association meeting, Oakland, December, 1895.

I was walking not long ago in the garden with a little girl, to whom I told James Whitcomb Riley's story of the "goblins that get you if you don't watch out"—a story supposed to be peculiarly attractive to children. "But there isn't any such thing as a goblin," said the practical little girl, "and there isn't ever going to be any such thing." Mindful of the arguments of Berkeley and Balfour, I said to her in the spirit of philosophic doubt, "Maybe there isn't any such thing as anything, Barbara?" "Yes, there is," she said, "such a thing as anything," and she looked about her for unquestioned reality; "there is such a thing as anything; there is such a thing as a squash."

And in this conclusion of the little girl the reality of the objective world, the integrity of science, and the sanity of man are alike bound up. And for its evidence, if we are not confined to Balfour's arguments in a circle, we may look to the facts of organic evolution, of which the existence of man is a part.

Each living being is a link in a continuous chain of life, going back in the past to the unknown beginnings of life. Into this chain of life, as far as we know, Death has never entered, because only in *life* has the ancestor the power of casting off the germ cells by which life is continued. Each individual is in a sense the guardian of the life-chain in which it forms a link. Each link is tested as to its fitness to the conditions external to itself in which it carries on its functions. Those creatures unadapted to the environment, whatever it may be, are destroyed, as well as those not adaptable; and this environment by which each is tested is the objective universe. It is not the world as man knows it. It is not the world as the creature may imagine it. It is the world as it is.

Nature has no pardon for ignorance or illusions. She is no respecter of persons. Her laws and her penalties consider only what is, and have no dealings with semblances. By this experience we come to know what reality is, that there is an external world to the demands of which our senses, our reason, our powers of action are all concessions. The safety of each chain of life is proportioned to the adaptation of its links to these conditions. This adaptation is in its essence obedience. The obedience of any creature is conditioned on its response in action to sensations or knowledge. Sense perception and intellect alike stand as advisers to its power of choice. The power of choice involves the need to choose right. For wrong choice leads to death. Death ends the chain of which the creature is a link, and the life of the world is continued by those whose choice has not been fatal. That "the sins of the fathers are visited on the children" is, in the long run, the expression of Infinite Mercy, "the goodness and severity of God." Severity of condition and stress of competition are met in life by the survival of those adequate to meet these conditions. Thus "in creatures sore bestead by the environment" when instinct and impulse fail, reason rises to insure safety. At last with the civilized man reason comes to be a chief element in guiding the choice of life.

With greater power to know and hence to choose safely, greater complexity of conditions become possible, and the multifarious demands of modern civilization finds some at least who can meet them fairly well. To such the stores of human wisdom must be open. To others right choice in new conditions is possible only through following the footsteps of others. The multitudes of civilized men, like the multitudes of animals, are saved to life by the i stinct of conventionality. The instinct to follow those whose footsteps are secure is one of the most useful of all impulses to action. In the same connection we must recognize authority as a most important source of knowledge to the individual. But its value is proportioned to the ability of the individual to use the tests wisdom must apply to the credentials of authority. But instinct, appetite, impulse, conventionality, and respect for authority all point backward. They are the outcome of past conditions. "New occasions bring new duties." New facts and laws must be learned if men are to remain adequate to the life which their own institutions, their self-realization, and their mutual help have brought upon them. To the wise and obedient the most complex life brings no special strain nor discomfort. It is as easy to do great things as small, if one knows how. But to the ignorant, weak, and perverse, the growth of civilization becomes an engine of destruction. The freedom of self-realization involves the freedom of self-perdition. Hence appears the often discussed relation of "Progress and Poverty" in social development. Hence it comes that civilization, of which the essence is mutual help or altruism, under changing conditions seems to become one vast instrument for the killing of fools.

In the specialization of life, conditions are constantly changing. Every age is an age of transition, and transition brings unrest because it impairs the value of conventionality. With the lowest forms of life there is no safety save in absolute obedience to the laws of the world around them. This obedience becomes automatic and hereditary because the disobedient leave no chain of descent to maintain their disobedience. All instincts, appetites, impulses to action, even many conditions of the nature of illusions, point toward such obedience. Whether we regard these phenomena as variations selected because useful, or as inherited habits, their relation is the same. They survive as guarantees of future obedience because they have brought obedience in the past. And so with the most enlightened man, the same necessity for obedience exists, and the instincts, appetites, and impulses of the lower animals remain in him, or disappear only as reason is adequate to take their place. And in any case there is no alleviation for the woes of life, "save the absolute veracity of action; the resolute facing of the world as it is."

The intense practicality of all this must be recognized. The truths of science are approximate, not absolute. They must be stated in terms of human consciousness, and they can never be dissevered from possible human action. Knowledge which can only accumulate without being woven into conduct has never been a boon to its possessor. As food must be formed into tissue, so must perception go over into action. In the lower forms, we have the devices, chiefly automatic, by which sensation transmitted to the sensorium reappears as motion. In like manner we find in man, besides these reflex transfers, and the reflex connections formed by habit, that science becomes changed to art and knowledge to power. Power and effectiveness are conditioned on accuracy. Every failure in the sense organ, every form of deterioration of the nerves, shows itself in reduction of power. Reduced effectiveness shows itself through the processes of natural selection, as reduction is safety in life. Thus the degeneration of the nervous system through excesses, through precocious activity, or through the effect of stimulants shows itself in untrustworthy perceptions, in uncontrolled muscles, and in the lack of security in life. Incidentally all these are recorded by fall in social standing. With the reduction of the accuracy of recognition of reality the person ceases to hold his place as a man among men.

Similar failure comes with any cause impairing the recognition of the reality of external things. The sober mind is necessary to safety in life. In general all civilized men are well born. They come of good stock. For the lineage of perversity, insanity, and even stupidity is never a long one. The perverse, insane, and the stupid live through the tolerance of others. They can not maintain themselves, and, in spite of charity and the sense of conventionality, the mortality caused by the fool-killer is something enormous. It is an essential element in race progress. It grows with increased civilization, because of increasing complexity of condition. It is the chief compensating influence for the life-saving which has been made possible for scientific research. As Prof. H. H. Powers has said, "There is in civilization not a single vice that race progress can spare." "The fool-killer," Dr. Bailey tells us, "the fool-curer, and the fool-preventer are alike servants of the living God."

The recent "recrudescence of superstition"—a striking accompaniment of an age of science—is in a sense dependent on science.

Science has made it possible. The traditions of science are so diffused among the people at large that fools find it safe to defy them. Those who take dreams for realities; those whose memory impressions and motor dreams are uncontrolled through defective will; those who mistake subjective sensations produced by disease or disorder for objective conditions—all these are sooner or later dropped from existence, taking with them the whole line of their possible successors. The condition of mind which is favorable to mysticism, superstition, and revery is unfavorable to life, and the continuance of such conditions leads to death. On the billboard across the street I saw just now the advertisement of a lecture on the "ethical value of living in two worlds at once." Whoever thus lives in two worlds is certain soon to prove inadequate for either.

If all men sought healing from the blessed handkerchief of the lunatic, or from contact with old bones or old clothes; if all physicians used "revealed remedies," or the remedies Nature finds for each disease; if all business were conducted by faith; if all supposed "natural rights" of man were made the basis of legislation; if all the protean phases of that which Zangwill has cleverly called the "higher foolishness" were worked out in action—the insecurity of these beliefs would speedily appear. Not only civilization but civilized man himself would vanish from the earth. The safe shelter of the cave and hollow tree would be the cradle of the "new man" and the "new woman." The long and bloody road of progress through fool-killing would for centuries be traversed again. The fool lives in society only by sufferance of the sane; the weak, by the altruism of the strong. That is strong which endures. Might does not make right, but that which is right will justify itself by becoming might. What we call social virtues are the elements of race stability.

In the ordinary affairs of life it may be as safe to believe in mahatmas and magic, in cobolds and norns, as to have the vague notions of microbes and molecules, atoms and protoplasm, which form part of the mental equipment of the average modern man. But the difference appears when the knowledge is to be turned into action. Microbes and molecules become more real the more nearly one comes to deal with them. If one learns to use them they become as real as rocks or dollars and as capable of influencing human welfare. But those conceptions which are figments of ignorance and insanity become less real as we try to deal with them, and the action based on them is not safe nor effective.

So clearly is knowledge linked to action that in general among animals and men when action is not possible sensation is absent or not trustworthy. Objects too small to be touched are invisible to the eye. Objects beyond our reach, as the stars or the clouds, are not truthfully pictured. Accuracy of perception grows less as distance increases. The unfamiliar lends itself readily to illusions; the familiar is recognized chiefly by breaks in continuity. The real forces of Nature are hidden by their grandeur, by their immortality. Men see the form of the surface, but not the mighty tides that move beneath it. Again, the senses are less acute than the mechanism of sense organs would make possible. This is shown through occasional cases of hyperæsthesia or ultra sensitiveness. This occurs in abnormal individuals or in unusual conditions. It occurs normally in creatures whose lives in some sense depend on it. Thus some of the most remarkable exhibitions of "mind reading" may be paralleled by retriever dogs whose reason for existence is found in the hyperæsthesia of the sense of smell. Hyperæsthesia of any of the senses would be to most animals a source of confusion and danger rather than of safety.

Man's high development of the brain in large degree takes the place of acuteness of special senses. It is part of the function of the will to keep down the senses; and in his perception of external relations he is aided by the devices of science, which may be taken up or laid down at will. By means of instruments of precision any of the senses may be aided to an enormous degree, and at the same time the personal equation or individual source of error is largely eliminated. The use of instruments of precision is the special characteristic of the advance of science. No instrument of precision can give us the ultimate essence of any part of the universe. No scientific experiment can do away with the measure of human experience as the basis of intelligibility. At the same time we can throw large illumination into "the dimly lighted room" in which, according to Balfour, the phenomena of consciousness take place. By the simple process of photography, for example, we may reproduce the objects of our environment. That such pictures do express phases of reality admits of no doubt, for in the photographic camera all personal equation is eliminated. As to form of outline and reflection of light, the "sun paints true," and the paintings thus made by means of the action of nonliving matter produce on our senses impressions coinciding with those of the outside world itself.

How do we know this is true? Because belief in it adds to the safety of life. We can trust our lives to it. If it were an illusion it would kill, because action based on illusion leads to death.

One can trust his life, for example, to the message sent on a telegraph wire. All who travel by rail do this daily. One can trust his life to the reading of a thermometer. The chemist's tests will select for us foods among poisons. We may trust these tests absolutely. We may safely and sometimes wisely take poisons into our bodies if we know what we are doing. By the advice of a physician, trusting in the weigher's instruments of precision, poisons may do no harm. One grain of strychnine may be an aid to vital processes; a dozen may mean instant cessation of these processes. The balance advises us as to all this. All these instruments of precision belong to science. These are examples taken from thousands of the methods of organized common sense. By means of common sense, organized and unorganized, all creatures that can move are enabled to move safely. The security of human life in its relations to environment is a sufficient answer to the "philosophic doubt" of Berkeley and Balfour as to the existence of external Nature; for if all phenomena were within the mind, no one of them could be more dangerous than another. A dream of murder is no more dangerous than a dream of an afternoon pink tea, so long as its action is confined to the limits of the dream; but the relation of life to environment is inseparable and inexorable. Cause and effect are perfectly linked. This is a world of absolute verity, and its demand is absolute obedience. Life without concessions of conditions is the philosopher's dream.

What we know as pain is the necessary signal of warning of bad results, of bad relations. Without pain life conditioned by environment would be impossible. We need such stimulus to veracity. Those dangers which are painless are the hardest to avoid; the diseases which are painless are the most difficult to cure. Misery in general is only Nature's protest against personal degradation. The way out of misery is the way into life.

In this relation must science recognize the value of ideals? The ideal in the mind tends always to go over into action. The noble ideal discloses itself in a noble life. It is part of the wisdom of each generation, its science as well as its religion, to form the ideals of the rest. History is written in these ideals before it is come to the stage of life. An ideal is not a dream; a dream is fleeting. An ideal has the *will* behind it. The persistence of a lofty ideal is the central axis of the life worth living.

An old parable of the conduct of life shows man in a light skiff in a tortuous channel beset with rocks, borne by a falling current to an unknown sea. He is kept awake by the needs of his situation. As his boat bumps against the rocks he must bestir himself. If this contact were not painful he would not heed it. If it were not hurtful he would not need to heed it. Had he no power to act, he could not heed it if he would. But with sensation, will, freedom to act, narrow though the limits of freedom be, his safety rests in some degree in his own hands. That he has secured safety thus far is shown by his continued existence. He may choose his course for himself—not an easy thing to do, unless he scans most carefully the nature of the rocks and waves and his control of the boat itself. He may follow the course of others with some degree of the safety they have attained. He may follow his own impulses, in man's case inherited from those who found them safe guides to action. But in new conditions neither conventionality nor impulse nor desire will suffice. He must know what is about him in order that he may know what he is doing. He must know what he is doing in order to do anything effectively. Ignorant action is more dangerous than no action at all. The "sealed orders" under which live the lower animals and our "brother organisms the plants" are in a measure inadequate for man. With the power of movement and the "knowledge of good and evil," he has no choice but to accept the conditions. He must shape his own life. He must make his ideals into actuality. And thus it comes that there is "no alleviation for the sufferings of man except through absolute veracity of thought and action, and the resolute facing of the world as it is." For wisdom is only knowing what should be done next, and virtue is doing it. And thus it comes that it is well for man "not to pretend to know or to believe what he really does not know or believe"; for there is no safety in life, either for ourselves or others, if we guide our conduct by any influence less wise or potent than that developed from the co-ordination of human wisdom. We may play at philosophy, if we have pleasure in doing so. We may find intellectual strength through exercise of the mind even on its own products. But we must guide our lives by science. The appetites, impulses, passions, illusions, if you choose, which have proved safe in the past development of life, science would not destroy. But they must be subordinate to the will and intellect. And this subordination of the lower to the higher motives in life is the culmination of evolution, as it has been the ideal of those whose strivings for better relations of man to man and of man to Nature have been worthy of the name of religion.

The will is the soul of man in action. The intellect is its guide. If the life of man is hemmed in by the Fates, the human will is one of the Fates, and must take its place by the side of the rest of them. The man who can will is a factor in the universe.

As knowledge is in its essence only a guide to action, and as knowledge, being human, can be approximate only—not reality, but a movement toward reality—we are brought to the oft-quoted words of Lessing:

"It is not the truth in man's possession that makes the worth of the man. Possession makes him selfish, lazy, proud. Not through possession, but through long striving, comes the ever-growing strength. If God should hold in his right hand all truth and in his left hand only the ceaseless struggle to reach after truth, and he should say to me, Choose; I would fall in humbleness before his left hand and say:

"'Father, give; the perfect truth is but for thee alone.'"

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

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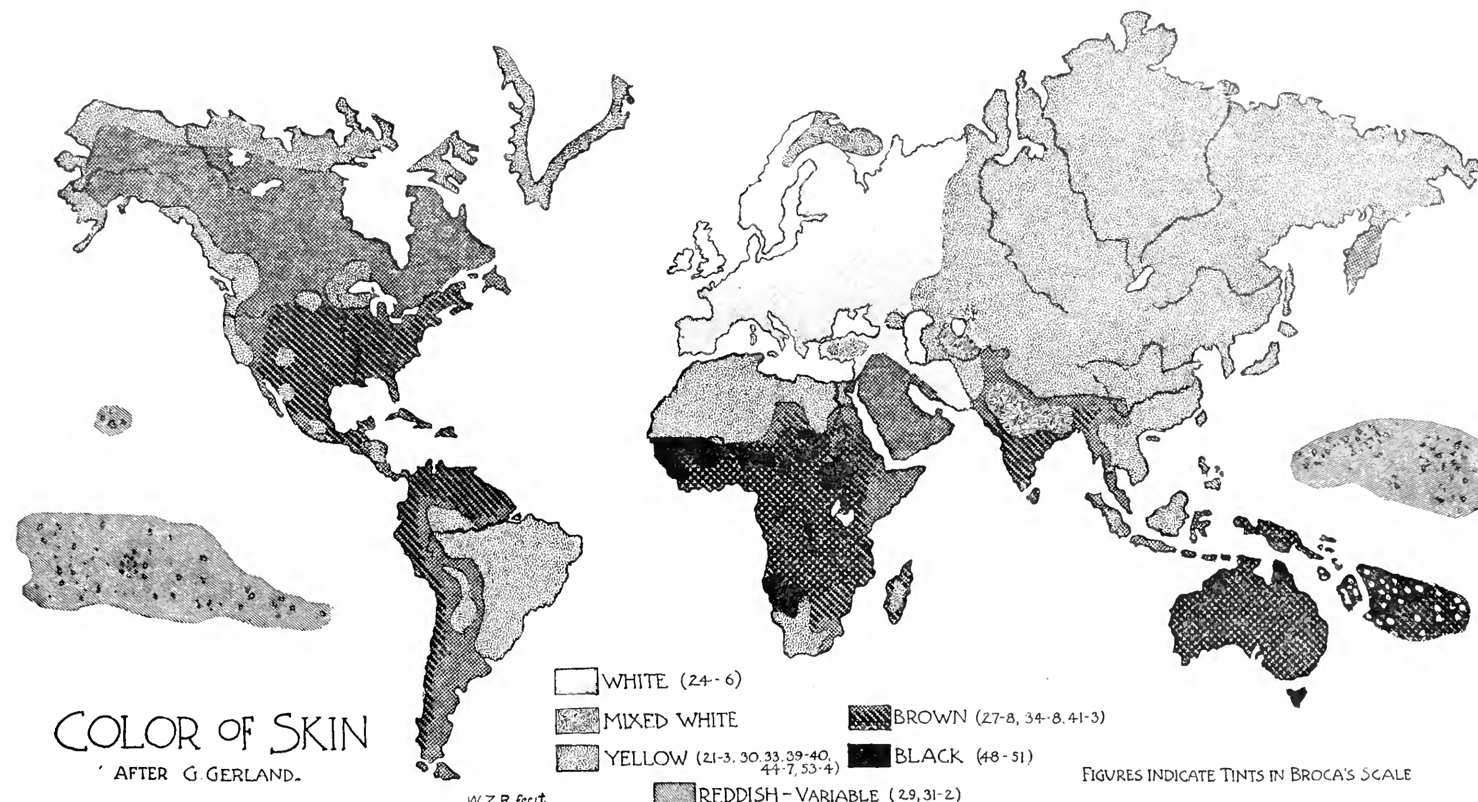
III.—BLONDES AND BRUNETTES.

THE color of the skin has been from the earliest times regarded as a primary means of racial identification. The ancient Egyptians were accustomed to distinguish the races known to them by this means both upon their monuments and in their inscriptions. Notwithstanding this long acquaintance, the phenomenon of pigmentation remains to-day among the least understood departments of physical anthropology. One point alone seems to have been definitely proved: however marked the contrasts in color between the several varieties of the human species may be, there is no corresponding difference in anatomical structure discoverable.

Pigmentation arises from the deposition of coloring matter in a special series of cells, which lie just between the translucent outer skin or epidermis and the inner or true skin known as the cutis. It was long supposed that these pigment cells were peculiar to the dark-skinned races; but investigation has shown that the structure in all types is identical. The differences in color are due, not to the presence or absence of the cells themselves, but to variations in the amount of pigment therein deposited. In this respect, therefore, the negro differs physiologically, rather than anatomically, from the European or the Asiatic. Yet this trait, although superficial so to speak, is exceedingly persistent, even through considerable racial intermixture. The familiar legal test in our Southern States in the *ante-bellum* days for the determination of the legal status of octoroons was to look for the bit of color at the base of the finger nails. Under the transparent outer skin in this place the telltale pigmentation would remain, despite a long-continued infusion of white blood.

In respect of the color of the skin, we may roughly divide the human species into four groups indicated upon our world map.


COLOR OF SKIN
AFTER G. GERLAND.
WHITE (24-6)
MIXED WHITE
YELLOW (21-3, 30, 33, 39-40, 44-7, 53-4)
REDDISH-VARIABLE (29, 31-2)
BROWN (27-8, 34-8, 41-3)
BLACK (48-51)
FIGURES INDICATE TINTS IN BROCA'S SCALE
W. Z. R. fecit

The jet or coal black color is not very widespread. It occurs in a narrow and more or less broken belt across Africa just south of the Sahara Desert, with a few scattering bits farther south on the same continent. Another center of dissemination of this characteristic, although widely separated from it, occurs in the islands southeast of New Guinea in the Pacific Ocean, in the district which is known from this dark color of its populations as Melanesia. Next succeeding this type in depth of color is the main body of negroes, of Australians, and of the aborigines of India. This second or brownish group in the above-named order shades off from deep chocolate through coffee-color down to olive and light or reddish brown. The American Indians fall within this class, because, while reddish in tinge, the skin has a strong brown undertone. In the Americas we find the color quite variable, ranging all the way from the dark Peruvians and the Mexicans to the aborigines north of the United States. The Polynesians are allied to this second group, characterized by a red-brown skin. A third class, in which the skin is of a yellow shade, covers most of Asia, the northern third of Africa, and Brazil, including a number of widely scattered peoples such as the Lapps, the Eskimos, the Hottentots and Bushmen of South Africa, together with most of the people of Malaysia. Among these the skin varies from a dull leather color, through a golden or buff to a muddy white. In all cases the shading is in no wise continuous or regular. Africa contains all three types of color from the black Dinkas to the yellow Hottentots. In Asia and the Americas all tints obtain except the jet black. There are all grades of transitional shading. Variations within the same tribe are not inconsiderable, so that no really sharp line of demarcation anywhere occurs.

The fourth color group which we have to study in this paper is alone highly concentrated in the geographical sense. It forms the so-called white race, although many of its members are almost brown and often yellow in skin color. As we shall show, its real determinant characteristic is, paradoxically, not primarily the skin but the pigmentation of the hair and eyes. Nevertheless, so far as it may be used in classification, the very light shades of skin are restricted to Europe, including perhaps part of modern Africa north of the Sahara, which geologically belongs to the northern continent. There is a narrow belt of rather light-skinned peoples running off to the southeast into Asia, including the Persians and some high-caste Hindus. This offshoot vanishes in the Ganges Valley in the prevailing dark skin of the aboriginal inhabitants of India. The only entirely isolated bit of very light skin elsewhere occurs among the Ainos in northern Japan; but these people are so few in number and so abnormal in other respects that we are warranted in dismissing them from further consideration in this place.

Anthropologists have endeavored for a long time to find the cause of these differences in the color of the skin.* Some have asserted that they were the direct effects of heat; but our map shows that the American stock, for example, is in no wise affected by it. A consideration of all the races of the earth in general shows no correspondence whatever of the color of the skin with the isothermal lines. The Chinese are the same color at Singapore as at Pekin and at Kamchatka. Failing in this explanation, scientists have endeavored to connect pigmentation of the skin with humidity, or with heat and humidity combined; but in Africa, as we saw, the only really black negroes are in the dry region near the Sahara Desert, while the Congo basin, one of the most humid regions on the globe, is distinctly lighter in tint. Others have attempted to prove that this color, again, might be due to the influence of the tropical sun, or perhaps to oxygenation taking place under the stimulation of exposure to solar rays. This has at first sight a measure of probability, since the color which appears in tanning or freckles is not to be distinguished physiologically from the pigment which forms in the main body of the skin of the darker races. The objection to this hypothesis is that the covered portions of the body are equally dark with the exposed ones, and that certain groups of men whose lives are peculiarly sedentary, such as the Jews, who have spent much of their time for centuries within doors, are distinctly darker than other races whose occupations keep them continually in the open air. This holds true whether in the tropics or in the northern part of Europe. This local coloration in tanning, moreover, due to the direct influence of the sun is not hereditary, as far as we can determine. Sailors' children are not darker than those of the merchant, even after generations of men have followed the same profession. Each of these theories seems to fail as a sole explanation. The best working hypothesis is, nevertheless, that this coloration is due to the combined influences of a great number of factors of environment working through physiological processes, none of which can be isolated from the others. One point is certain, whatever the cause may be—that this characteristic has been very slowly acquired, and has to-day become exceedingly persistent in the several races.

Study of the color of the skin alone has nothing further to interest us in this inquiry than the very general conclusions we have just outlined. We are compelled to turn to an allied charac-

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* Th. Waitz: Anthropologie der Naturvölker, vol. i, p. 55 *seq.*, contains some interesting remarks on this subject.

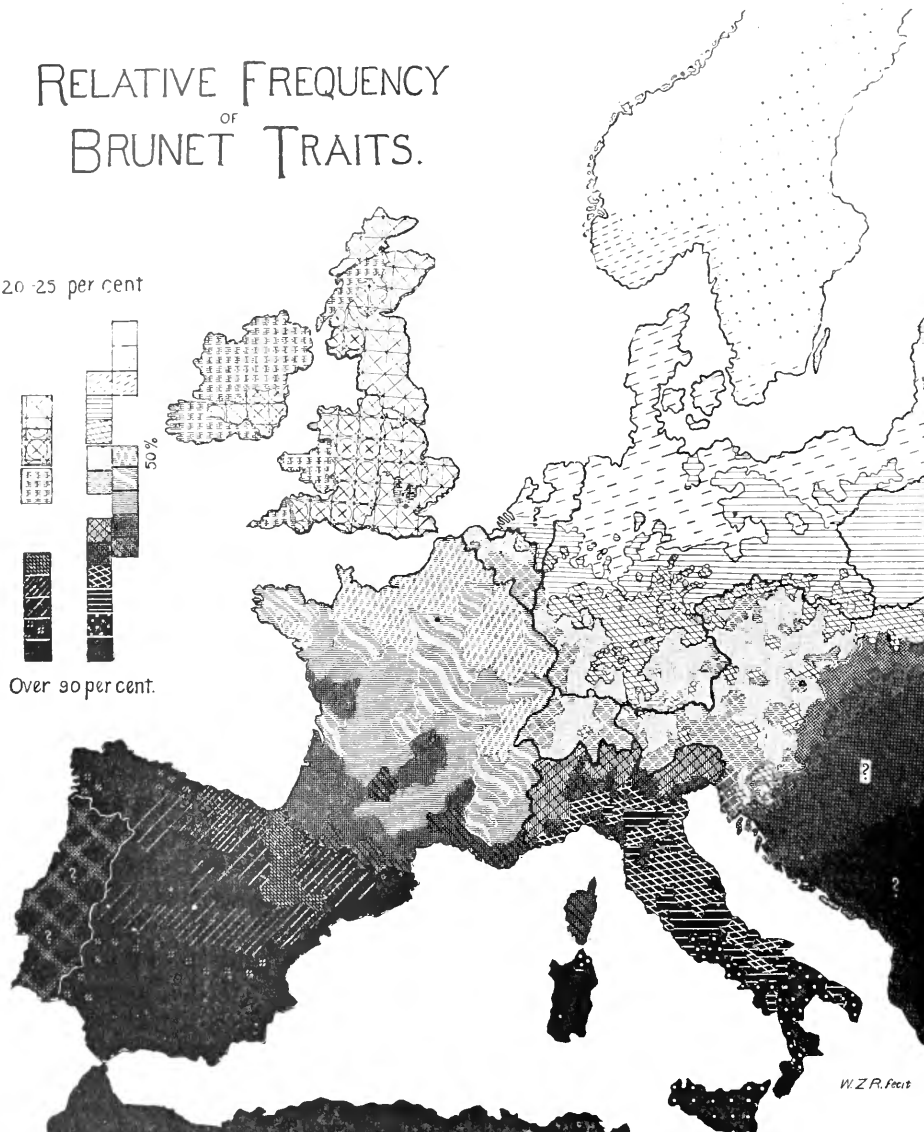
teristic—namely, the pigmentation of the hair and eyes—for more specific results. There are three reasons which compel us to take this action. In the first place, the coloration of the hair and eyes appears to be less directly open to disturbance from environmental influences than is the skin, and variations in shading may be at the same time more easily and delicately measured. Secondly, the color or, if you please, the absence of color, in the hair and eyes is more truly peculiar to the European race than is the lightness of its skin. There are many peoples in Europe who are darker skinned than certain tribes in Asia or the Americas; but there is none in which blondness of hair and eyes occurs to any considerable degree. It is in the flaxen hair and blue eye that the peculiarly European type comes to its fullest physical expression. This at once reveals the third inducement for us to focus our study upon these apparently subordinate traits. Europe alone of all the continents is divided against itself. We find blondness in all degrees of intensity scattered among a host of much darker types. A peculiar advantage is herein made manifest. Nowhere else in the world are two such distinct varieties of man in such intimate contact with one another. From the precise determination of their geographical distribution we may gain an insight into many interesting racial events in the past.

The first general interest in the pigmentation of the hair and eyes in Europe dates from 1865, although Dr. Beddoe began nearly ten years earlier to collect data from all over the continent. His untiring perseverance led him to take upward of one hundred thousand personal observations in twenty-five years. During our own civil war about a million recruits were examined in this respect, many of them being immigrants from all parts of Europe. The extent of the work which has been done since these first beginnings is indicated by the following approximate table:

Number of Observations.

	School children.		Adults.
Germany	6,758,000	Italy	299,000
Belgium	608,000	France	225,000 ±
Switzerland	497,000	British Isles:	
Austria	2,304,000	General	53,000
		Criminals, etc.	12,000
		United States	1,000,000
		Remainder of Europe	50,000 ±
	10,167,000		1,639,000

It thus appears that the material is ample in amount. The great difficulty in its interpretation lies in the diversity of the systems which have been adopted by different observers. It is not easy to give an adequate conception of the confusion which prevails. Here are a few of the obstacles to be encountered. As the table indicates, the countries north of the Alps have been mainly studied through their school children. In the Latin half



of Europe adults alone are included. Secondly, it is a matter of common observation that flaxen hair and blue eyes are characteristic of childhood. As it has been proved that from ten to twenty per cent of such blond children at maturity develop darker hair or eyes, the fallacy of direct comparison between the north and south of Europe again becomes apparent. In the third place, it is not easy to correct for the personal equation of different observers. A seeming brunette in Norway appears as quite blond in Italy because there is no fixed standard by which to judge. The natural impulse is to compare the individual with the general population round about. The precision of measurements upon the head is nowise attainable.

There are two principal modes of determining the pigmentation of a given population. One is to discover the proportion of so-called pure brunette *types*—that is to say, the percentage of individuals possessed of *both* dark eyes and hair. The other system is to study brunette *traits* without regard to their association in the same individual. This latter method is no respecter of persons. The population as a whole, and not the individual, is the unit. North of the Alps they have mapped the pigmentation in the main by types; in France, Norway, Italy, and the British Isles they have chosen to work by dissociated traits. Here again is a stumbling-block in the way of comparisons. The absolute figures for the same population gathered in these two ways will be widely different. Thus in Italy, while only about a quarter of the people are pure brunette types, nearly half of all the eyes and hair in the country are dark. That is to say, a large proportion of brunette traits are to-day found scattered broadcast without association one with another. In Europe, as a whole, upward of one half of the population is of a mixed type in this respect. In America the equilibrium is still further disturbed. Nor should we expect it to be otherwise. Intermixture, migration, the influences of environment, and chance variation have been long at work in Europe. The result has been to reduce the pure types, either of blonde or brunette, to an absolute minority. Fortunately for us, in despair at the prospect of reducing such variant systems to a common base, the results obtained all point in the same direction whichever mode of study is employed. In those populations where there is the greatest frequency of pure dark types there also is generally to be found the largest proportion of brunette traits lying about loose, so to speak. And where there are the highest percentages of these unattached traits, there is also the greatest prevalence of purely neutral tints, which are neither to be classed as blond or brunette. So that, as we have said, in whichever way the pigmentation is studied, the results in general are parallel, certainly at least so far as the deductions in this paper are concerned. Our map is indeed constructed in conformity with this assumption.*

* Dr. Livi, in his atlas to the superb Anthropometria Militare, has shown the parallelism very clearly in Charts VI to IX, inclusive. The method employed in reducing the

By reason of the difficulties above mentioned, our map is intended to convey an idea of the relative brunetteness of the various parts of Europe by means of the shading rather than by concrete percentages. It is, in fact, impossible to reduce all the results to a common base for exact comparison. What we have done is to patch together the maps for each country, adopting a scheme of tinting for each which shall represent, as nearly as may be, its relation to the rest. In the scale at the left the shades on the same horizontal line are supposed to represent approximately equal degrees of pigmentation. The arrangement of the colors in separate groups, it will be observed, corresponds to national systems of measurement. Thus the five tints used in Germanic countries and the six in Italy are separately grouped, and are each distinct from those used for the coloration of France. It will be observed that these separate national groups often overlap at each end. This arrangement indicates, for example, that the darkest part of Scandinavia contains about as many brunette traits as the lightest portion of Germany, and that they are both lighter than any part of Scotland; or that the fourth zone of brunetteness in Germany contains about as high a proportion of dark traits as the lightest part of France, and that they are both about as dark areas as the middle zone in England. As the diagram shows, central France is characterized by a grade of brunetteness somewhat intermediate between the south of Austria and northern Italy. In other words, the increase of pigmentation toward the south is somewhat more gradual there than in the eastern Alps. To summarize the whole system, equally dark tints along the same horizontal line in the diagram indicate that in the areas

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widely differing systems to a common base, so that comparisons may properly be drawn, is simple. In many areas along the border line of systems the same population has been studied from each side. Thus, in the Tyrol, Tappeiner (Zeit. für Ethnologie, xii, p. 269) has studied adults, so that his results may be correlated with those of Livi in Italy (Anthropometria Militare, Rome, 1896). At the same time Schimmer has studied the children (Mitt. der anth. Ges. in Wien, Supp., 1884), so that his data from the same people may bind them to the German-Austrian populations. Weisbach, from adults in Austria, also works near by (Mitt. der anth. Ges. Wien, xxv, p. 73). Dr. Beddoe, in his monumental work, The Races of Britain, with results of personal observation from all over Europe, gives data for international comparison, showing, for example, that southern England equals Alsace, and that Zurich equals London (p. 73, *seq.*). In another place he gives opportunity for comparison with the French system (Bull. de la Soc. d'Anth., Paris, 1882, p. 146; and Revue d'Anthopologie, Series III, iv, p. 513). Topinard (Eléments, pp. 338, 339), from the same observations, has shown that Normandy, Vienna, and Cornwall are about equally pigmented, and that the Walloons and the Bretons are about alike in this respect. Knowing from Vandekindere, Virchow (Archiv für Anth., xvi, p. 275), and Schimmer how the Walloons are related to the rest of central Europe, the way is clear. For Spain we have the merest hint from study of the eyes alone (Archiv für Anthropologie, xxii, p. 431). Weisbach (Zeitschrift für Ethnologie, Supplement, 1884) gives data for southeast Europe. In due time the further details of preparation for the map will be published.

thus equally shaded there are about the same proportions of traits or types, as the case may be, which are entitled to be called brunette.

In a rough way, the extremes in the distribution of the blond and brunette varieties within the population of Europe are as follows. At the northern limit we find that about one third of the people are pure blondes, characterized by light hair and blue eyes; about one tenth are pure brunettes; the remainder, over one half, being mixed with a tendency to blondness. On the other hand, in the south of Italy the pure blondes have almost entirely disappeared. About one half the population are pure brunettes, with deep brown or black hair, and eyes of a corresponding shade; and the other half is mixed, with a tendency to brunetteness.* The half-and-half line seems to lie about where it ought, not far from the Alps. Yet it does not follow the parallels of latitude. A circle, described with Copenhagen as a center, sweeping around near Vienna, across the middle of Switzerland, thence up through the British Isles, might serve roughly to indicate such a boundary. North of it blondness prevails, although always with an appreciable percentage of pure brunettes. South of it brunetteness finally dominates quite exclusively. It should not fail of note that toward the east there is a slight though constant increase of brunetteness along the same degrees of latitude and that the western portion of the British Isles is a northern outpost of the brunette type.

Thus we see at a glance that there is a gradual though constant increase in the proportion of dark eyes and hair from north to south. There are none of those sharp contrasts which appeared upon our map showing the distribution of the long and broad heads in Europe. On that map the extremes were separated by only half a continent in either direction from the Alps; whereas in this case the change from dark to light covers the whole extent of the continent. It is as if a blending wash had been spread over the map of head form, toning down all its sharp racial division lines. Some cause other than race has evidently exerted an influence upon all types of men alike, tending to obliterate their physical differences. It is not a question of Celt, Slav, or Teuton. It lies deeper than these. The Czechs in Bohemia are as much darker than the Poles to the north of them, both being Slavic; as the Bavarians exceed the Prussians

* For Scotland, *vide* Report of 1883 of the Anthropometric Committee of the British Association for the Advancement of Science, p. 10. Norway is examined in Revue d'Anthropologie, Series III, vol. iv, p. 293. For Italy, Dr. R. Livi (Anthropometria Militare, Atlas, Plates 6 and 7). Still farther south Dr. Collignon has studied Tunis in Étude sur l'Ethnographie de la Tunisie, Paris, 1887. See also Revue d'Anthropologie, Series III, vol. iii, p. 3 *seq.*

in the same respect, although the last two are both Germans. It would be unwarranted to maintain that any direct relation of climate to pigmentation has been proved. The facts point, nevertheless, strongly in that direction. We do not know in precisely what way the pigmental processes are affected. Probably other environmental factors are equally important with climate. To that point we shall return in a few pages. We may rest assured at this writing that our map for Europe corroborates in a general way testimony drawn from other parts of the earth that some relation between the two exists.

It seems to be true that brunetteness holds its own more persistently over the whole of Europe than the lighter characteristics. Probably one reason why this appears to be so is because the dark traits are more striking, and hence are more apt to be observed. Yet, after making all due allowance for this fact, the relative persistency, or perhaps we might say penetrativeness, of the brunette traits seems to be indicated. Our map shows that, while in Scandinavia seldom less than one quarter of all the eyes and hair are dark, in the south the blond traits often fall below ten per cent of the total. Thus in Sardinia there are only about three per cent of all the eyes and hair which are light. The same point is shown with added force if we study the distribution of the pure blond or brunette types, and not of these traits independently. In the blondest part of Germany there are seldom less than seven per cent of pure brunette children. Among adults this would probably not represent less than fifteen per cent of pure brunettes, to say the least. As our table shows, in Scotland direct observations on adults indicate nearly a quarter of the population to be pure brunettes. On the other hand, the pure blondes become a negligible quantity long before we reach the

Percentage of—

	PURE BRUNETTES.		PURE BLONDES.	
	Children.	Adults.	Children.	Adults.
North Germany	7–11	..	33–44	..
Middle Germany	12–15	..	25–32	..
South Germany	15–25	..	18–24	..
Scotland	.....	22	....	50
Ireland	.....	23	.....	48
Wales	.....	27	....	34
Belgium	.....	27	.....	..
England	.....	31	.....	40
Switzerland	26	..	11	36
Austria	23	18	20	18
Italy	.....	25	.....	3
Sardinia	.....	49	.....	0·5
Croatia	.....	57	.....	...
Greece	.....	96	.....	..

bottom of the table at the south. Thus, among two thousand and fifty natives of Tunis in North Africa, true Europeans as we must repeat, Dr. Collignon found that, while blond hair or eyes were noticeable at times, in no single case was a pure blonde with both light hair and eyes to be discovered. Similarly, in Sardinia, less than one per cent of the population was found by Dr. Livi to be of this pure blond type. The interest and significance of this undoubted fact lie in its bearing upon the theory, propounded by Dr. Brinton, that northern Africa was the center of dispersion of the blond invaders of Europe, who introduced a large measure of its culture. The same thesis is upheld in the latest comprehensive work in anthropology: I refer to Keane's Ethnology. We shall return to this theory at a later time. It is sufficient here to notice how completely this blond type vanishes among the populations of the south of Europe and northern Africa to-day. Such blondes do occur. Each one in so dark a general population as here prevails is a host itself in the observer's mind. The true status is revealed only when we consider men by hundreds or even thousands.

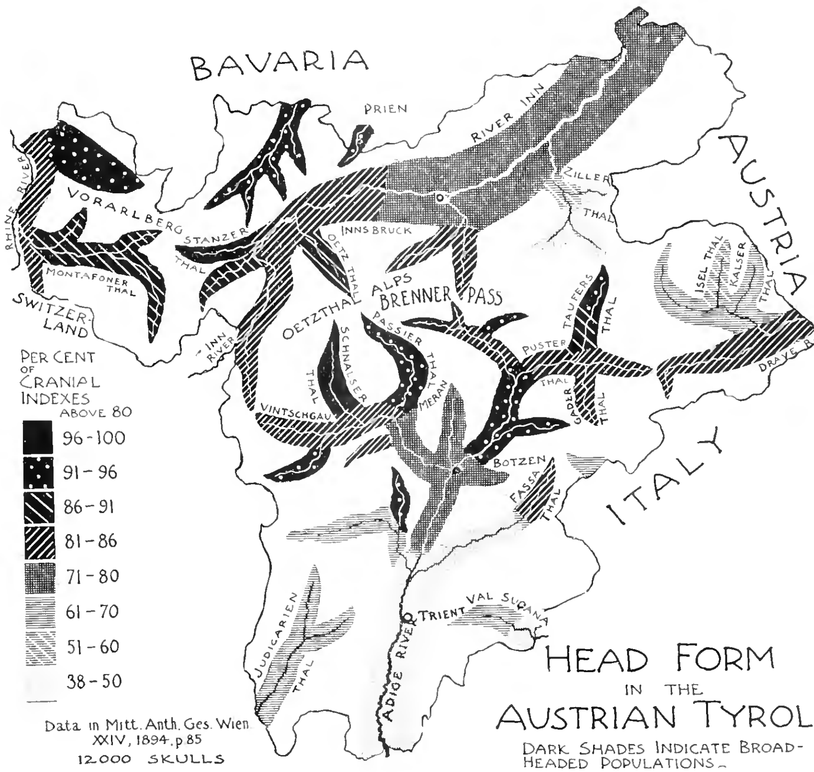
Thus far we have been mainly concerned with the pigmentation of the hair and eyes as a result of climatic or other environmental influences. Let us now consider the *racial aspect* of the question. Is there anything in our map which might lead us to suspect that certain of these gradations of pigmentation are due to purely hereditary causes? In other words, do the long heads and the short heads differ from one another in respect of the color of the hair and eyes, as well as in cephalic index? In the preceding paper we took occasion to point out in a general way the remarkable localization of the round-headed element of the European population in the Alps. The great central highland seemed indeed to constitute a veritable focus of this peculiar physical type. In this way it divided two similar centers of long-headedness—Teutonic in the north, Mediterranean in the south—one from another. This geographical characterization of the broad-headed variety entitled it, in our opinion, to be called the Alpine type, in distinction from the two others above mentioned. It will now be our purpose to inquire whether or not the physical traits of pigmentation stand in any definite and permanent relation to the three types of head form we have thus separated from one another in the geographical sense.

Many peculiarities in our color map point to the persistence of racial differences despite considerable similarity of environment. Thus the Walloons in the southeastern half of Belgium, with a strip of population down along the Franco-German frontier, are certainly darker than the people all about. Among these Walloons brunette traits are upward of a third more frequent than among the Flemish in northern Belgium. This is especially marked by the prevalence of dark hair in the hilly country south of Brussels. The British Isles offer another example of local differences in this respect which can not be ascribed to environment. Wales and Ireland, Cornwall and part of Scotland are appreciably brunette, as compared with other regions near by. The contrast between Normandy and Brittany in France is of even greater value to us in this connection. Dark hair is more than twice as common in the Breton cantons as it is along the English Channel in Normandy. These differences can not be due to the Gulf Stream mildness of the western climate or to the physical environment in any other way. If we may judge from our scanty data for Spain, another racial break occurs here as well, which seems to justify the statement that "beyond the Pyrenees begins Africa." In the other direction, among the Hungarians, we begin to scent an Asiatic influence in the dark population of the southeast of Europe.

Perhaps the most conspicuous example of the racial fixity of this trait of pigmentation is offered by the Jews. They have preserved their Semitic brunetteness through all adversities. Socially ostracized and isolated, they have kept this coloration despite all migrations and changes of climate. In Germany to-day forty-two per cent of them are pure brunettes in a population containing only fourteen per cent of the dark type on the average. They are thus darker by thirty per cent than their Gentile neighbors. As one goes south this difference tends to disappear. In Austria they are less than ten per cent darker than the general population; and finally in the extreme south they are even lighter than the populations about them. This is especially true of the red-haired type common in the East. To discover such differences requires minute examination. The reward has been to prove that pigmentation in spite of climate is indeed a fixed racial characteristic among the people of Europe. We are therefore encouraged to hope that great racial groups of population may still yield us evidence of their relationship or lack of it in this respect, as well as in the head form.

It will be necessary, before considering this matter further, for us to turn aside for a moment to study the population of central Europe a little more in detail than we have thus far been able to do. We shall attempt to prove a point of great significance. The broad-headed type not only forms the bulk of the present population of the Alpine highlands. This was established in the preceding paper. We have now to prove that it at the same time is clearly the oldest or most primitive element among the inhabitants of this region; that it lies so near the soil that the racial character of the population of the Alps varies in direct relation with the physical geography of the country.

The Austrian Tyrol is one of the most favored spots in Europe for the study of the order and succession of the long and the broad heads respectively. It is the geographical center of the continent. It holds strategically the great highway of communication—the Brenner Pass—between the north and the south of Europe. As our map shows, it is also the crest of the great European



watershed. From it flow the Inn River and the Drave into the Danube, thence to the Baltic Sea on the east; the Adige is an affluent of the Po, running due south to the Adriatic; and on the west the branches of the Rhine carry its waters into the Atlantic. Each of these great river systems has marked a line of human immigration and has directed racial movement to this spot. By the Danube the Slavs have come, and by Innsbruck, over the Brenner, the Teutons have passed across into the valley of the Adige and thence directly into the plain of Italy. Back over the same route have flowed many phases of Mediterranean culture into the north from the time of the Phœnicians to the present. The Tyrol, for these reasons, is the one spot in Europe in which racial competition has come to a focus. The population is exceedingly mixed. I have seen men of the purest Italian type speaking the German tongue; and at Botzen blond Teutons who made use of good Italian. Despite this circumstance of racial intermixture, there are within the Tyrol at the same time a number of areas of isolation which possess very marked individuality. We thus have the sharpest contrasts between mixed and pure populations. The Oetztal Alps, in the very center of the country, are as inaccessible as any part of Europe. So rugged is this latter district that the dialects differ from valley to valley, and the customs and social institutions as well.

Turning now to the anthropological map of this region, based upon a measurement of over twelve thousand skulls, it will be found that in nearly every case the broad heads become numerous in direct proportion to the increase in altitude. In other words, the broad open valleys leading out toward the great river systems of Europe are relatively dolichocephalic; while the side branches in the Oetztal Alps, isolated from foreign influences, show a marked preponderance of round-headedness. Thus in the Stanzerthal and the valley of the Schnals, indicated upon our map by the solid black tint, are two of the broadest-headed spots in the world. Over seventy per cent of all the heads measured from these two districts had indices above 85. These both lie, it will be observed, well off the main line of travel, either by the Inn Valley or over the Brenner. At their outlets they contain many heads of medium breadth, but these become less frequent as we penetrate the highlands. Like them are nearly all the side valleys in this part of the Alps. So closely, indeed, does this physical trait follow the topography that Ranke of Munich, as we have already said, has endeavored to connect the broad-headedness and altitude as cause and effect. For us the true explanation of this phenomenon is entirely racial. It is a product of genuine social selection. The two great branches of narrow-headedness, the blond Teuton at the north and the Mediterranean at the south with dark eyes and hair, have invaded the Alps all the way from France to the Balkan states. At the time of their coming a broad-headed population, as it would appear, occupied the whole mountain chain. The result is that to-day its main peculiarity has become attenuated exactly in proportion to the degree to which it has been exposed to racial intermixture with the newcomers.

Here is an example, then, of purely human stratification. The Alpine type has been overlaid by the newcomers, or else has been gradually driven up and back into the areas of isolation. Those who remained along the great routes of travel have been swamped in a flood of foreign intermixture. The only exceptions to the rule we have observed of a primitive broad-headed layer of population isolated in the uplands are offered by the two valleys of the Ziller in the northeast and of the Isel and Kalserthals just across the main chain of the Alps by Linz. In these places the converse of our proposition is true, since, as one ascends the valleys the broad heads become less frequent. No explanation for this has been offered; but I have a suspicion that it points to still a third layer of population. The Slavic peoples immigrating within the historic period are all very broad-headed. It is not impossible that this racial element which has overlaid the Teutons in parts of eastern Europe may have followed them into these valleys. Certain it is that Slavic skulls begin to occur in this region. It may have happened in this way: When the long-headed Teutons came, they drove the primitive Alpine population into the side valleys. Then, when the Slavs followed the Teutons, these latter types drifted up and back as well, merging with the original broad-headed stock to produce an intermediate type of head form. This would obviously be less broad than the new Slavic type in relative purity along the main channels of immigration.

The evidence from the Tyrol that in this part of the Alps the broad heads lie nearest the soil is sustained by similar testimony from the other end of the same mountain chain. Dr. Bedot has studied in some detail the population of the Valais—the valley of the upper Rhone in western Switzerland.* Here precisely as in the Tyrol the side valleys are distinctly broader-headed than that of the Rhone. Wherever the foreigner has come he has lowered the cephalic index. Thus, for example, in the open valley of the Rhone the average index is but 82, while in the Gorge du Trient, leading over toward Chamounix, it rises 87. Few of the villages investigated are as isolated to-day as those in the Oetztal valleys of the Tyrol; but in proportion as they lie off the main track the index rises appreciably. The evidence is indubitable that the broad-headed type is the oldest and most primitive all through the Alps.

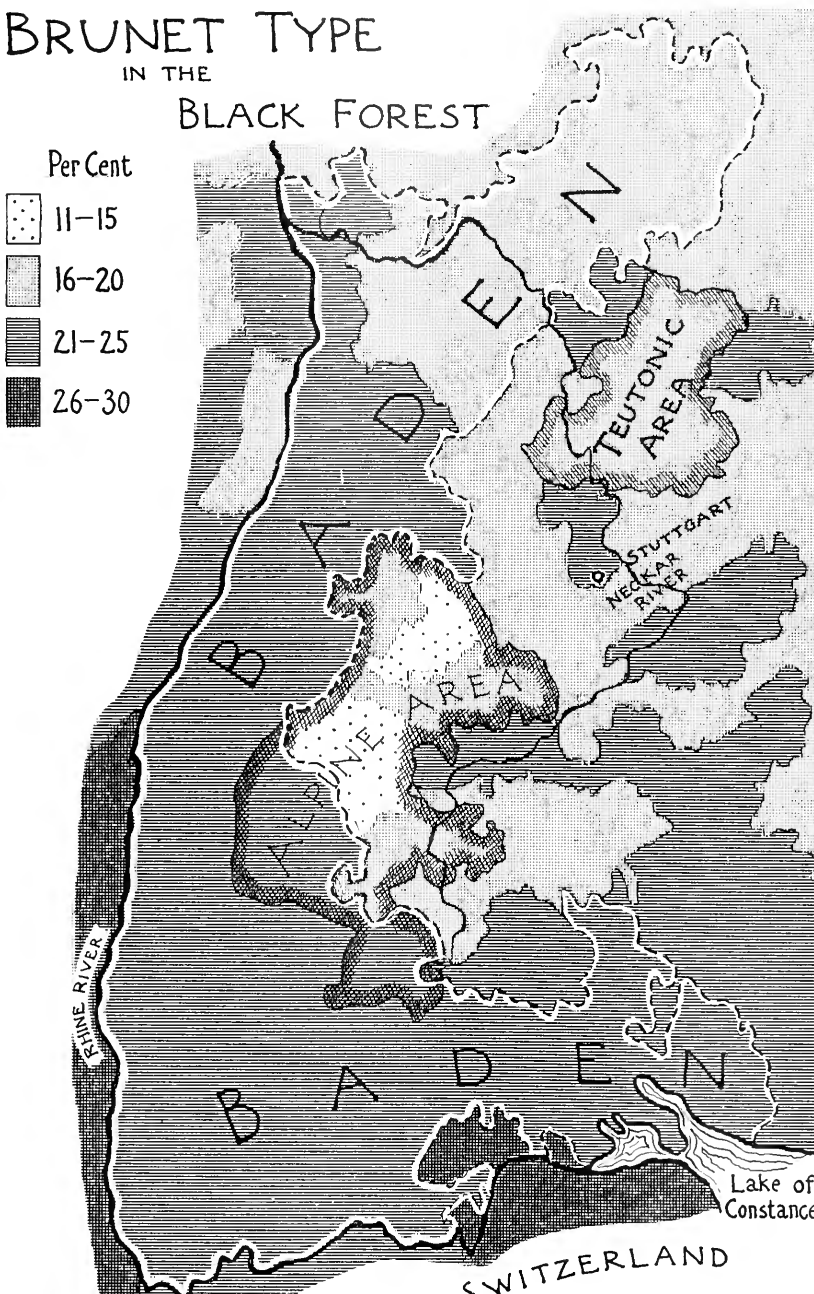
The fact which we have just indicated—namely, that the racial type of the population of the Alpine areas changes with the character of the country—will now serve us as a foothold for another advance in our argument. By it we shall hope to prove that while the Alpine racial type is intermediate in the pigmentation of the hair and eyes between the Teutonic populations on the north and the Mediterranean at the south, at the same time this physical trait is open to profound modification by the direct influences of environment. We shall hope to prove directly what we have already inferred from consideration of our general map of Europe;

* Bull. Soc d'Anth., Paris, Series IV, vol. vi, p. 486 *seq.*

namely, that certain factors, either climate, economic status, or habits of life, are competent to produce appreciable changes in the color of the hair and eyes.

Since, at this point, we are venturing forth upon an uncharted sea, it behooves us to stop a moment and examine what store of argument we have on hand. Two theses we hope to have proved respecting those portions of central Europe which are characterized by the broad-headed Alpine type of population. The first is that this racial element being the most ancient, becomes relatively more frequent in the areas of isolation, where natural conditions have been least disturbed by immigrants. In the byways, the primitive inhabitant; in the highways, the marauding intruder! This principle is as old as the hills. It is certainly true of languages and customs, why not likewise of race? We shall be able to establish its verity for all parts of Europe in due time. It forms the groundwork of our socio-geographical theory. The second thesis, no less important, is that this primitive Alpine type of population normally tends to be darker in hair and eyes than the blue-eyed, flaxen-haired, and long-headed Teutonic peoples on the north; and that, on the other hand, by its grayish hazel eyes and brownish hair, this broad-headed type is to be distinguished from its more thoroughly brunette neighbor at the south. The geographical evidence afforded by our map of Europe all gives tenability to this view that the Alpine type is intermediate in the color of hair and eyes. It will serve as proof provisionally at least. In the next paper we shall discuss the matter of the association of separate traits into racial types from another point of view. We shall run up against some contradictory evidence, to be sure, but satisfactory disposition may be made of this when it appears. In the meantime we assume it to be geographically, if not indeed as yet anthropologically, proved beyond question.

What deduction is to be made from these two theses we have just outlined? The third side of our logical triangle seems to be fixed. If the areas of isolation are essentially Alpine by race, and if this ethnic type be truly intermediate in pigmentation, the byways, nooks, and corners of central Europe ought normally to be more brunette than the highways and open places all along the northern Teutonic border. Contrariwise, toward the south the indigenous undisturbed Alpine populations ought to be lighter than the heterogeneous ones, infused with Mediterranean brunette blood, if we may use the term. Since mountainous areas are less exposed to racial contagion by virtue of their infertility and unattractiveness as well as by their inaccessibility or remoteness from dense centers of population, we may express our logical inference in another way. Where the Teutonic and the Alpine racial types are in contact geographically the population of mountainous or isolated areas ought normally to contain more brunettes than the people of the plains and river valleys, since blond traits have had lesser chance of immigration. The opposite



rule would obtain south of the Alps. If this relation does not hold, there must obviously be something environmentally the matter. Let us examine the facts.

The Black Forest in southwestern Germany affords us a good opportunity for the comparison of relatively pure and mixed

PURE BLOND TEUTONIC TYPE. Cephalic Index, 75.

populations. This mountainous, heavily wooded district, shown in our map, lies close by the upper courses of the two principal rivers of Europe, which have both formed great channels of racial migration. The Rhine encircles it on the west and south, and an important affluent of the same river bounds it on the east; for the Neckar drains the fertile plains of Würtemberg, or Swabia, which lie about Stuttgart. This capital city, it should be observed, lies not far from the point of that blond Teutonic wedge which, we have already shown, penetrates central Europe from the north. Finally, the Danube, not shown upon the map, takes its source in the southeastern part of the Forest, and has therefore opened up still another route of racial immigration from this quarter.

There is every evidence that here in the Black Forest is a mountainous area of isolation containing a people which is distinctly Alpine in type of head form as compared with the mixed populations of the fertile plains and valleys round about it. For example, the cephalic index in Wolfach in its center is above 86, three units and more above the average for the Rhine Valley communes.* This difference is almost appreciable to the eye; it may be approximately shown by the three portraits in our text. The first one represents a pure Teutonic blond type with the relatively narrow head and long face characteristic of the race of northern Europe. The second is the average type found in Baden, probably about half Teutonic and half Alpine by race. The breadth of the head compared with its length as well as the roundness of the face appear to be well marked. It should be added that it was characterized by brown hair and blue eyes. The third portrait, unfortunately not of a native of the most retired upland of the Forest, is nevertheless fairly typical of the extreme breadth of head form which there prevails. In this particular case the face is rather long for the breadth of the head, a combination not uncommon in southern Germany. For reasons given in the preceding paper, this facial feature may be regarded as less important than the proportions of the cranium itself. Judged by this latter standard, there is every indication that the Black Forest

Mixed Baden Type. Cephalic Index, 83.

contains the broad-headed Alpine type in comparative purity. Dr. Ammon, of Baden, has very kindly placed his unpublished data at my disposition. These have been suitably mapped † by com-

* Dr. Otto Ammon, in Sammlung gemeinverständlicher wissenschaftliche Vorträge, neue Folge, Series V, Heft 101.

† Certain statistical liberties have been taken with this map. For instance, it has been assumed that in the long and narrow administrative districts, extending from the Rhine

munes, proving that in so far as Baden itself is concerned there is no doubt about the increased broad-headedness as one penetrates the innermost recesses of the Schwarzwald.

For Würtemberg and the Neckar Valley we have no modern researches upon living men to offer as evidence. In place of it we possess results obtained upward of thirty years ago from a study of the crania of modern populations.* At that time von Hölder discovered the existence of two distinct types of head form in the population of Swabia, and he found them severally clustering about the two "areas" outlined upon the map. In the northern one, lying just outside the old Roman wall which cut diagonally across the map from the southeast not far from Stuttgart, he found traces of a long-headed population, deemed by him typical of the barbarians of Germany. Within the "Limes Romanus" were mixed populations infused with Roman characteristics, but pointing to an isolated center of broad-headedness. This is shown by the "Alpine area." It will be observed at once that these results for Würtemberg and Baden are a check upon one another, despite the fact that the two researches were made over thirty years apart—one upon skulls, the other upon living men. That in this Black Forest area of isolation we have to do with an island of the Alpine type is also rendered more probable by the relative shortness of its people. Our next paper will deal with bodily stature as an ethnic trait. We may here anticipate enough to assert that a tall stature is one of the most constant characteristics of the Teutonic type. The Alpine race is distinctly shorter. Therefore this third physical trait helps to confirm us in our deduction.

ALPINE TYPE. Cephalic Index, 87±.

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clear across to the eastern frontier of Baden, the eastern or upland half was as much broader-headed than the western Rhine half as separate districts lying along the east were above others along the Rhine. In such cases the technical averages have been split up into two others conforming in general with the averages for those districts which really follow the topographical features of the country.

* Dr. von Hölder, in Archiv für Anthropologie, vol. ii, p. 50. The indicated "Alpine" and "Teutonic Areas" are mapped from his enumeration of the communes in which he asserted the several types to be most prevalent. As such the results can not be more than roughly approximate. That they accord so fully with the data for Baden gives hope that the true conditions are represented.

Probability is rendered certainty by corroborative evidence from a large part of Europe that the Alpine type for some reason always takes to the woods and hills when in competition with the Teutonic race. We shall be able to show it in detail for France, Germany, Austria, and elsewhere, as we have already done for the Tyrol. Just across the Rhine in the Vosges it is true, and in Belgium it determines the division line of Walloons from Flemings. We may accept the law as proved beyond reasonable doubt.

This population of the inner Black Forest being Alpine, ought racially to be dark in the color of the hair and eyes. Nevertheless, the evidence all goes to show that, instead of being darker, it really manifests a distinct tendency toward blondness. Here, again, we are able to draw proof from two separate sources which serve as a check upon one another. The ground tints upon our map represent the percentage of pure blondes among the school children, as gathered in the great census conducted by Virchow. They show that a considerable part of the "Alpine area," measuring the head form, contains an abormal number of blond children. For example, forty-two hundred children in this Alpine area comprised but fifteen per cent of blond types, as compared with an average of nearly twenty-five per cent in the Rhine and Neckar Valleys. For Baden, however, the blondness of the upland interior region does not appear upon this map. Fortunately, we possess detailed results for this side of even greater value, since Dr. Ammon has studied the adult population. He asserts that there is a regularly increasing blondness toward the center of the Forest.* Why did this not appear among the thousands of school children in Baden studied by Virchow? To venture a rash hypothesis, may it not have been because the influences of environment had not had time to produce their effects so strongly in childhood, and that they appeared in accentuated form at a later period of life? Before we proceed to discuss the exact cause of this surprising reversal of racial characteristics, let us consider one other example of a similar character.

Some years ago Dr. Studer conducted a great investigation upon the color of the hair and eyes of some ninety-four thousand school children in the canton of Berne, in Switzerland.† As a result he discovered another one of these confusing phenomena of racial improbabilities. It appeared that here also there was an appreciable tendency toward blondness in the high Alps, racial tendencies to the contrary notwithstanding. Topographically,

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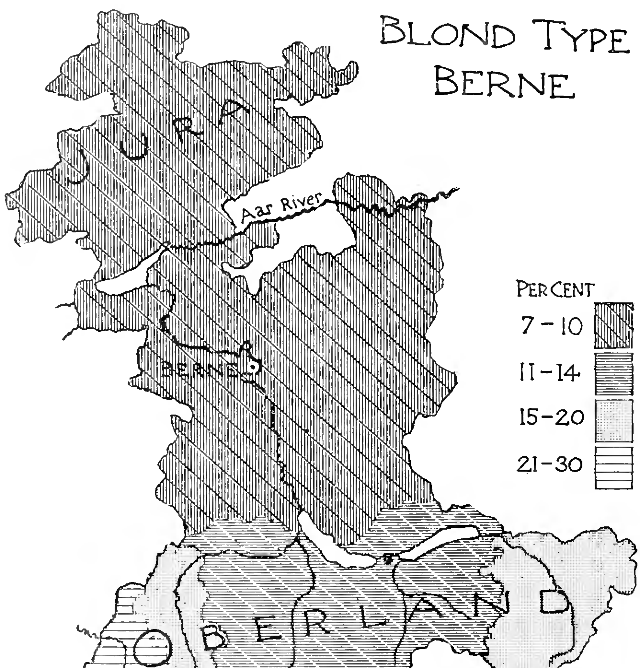
* For example, Wolfach, in the southern part of the "Alpine area," with the broadest heads in Baden, contains thirty-one per cent of blondes among adults. Ammon, *op. cit.* In this commune sixty-four per cent of the cephalic indices were above 85.

† Mittheilungen der Naturforschenden Gesellschaft in Bern, 1880, Heft 979, p. 54 *seq.*

the canton of Berne extends over three regions quite distinct in character. A middle strip along the valley of the Aar as far as the city of Berne consists of an elevated, not infertile table-land, with a rolling, hilly surface. This becomes gradually more rugged, until it terminates in the high mountains of the Bernese Oberland south of Interlaken. Here in this chain we have the most elevated portion of Switzerland; and, we may add, one of the most unpropitious for agriculture or industry. The peasants hereabouts must live upon the tourist or not at all. The north-



ern third of Berne covers the Jura Mountains, quite high, but of such geological formation that the soil yields not ungraciously to agriculture. Thus from the economic point of view we may divide the canton into two parts, setting aside the southern third—the Oberland—as decidedly inferior to the rest. The people of this region in the ante-tourist era could not but be unfavorably affected by their material environment.

Our map shows that this economic contrast is duplicated in the anthropological sense by a considerable increase of blondness within the Oberland, which becomes more marked as the fastnesses of the mountains are approached. North of the city of Berne there are from seven to eleven per cent of pure blondes; in the Oberland sometimes upward of three times as many. Is it possible that this blondness in the mountains may be due to race? If so, it must be Teutonic. Our map of Europe shows that Switzerland is cut in halves at just this point by an intrusive strip of northern blondness. Dr. Studer explained it on the assumption that this blondness migrating to the south along the Rhine, and then up the Aar, had heaped itself up, so to speak, against this great geographical barrier. This supposition might be tenable were not the evidence of the head form for all Europe flatly opposed to it. There is nothing to show that the law of segregation of the Alpine type in the areas of isolation does not hold here as in the Tyrol, in western Switzerland, and the Black Forest. Central Switzerland was historically overrun by the Helvetians, who have been identified as Teutonic by race. The Rhætians were the more primitive Alpine type. Every principle of human nature and ethnology opposes the supposition that these conquering Helvetians would be content to leave the darker Rhætians in full possession of the fertile plain of the Aar while they betook themselves to the barren valleys of the Oberland. Everywhere else in Europe the rule is, "To the conqueror belong the plains, to the vanquished the hills." The blondness of the Oberland must therefore be regarded as racially anomalous. Another explanation for it must be found in the influence of environment.

Our final example, tending to prove that in mountainous areas of isolation some cause is at work which tends to disturb racial equilibrium in the color of the hair and eyes, is drawn from Dr. Livi's monumental treatise on the anthropology of Italy. In entire independence of my own inferences, he arrived at an identical conclusion that blondness somehow is favored by a mountainous environment. From a study of three hundred thousand recruits he found that fourteen out of the sixteen *compartimenti* into which Italy is divided conformed to this law. There was generally from four to five per cent more blondness above the four-hundred-metre line of elevation than below it.* The true significance of these figures is greater than at first appears, for we have again to consider the contrasts in the light of racial probability. In northern Italy the mountains ought to be lighter than the plains, because the Alps are here as elsewhere a stronghold of a racial type relatively blond as compared with the Mediterranean

* Anthropometria Militare, p. 63 *seq.* A review of this work is given by the author in Publications of the American Statistical Association, vol. v, pp. 38 and 101 *seq.* This law is shown by study of provinces also. There are sixty-nine of these available for comparison. Twelve of these contain no mountains; thirty-two show manifestly greater blondness in both hair and eyes; fifteen show it partially; in two, mountain and plain are equal; and in the remaining seven the law is reversed. Several of these latter are explainable by local disturbances.

brunettes. Environment and race here join hands to produce greater blondness in the mountains. It is in the south of Italy that the two work in opposition, and here we turn for test of our law. In the south the mountains should contain the Mediterranean brunette type in relatively undisturbed purity, for the northern blondes are more frequent in the attractive districts open to immigration. Even here in many cases this racial probability is reversed or equalized by some cause which works in opposition to race, so that we find comfort at every turn.

The law which we have sought to prove is not radically new. Many years ago Waitz asserted that mountaineers tended to be lighter in color of skin than the people of the plains,* educing some interesting evidence to that effect from the study of primitive peoples. He held that the true cause lay in the modifying influences of climate. Much of the data which we have here collected does not prove this. In fact, climatic changes can not be related to some of the variations in blondness which have been outlined. It seems as if some other factor had been at work. Dr. Livi ascribes the blondness of mountain peoples rather to the unfavorable economic environment, to the poor food, unsanitary dwellings, and general poverty of such populations. This explanation fits neatly into our social theory: for we assert that the population of mountains is relatively pure because there is no incentive for immigration of other types. Thus a pure population implies poverty of environment—a poverty which may stand in direct relation to the lack of pigmentation. It is yet too early to assert that this is the main cause. For the present it will suffice to have proved that appreciable differences in pigmentation exist, leaving the cause for future discussion. Much interesting material drawn from comparisons of urban with rural populations may help to throw light upon it. Our main purpose here has been to prove that pigmentation is a trait which is affected by environment. If, as we hope to have shown, the shape of the head is not open to such modification, we shall know where to turn when conflict of evidence arises. We shall pin our faith to that characteristic which pursues the even tenor of its racial way, unmoved by outward circumstances.

COMMENTING on the possibilities foreshadowed by the opening of the Niagara water power and foreseeing the extension of the principle to other cataracts, the London Spectator suggests that we shall perhaps ask in the future not "Has the country got coal?" but "Has it got waterfalls?"

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* Anthropologie der Naturvölker, vol. i, p. 49 *seq.*

REVERSIONS IN MODERN INDUSTRIAL LIFE.

By FRANKLIN SMITH.

PART FIRST.

IF the law of reversion holds true of physical life, it holds equally true of industrial life. Under its operation is revived the career of institutions as indicative of conditions long passed away as any deformity that may once have saved from extinction a race of brutes. However useful in the elevation of man from degradation and savagery, they contributed, after the completion of their purpose, no further service than one of evil. To many social reformers, the legislation in revival of the old trade and professional corporations, whose noble achievements fill one of the lighter pages of history, seems important and beneficent. But an error more alluring and dangerous was never current. Such legislation will not, as Herbert Spencer has often shown, further human welfare. On the contrary, it will undo the work of civilization, and renew the ravages of barbarism.

I.

When feudal corporations came into the world, there was an excuse for them. It was to prepare the way for modern industrial civilization. They found Europe in a state of anarchy. Every man's hand was against his neighbor's. War was almost the universal occupation. The men not engaged in robbery and slaughter were the menials—the serfs and slaves. It was in the midst of this disorder and carnage that the feudal corporations were born. The natural and spontaneous product of the times, and not of the wisdom of some philanthropist or statesman, they met the most urgent of needs—peace and security. "The working-men's corporation and the commercial guild," says Pigeonneau, "were, first of all, an instrument of defense, a kind of mutual assurance against the violence, the exactions, or the negligence of the seignior and his representatives." * For these most unfortunate people, there was no police, no armed force for protection, no public security of any kind. They were plundered and murdered with impunity. For them there were no schools, no charities, no social organizations. Even religious privileges were denied them. Under the stress of threatened extermination, as well as the loss of all the blessings of life, the industrial classes, the most contemptible of human creatures, came together in powerful organizations for mutual aid and protection. "Individuals," says

* Histoire du Commerce de France. Par H. Pigeonneau, vol. i, p. 111. See Palgrave, Dictionary of Political Economy. Corporations, by Prof. J. K. Ingram, vol. i, p. 429.

Boehmert, "engaged in the same profession formed associations for the protection of their person, their families, and their property; for the creation of an internal moral and economic police, and particularly to punish associates who, by cheating in the quality of their products, could injure the reputation of the whole city; to watch over the completion of a regular apprenticeship, and to exercise a moral censorship over apprentices and journeymen; to take care of the widows, the orphans, the aged, and the infirm among them; to join together in the parish and to have masses said over the dead; to furnish a contingent of arquebusiers to the troops of the city, and, in general, to satisfy all social wants." *

Even when Étienne Boyleau, the famous provost of Paris under St. Louis and the author of the still more famous *Livre des Métiers*, gave these corporations a legal status, there was still an excuse. He was a warrior, with a warrior's love of discipline and system; he was a magistrate, with a magistrate's hatred of all kinds of lawlessness and dishonesty; he was a tax reformer, with tax reformer's eye to new sources of revenue for the impoverished treasury of a crusading monarch. "He re-established discipline in commerce, and in the arts and trades," says a writer in the *Biographie Universelle*, "in the collection of the royal taxes within his jurisdiction, and fixed those of the seigniorial courts included in his provostship; he moderated and fixed the imposts that were raised arbitrarily, under the provost farmers, on commerce and merchandise; he arranged all the traders and all the artisans in different bodies and communities under the title of brotherhoods; it was he that gave these corporations their first status for disciplinary purposes, and established the rules for the encouragement of honesty and commerce." † But there is reason to believe that the chief purposes of this feudal reformer were police and fiscal. "The kings," says Depping, "made successful use of the corporations for the collections of imposts, then very imperfectly done. When the artisans and traders were formed into a body, it sufficed to summon the head men and to charge them with the collection of the taille for each trade. . . . It became easier to designate the persons that should keep watch during the night, a forced labor that displeased the Parisians very much, and from which they sought as much as possible to escape." ‡

It is an inevitable tendency of all organizations, whatever be their purpose, be it political or industrial, to consolidate and

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* Dictionnaire général de la Politique. Par M. Maurice Block. See Corporations, by V. Boehmert, vol. i, p. 537.

† Vol. v, p. 436.

‡ Règlemens sur les Arts et Métiers de Paris. Avec Notes et une Introduction. Par G.-B. Depping, p. lxxxiv. See also Palgrave, Dictionary of Political Economy, pp. 430, 431.

strengthen their power.* As long as the corporations of the arts and trades remained voluntary organizations, meeting wants that could be provided for in no other way, they played an important and indispensable part in the machinery of feudal society. It was in the interest of order and industry that they established monopolies, collected fees and dues, and sold privileges. With the money thus obtained, they protected life and property, promoted trade and commerce by the construction and maintenance of land and river routes,† and provided for the social wants of their members. But when they fell into the hands of the Government they were doomed. The vicious traits inherent in all organizations received a new impulse under the protection of the law, and eventually converted them into an intolerable evil. "Each corporation," says Depping, after telling how the interests of the public were ignored, "had in view only the personal advantage of the masters of the trade. The result was long apprenticeships, . . . heavy fines imposed on the apprentices, efforts to exclude from the markets of Paris the unauthorized traders and artisans, special privileges demanded by the industries devoted to the production of luxuries, restriction put upon emulation and competition, and finally a mechanical uniformity in manufacture." ‡

Even in the time of Philippe le Bel these evils were recognized, and an effort was made by that prince to remedy them. Many of the privileges of the corporations were abolished, the most notable being the permission granted to the Parisians to bake their own bread.# But the poison of monopoly had entered too deeply into the industrial system of the age to be eradicated so easily. The constant effort of the monopolists was to increase their monopoly; the constant effort of the Government was to exploit it—to convert it into a gold mine for the tax gatherers and an asylum for the office seekers. Enormous initiation fees were charged. In Paris they reached the incredible sum of a thousand livres; in the lesser cities they were five hundred.‖ It became impossible in some places in Germany to gain admission to the corporations except through marriage with the daughter or the widow of a master.△ The terms of apprenticeship and journeymanship were prolonged beyond all rational limit. The French coopers had to serve seven years, and the hatmakers ten years. If a man served an apprenticeship in Rouen and moved to Paris, he had to serve another.◊ Tests of fitness for admission, like the production of a

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* See the striking example given by Depping, p. xxxii. † Pigeonneau, vol. i, p. 117.

‡ Règlemens sur les Arts et Métiers, p. lxxxiii. # Ibid., lxxxiv.

‖ Boehmert. Block's Dictionnaire général de la Politique, vol. i, p. 538.

△ Palgrave. Dictionary of Political Economy, vol. i, p. 431.

◊ Blanqui. History of Political Economy, p. 185.

masterpiece, made under rules that either hampered or destroyed all skill and originality, were rigorously applied. To draw the cords of monopoly still more tightly, rites and ceremonies were invented, the aid and protection of saints invoked, and emblems, banners, badges, and distinctive costumes to mark off each art and trade designed and adopted.

The moral havoc wrought by these monopolies was greater even than the industrial havoc. It crushed all feelings of justice and humanity, making its victims more grasping and cruel than Shylock; it led them to the practice of every trick and deception of a Newgate sharper to evade the laws; it stirred up a contention that rivaled the quarrels of the Guelphs and Ghibellines. Apprentices became no better than serfs and slaves. They were not merely pitilessly fined and brutally punished; they were often left in ignorance of the craft that they had purchased the right to learn. In that frightful social and moral revulsion following the long and devastating wars of the sixteenth and seventeenth centuries, the corporations became more determined than ever to maintain their industrial aristocracy and monopoly. They refused to admit any trade less ancient and honorable than their own, to the rights and privileges of the law; they soiled themselves by contact with no person of illegitimate birth; and in their savage and relentless pursuit of persons engaged in unauthorized traffic they invaded the homes of contraband workmen, confiscating both their tools and the hidden products of their toil, leaving them and their families destitute and starving.* To such absurd lengths was the creation of corporations carried for the production of new taxes and new places for court favorites that occupations like the teaching of dancing, the selling of flowers, and the catching of birds were organized, and homogeneous occupations like the hatmakers' and carpenters' were divided and subdivided beyond the comprehension of the modern mind. But despite the ingenuity of lawyers and the vigilance of armies of inspectors, the lines of demarcation could not be drawn so sharply as to avoid conflicts of interests. The makers of felt hats quarreled with the makers of cotton hats. The spinners who had purchased the right to use hemp quarreled with those that had purchased the right to use flax. The shoemakers fought with the cobblers that reproduced more than two thirds of an old shoe. The cutlers that made the handles of knives fought with those that made the blades. The relations of the makers of wooden porringers and the makers of wooden spoons were equally belligerent. Blanqui says that in the middle of the seventeenth century the annual cost of litigation over these inevitable inva-

* Boehmert. Block's Dictionnaire général de la Politique, vol. i, pp. 537, 538.

sions of industrial territory amounted in Paris alone to more than five hundred thousand francs; that the money wasted upon the suits of comparatively small corporations amounted to twenty-five thousand. "From St. Louis to Louis XIV," he says further in a striking summary of the fate that befell them, "there was not a sovereign who did not impose restrictions, taxes, and new regulations upon them; the courts overpowered them with judgment and fines without diminishing their ardor or calming their hatreds." * Founded to establish order and to fulfill a mission of mercy, they degenerated into engines of oppression, confusion, and degradation, giving birth, in a word, to all the evils of a society in a state of dissolution.

Such anarchy, which prevailed in England as well as in France, though in a less degree, could not be permitted to last. It would in time have wrecked society morally and industrially. Although ruinously delayed, relief came at last through the labors of thinkers, statesmen, and revolutionists, but especially through the ameliorations of the long peace that followed the devastating and demoralizing wars of Napoleon. Adam Smith was among the first to come to the rescue. The whole of his great work was a potent protest against monopoly in all forms. He pointed out that "the exclusive privileges of corporations, statutes of apprenticeship, and those which restrain in particular employments the competition of a smaller number than would otherwise go into them" were "encroachments upon natural liberty." † But it was more than fifty years before the laws that he inveighed against so powerfully were finally repealed. In France also the thinkers led the way. "Let complete liberty of commerce be maintained," said Quesnay. "When the interest of the individual is exactly the same as the general interest," said Gournay, "the best thing to do is to leave every man to do as he likes." ‡ Applying these principles to the corporations, Turgot proclaimed that "the right to work is the sacred and inalienable property of the poor man." Again he said, "All sound principles were violated by the accepted doctrine that it was a royal right that the prince might sell and subjects might buy." # But the work of industrial emancipation that he tried in vain to do—a work that might have saved his country from the horrors of the Revolution—was among the first and most beneficent achievements of that frightful convulsion. The Wealth of Nations early

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* Blanqui. History of Political Economy, pp. 183, 184.

† Palgrave. Dictionary of Political Economy, vol. i, p. 430. See whole of Part II. chapter x, Wealth of Nations, Rogers's edition.

‡ Lowell. Eve of the French Revolution, pp. 234, 235.

\# Palgrave. Dictionary of Political Economy, vol. i, p. 431

made its way into Germany, and soon leavened the views of her economists and statesmen. From 1808–'10, when the Stein-Hardenberg legislation was enacted, down to the Revolution of 1848, when a change of policy began, the rulers of that war-infested land conferred upon labor their most precious gift and its most precious boon—the right to work. But with the destruction of the tranquillity that closed the first half of the century came the inevitable reversions to political and industrial despotism. "The principles that they recommended for adoption," says Boehmert, referring to the results of the Berlin conference of the Government with the workingmen, afterward crystallized into legislation, "were worthy of the worst epochs of the middle ages." * It was not until twenty years later, under the *régime* of the Confederation, that this legislation was wiped out, and industrial liberty again established. Since then, however, the Franco-Prussian War has occurred. The result was the same as in 1793 and 1848. Freedom has fallen into discredit, and is in danger of eclipse. "There has of late," says Prof. Ingram, "been a feeling in France and Germany that, with the abolition of the restrictions enforced by the corporations, there was a real loss of moral and social as well as economic benefits. In Prussia several efforts have been made to restore them to a free basis; and it is understood that further steps of the same kind are likely to be taken by the German Governments, whose object is thus to establish a sort of police of the industrial world, and solve a part of the great problem of the organization of labor." † As though despotism could, in times of peace and honest toil, solve any problem but the loss of liberty and the ruin of civilization!

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* Block's Dictionnaire général de la Politique, vol. i, p. 539.

† Palgrave. Dictionary of Political Economy, vol. i, p. 43. Since this was written the publication of Mr. Spencer's third volume of Principles of Sociology, page 595, acquaints me with the existence of "a recent measure for establishing compulsory guilds of artisans, a manifest reversion." Even Mr. Lecky, whose views have very little in common with those of Mr. Spencer's social philosophy, has recognized this tendency to revert to feudal despotism. Referring to the ideal of labor leaders, he says, "The industrial organization to which they aspire approaches far more nearly to that of the middle ages or of the Tudors than the ideal of Jefferson and Cobden." (Democracy and Liberty, vol. i, p. 258.) Again he says (vol. ii, p. 441): "A considerable workingmen's party on the Continent, but especially in Austria, Germany, and Switzerland, desires 'obligatory syndicates,' or, in other words, corporations for carrying on particular trades, to which all who practice those trades must necessarily belong. It is a system curiously like the guilds and other trade organizations and monopolies that flourished in the middle ages. In Austria a very remarkable law, enacted in 1883, established compulsory guilds, including all employers and workmen, for the smaller industries, with power of regulating apprenticeships. . . . In 1893 a workingmen's congress, held at Bienne, in Switzerland, unanimously voted for obligatory corporations; a revision of the Constitution was prepared which would have made it possible to establish such corporations and suppress free labor, but it was defeated by a small majority on a referendum vote."

II.

Since Boyleau impressed the corporations into the police and fiscal service of a military despotism, thus converting agencies of order, industry, and humanity into engines of greed and oppression, the conditions of society and the thoughts and feelings of enlightened races have been revolutionized. A state of anarchy no longer exists. War has ceased to be the chief occupation of men. Their ambition is not to murder and plunder their fellows. Devoted to the arts of peace, they have come more and more to exhibit the manners and sentiments of civilized life. There is therefore no occasion for the institutions that feudal confusion and anarchy made needful. A powerful police organization restrains the robbers and murderers. An elaborate system of courts investigates crimes, both great and small, settles disputes between the contentious, and seeks to maintain the rights of the simple and weak against the cunning and strong. Asylums, hospitals, refuges, homes, and charitable societies without number provide for the sick, the aged, the destitute. Education in all the fields of human knowledge, fitting men and women for every position in life, can be had in the universities, colleges, academies, technical schools, and public schools, both primary and secondary, that cover the land. Social and religious organizations minister to every conceivable social and religious need. No obloquy is attached to any honest pursuit. Character and ability have come more and more to be the test of social worth. The great men of the world are not the warriors; they are the captains of industry, the discoverers in science, the thinkers, the scholars, the artists, the philanthropists, the statesmen.

Yet it is proposed to introduce into a society like this—one based not upon war, but upon peace and industry—the institutions that finished their proper work centuries ago; * that survived, in consequence of their alliance with the state, their usefulness so long that they became a curse to man and an obstruction to social and industrial progress. Not only is it proposed, but, as already intimated, steps have actually been taken, to convert the plumbers, the undertakers, the barbers, the horseshoers, the opticians, the dentists, the druggists, the stationary engineers, and other trades and professions into close organizations like those that once covered Europe.† Legislation has been had in several

* Pigeonneau, vol. i, p. 176.

† Since this was put in type my attention has been called to a New York State law, enacted last year, for the regulation of "public accountants," who may be regarded simply as glorified bookkeepers. It provides that any person "over twenty-one years of age and of good moral character," who shall have passed a prescribed examination, shall "be styled and known as a certified public accountant." It forbids any other person to "assume such

States to give them rights and privileges as violative of the principle of equal freedom and as hostile to the interests of society and civilization as those that Boyleau conferred upon the corporations of Paris. Under the specious plea of protecting the interests of the public and of self-improvement, both morally and intellectually—a plea that Boyleau himself did not forget to make *—there is in progress a movement to extend these rights and privileges to the members of the same trades and professions in other States. Unless it is checked, an achievement that has not yet been undertaken, we shall have fastened upon us before we are aware of it the same intolerable industrial and professional tyranny that contributed so powerfully to the French Revolution; for the rules and regulations are becoming so numerous and despotic, particularly those that have emanated from the plumbing trade, that individual liberty, in all that pertains to that business at least, is practically denied. They rival in minuteness and vexatiousness anything that Boyleau produced. For the judgment and will of the person most interested in the perfection of a piece of work are substituted the judgment and will of the person least interested.

If organization, whether industrial or political or social, involves a loss of liberty, it also involves, as the story of the French corporations shows, a more serious loss of truth and honor. It does not lead simply to cruel intolerance; it leads to the grossest hypocrisy. Were the slightest value to be attached to the pleas and apologies of the modern corporations, there would be no possible escape from the conviction that they are animated by the loftiest motives. Their ambition is not limited to self-improvement and deliverance from an obloquy and con-

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title, or use the abbreviation C. P. A., or any other words, letters, or figures to indicate that the person using the same is such certified public accountant." Very curiously so intelligent a journal as the Commercial and Financial Chronicle (February 13, 1897) regards such absurd and obsolete legislation as "very important," believing evidently that it will do much to insure a correct audit of corporation accounts. Yet it is clear-headed enough to see "that even under the best of conditions accountants' examinations are subject to certain limitations," and "such examinations by no means provide a remedy for all the ills of corporate management."

* "Because," says Boyleau, in the introduction to the Livre des Métiers, "we have seen in Paris in our time much jocularity and unbridled lust which is becoming corrupt, and likewise the nonsense of the young and ignorant among the young foreigners and those of the city who neither have nor practice any trade, because they had sold to strangers no things so good or so loyal as they should be." After mentioning the courts of jurisdiction he has established, Boyleau continues: "This we have done for the profit of all, including the poor and the strangers who come to Paris to buy commodities; that the commodities may be so loyal that they will not be deceived by there being some defect; and to punish those who shall receive dishonest gain or, through lack of sense, ask it and take it contrary to God, to law, and to reason."—*Blanqui, History of Political Economy, p. 180.*

tempt hardly less profound and humiliating than that visited upon the honest toil of feudal times; it includes the noble rôle of philanthropist and benefactor. "The principal object of this bill," says the note appended to a measure to regulate the practice of optometry in the State of New York, but really to restrict the sale of spectacles to opticians, "is to protect the public against incompetent and designing persons who may in the future attempt to traffic upon postulate skill in adapting glasses to the sight!" * "To the end that public health and our loved ones" may "be more adequately protected," and "to the elevation of our profession" and the suppression of "the impostors in our business," the undertakers of Indiana, with more tenderness than the opticians, due perhaps to the nature of their calling, ask for the enactment of a bill to create a "State Board of Funeral Directors," and to prescribe certain requirements to the trade. When the barbers of the State of New York met in Syracuse last November to frame a similar measure, they, too, felt moved to proclaim the purity of their motives. "We have been hampered and humiliated for years," they said, "by incompetent people working at our profession." Among these obnoxious persons are "the drunken barbers," the workmen graduated from so-called barber colleges "in the remarkably short time of eight weeks," and, finally, the laborers and mechanics engaged in other occupations during the day that shave and cut hair in the evening, using "one towel on six persons," and charging the demoralizing price of five and ten cents for their dangerous services. "Innumerable people," they add, referring to this alarming peril, "have been inoculated with vile skin diseases, which, in many cases, have baffled the skill of physicians; and we claim," they assert, with the firmness of true philanthropists, animated by a noble principle, "that the public should be protected from these impostors." †

But the most edifying exhibition of disinterested benevolence is to be found in the pleas and apologies of the master plumbers —the strongest of these modern corporations and the happy possessors of the largest rights and privileges under the law.‡ It

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* The Optical Journal, vol. ii, No. 10, p. 393.

† The National Barber, December 31, 1896.

‡ As proof of this statement the following extract from the report of the Sanitary Committee at Philadelphia, 1895, may be given: "We have recited the utter lack of sanitary laws as we found at the time of our organization. Now note the change. The necessary preliminaries performed, immediately throughout the entire country the master plumbers' association, by various honorable, just, and enlightened efforts, exerted, too, under the most trying conditions of ridicule, sarcasm, ignorance, and narrow-mindedness, formulated and caused to be adopted regulating laws, now generally termed 'plumbing laws,' or 'rules and regulations of plumbing and drainage.' To such an extent did our labors ramify that, at this writing, there is no city or town, and hardly a hamlet, which is not in a greater or less degree controlled and benefited by our labors."—Proceedings, p. 42.

would not be possible for one unfamiliar with their history to imagine that any labor could ever have been in a more despicable condition. "I have served a sufficient time," said an official essayist * at the Detroit convention of master plumbers, "when the plumber was regarded as somewhat of a scavenger." † How shockingly degraded was the condition of these honest toilers is made still more vivid by the powerful picture of another essayist. "At that time," he said, alluding to the same distressing period, "the term 'master plumber' was a misnomer; he was a slave—slave to the tyranny of established business customs, slave to the reckless, demoralizing practices of dealers, slave to an embittered and hostile public sentiment, slave to the meanest drudgery and sacrifices of the trade, slave to his own weakness and submission." ‡ After speaking of the convention as composed of men "gathered together with no thought of pecuniary reward, to enhance the common welfare of man, to present and discuss the best means of preventing the ravages of disease with its resulting misery and woe," he declared, with rhythmic eloquence on another occasion, that "their profession has made them philanthropists, and their love of mankind has made them benefactors." # The power that wrought this miracle is the organization and legislation that have weeded out "the so-called master plumbers who do not understand their business," who, in consequence "jeopardize the health of the public," and who, through ignorance as to how plumbing should be done, "figure and take work at prices which can not be met by those who are skilled and desire to do good work." ‖

Here we come in contact with the true spirit that animates every modern trade and professional corporation. Without exception, they are struggling, like the old feudal corporations, to limit competition and to secure a monopoly of labor and trade. The plumbers may find much pleasure in calling themselves "philanthropists" and "benefactors"; they may strive laboriously to lift themselves to the plane of "professional sanitarians," ranking, to use the fine phrases of an official essayist, with "God's nobleman, the honest physician"; △ but their real object, however concealed under the alluring garb of rhetoric and sentiment, is to get the largest amount of money for the smallest amount of

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* The National Convention of the Master Plumbers has a Committee on Essays, which makes up a list of subjects and selects the best essays on them to be read before the convention. The views set forth in these essays, which are published in the regular reports of the proceedings, may therefore be regarded as "official."

† Proceedings, Detroit, 1894, p. 167.

‡ Proceedings, Cincinnati, 1891, p. 129.

Proceedings, Denver, 1890, p. 86.

‖ Proceedings, Cleveland, 1896, p. 38.

△ Ibid., p. 95.

work.* One of their number has been honest and frank enough to confess as much. "It is true," said Mr. John L. E. Firmin, of San Francisco, an official essayist at the Philadelphia convention, "that the prime moving cause of our organization was the betterment of our condition in dollars and cents." † However bald and brutal we may think such an impeachment of a noble purpose to "enhance the welfare of man" without "thought of pecuniary reward," it is the exact truth; and for a complete justification of every letter and syllable, no one need go beyond the official statements of the plumbers themselves. The annual reports of the proceedings of the National Conventions of the Master Plumbers' Association of the United States show that in spite of the exalted virtue they have assumed, they have not scorned the selfish policy and despotic practices of feudal times. By proposing the restriction of apprenticeship, by making more onerous the requirements for admission to their associations, by driving from the field they have seized upon the unauthorized persons called in to do their work, by striving to obtain a monopoly of the retail trade in plumbing supplies, they have exhibited all the traits that made the feudal corporations so odious and intolerable, and finally brought them to complete and merited ruin.

That they are not without some conception of the rights of the individual, that they realize the "irrepressible conflict" between their conduct and the principles of the institutions under which they live, there is ample evidence. When the journeymen plumbers of Omaha struck for an advance in wages, the master plumbers of the city discovered a keen enough appreciation of these rights and principles. "Resolved," said one of their resolutions in condemnation of the strikers, "that the members of the Omaha Master Plumbers' Association feel that their business interests are being unnecessarily and unwarrantably interfered with by the Journeymen's Union of this city, in that said organi-

* Besides the proofs of this statement in the text, the following may be given: A member of the New York Board of Horseshoers told me that one of the objects of their law was to increase the price for shoeing a horse all round from one dollar, charged by the poor horseshoers, to one dollar and a half and two dollars. "Ultimately," said the President of the New York Optical Society, in his address at Syracuse, June 2, 1896, published in the Optical Journal, vol. ii, No. 4, p. 124, "we should . . . endeavor to establish uniform prices for certain articles which are recognized as staples in our business. Great differences in our charges shatter public confidence in their legitimacy." Speaking of the benefits that should follow the enactment of a law to protect the barbers, the National Barber of April 30, 1896, says: "The better class of barbers would reap benefit, *better prices would prevail*, and the barber would then be classed with other professional men." Alluding to the barbers of Illinois, who demand protection also, a writer in the National Barber of December 31, 1896, says: "They are tired of seeing people buying their own razors, and will try to put a stop to such a one-sided practice if they can."

† Proceedings, Philadelphia, 1895, p. 90.

zation, by its rules and acts, denies to the master plumbers the right, as business men, to direct and manage their business affairs according to their own ideas." * How great a difference it makes whose ox is gored is disclosed again in the reply to the demand of the jobbing houses of Salt Lake City that the master plumbers of the town should, under the famous Baltimore resolutions,† restricting the sale of plumbing supplies to master plumbers only, purchase of them alone. "We hold the right," they said, with the true American spirit, "to buy where we can buy the best." ‡ The same view as to the rights of labor are to be found in the official essay that Mr. Edward Hayward, of Brooklyn, read before the Milwaukee convention. "Such claim," he said, referring to the claim that "organized labor has rights superior to those of the craftsman or laborer standing alone on his own merits, and supporting the dignity of his manhood," "could never have rooted well and can never flourish long in the atmosphere of a people possessing equal rights and capable of maintaining them. It would not," he added, in a tone of mild admonition,

* Proceedings, Pittsburg, 1889, p. 55.

† These resolutions were first adopted at Baltimore, June 26, 1884, and reaffirmed and amended at subsequent conventions. The essential part of the original resolutions is as follows: "*Whereas*, the manufacturers and wholesale dealers in plumbing material persist in selling to consumers, to our injury and detriment, placing us toward our customers in the light of extortionists, causing endless trouble; and *whereas*, the system of protecting us from this wrong, which draws in its wake other wrongs, is ineffective, it is absolutely necessary to perfect such a system by united action that will remove these evils from which we have suffered for years; therefore be it *resolved*, that the members of this association confine the purchase of plumbing material to manufacturers and wholesale dealers who sell goods to master plumbers only, as defined in these resolutions." The term master plumber was defined in the following resolution adopted at Washington in 1892 and amended at Philadelphia in 1895: "*Resolved*, that it is the sense of this convention that in the future the interpretation of the term 'master plumber,' as set forth in the above resolutions to entitle him to purchase plumbing material, be construed to mean a master plumber who has an established place of business and represents the industry of plumbing, and who has qualified under State or local enactments regulating plumbing and plumbers, where such exist; or, where no license is required, an individual or firm with an established place of business and representing the industry of plumbing." The following important additions were made at the Philadelphia convention: "*Resolved*, that the members of this association should not sell plumbing material to consumers when they do not furnish the labor for putting the material in. *Resolved*, that the supply houses doing a plumbing supply business and contracting for plumbing work shall be considered unjust competitors." The following are at present exempt from the operation of these resolutions: The United States Government, State, county, and city institutions, Sailors' Snug Harbor, railroad, gas, water, and electric light companies only for such goods as are necessary for their respective lines of business.

‡ Proceedings, Cleveland, 1896, p. 68. See also p. 161, Proceedings, Milwaukee, 1893, where the essayist says: "When rules governing a household, the laws of a State, or of a trade associate alike, are oppressive, they become inoperative by a general disregard of them. The inability of the governing power to enforce them is seen, and contempt for it follows."

"be wise, therefore, for a master plumbers' association, now free, to commit itself to such a dogma, or become a party to practices that would deprive any fellow-workingman of his natural means of obtaining a living." * Neither Adam Smith nor Turgot could have said anything better.

But poor human nature, even of the variety vouchsafed to master plumbers after they have been transformed by organization and legislation into "philanthropists" and "benefactors," is not able to live up to these vigorous assertions of the principle of personal liberty. The yearning it feels for "the fleshpots of Egypt" is too strong to be overcome by unselfish thoughts and sentiments. Blinded morally as well as industrially by its anxious pursuit of "betterment in dollars and cents," it denies to others the rights that it arrogates to itself. Like the old feudal corporations, it would make membership of its benevolent organizations as difficult as possible. "The St. Louis association," said the president of the Milwaukee convention, "has adopted a new constitution, making it a necessary requisite for membership that a candidate must have served five years' apprenticeship and three years a journeyman plumber. This qualification for membership," he added apologetically, "may be a little advanced for some localities, but I believe that the line ought to be drawn between practical and impractical men." † Indeed, it ought; but that is not the object of this restriction; otherwise the work of drawing lines between practical and impractical men would be left entirely to the person that employs them. The object is to make the plumber's business as exclusive as possible, and thus to restrict competition. "It is an undoubted fact," says a report on apprenticeship to the Cleveland convention, which discloses this ignoble purpose, "that many of the evils arising from the present ruinous competition in the plumbing business are due almost entirely to the great number of young men who have partially served an apprenticeship at the trade." ‡ But when an organization is once started upon the path of proscription, the steps to the most shameless exhibitions of the spirit of greed and intolerance are soon and easily taken. The Master Plumbers' Association of the United States is no exception. At the Cleveland convention, the Wisconsin delegation proposed that the number of apprentices should be restricted to one for every three journeymen and fraction thereof, and that the plumbers of the United States withdraw their "moral and financial support from all plumbing trade schools, as we think they tend to increase the ranks of the master plumbers." # Reflect upon the significance of such extraordinary

* Proceedings, Milwaukee, 1893, p. 162. † Ibid., p. 71.

‡ Proceedings, Cleveland, 1896, p. 130. # Ibid., p. 77.

words. They are a condemnation of technical education. Never were the feudal corporations guilty of anything more retrogressive, or more subversive of their own interests or the interests of the public.

It is but just to say that as yet the master plumbers have not established an apprenticeship or a journeymanship despotism. But that they are not lacking in the spirit that leads to both is manifest from their efforts to control the retail trade, which have been more persistent and systematic, and therefore more successful. Ever since the National Association was organized, they have striven to put a stop to the traffic between jobbers and consumers. So twisted have become the moral perceptions of the master plumber that deprivation of the profits from this traffic appears hardly less reprehensible than a fraud. "The jobbing houses," says the report of the vice-president of the Minnesota Association to the Detroit convention, calling attention to this species of crime, "are selling material to general contractors and owners of buildings, and hiring a plumber by the day to do the work, thus doing the boss plumber out of the profit that rightfully belongs to him." * Because of such a perversion of the ethics of trade, the natural fruit of organization and monopoly, it has almost ceased to be possible for corporations and the owers of large buildings, not to speak of the smaller and less influential victims of the "philanthropists" and "benefactors," either to do any part of their own plumbing or to get from a dealer the supplies needed for the work.† The definition of a plumber has been so narrowed that it does not apply to plumbers in the employ of either of these classes; and the definition of plumbing materials has been so broadened that it includes everything that a plumber handles. "I believe," said a New York delegate to the Cleveland convention, setting forth the view that has generally been adopted, "that everything that we handle is plumbing goods. I believe the meter, and the pump, and the range, and everything in a specification called for in the plumbing line, and which we have to handle, is plumbing goods." ‡ To such refinements has the lexicography of the plumbing trade been carried that a distinction has been drawn between plumbing goods that can and those that can not be sold to a shipbuilder, without the intervention of

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* Proceedings, Detroit, 1894, p. 67.

† In 1894 Mr. Oakes A. Ames and other large property owners attempted to get the following reasonable amendment made to the Massachusetts plumbing law: "Any person may, by himself, or his usual employees, without obtaining a plumber's license," as provided by the law, "do any proper plumbing work upon his own premises, and in doing such work shall not be restricted to the use of plumbing materials that can not be purchased in open market." But the amendment, which was denounced by so enlightened a journal as the Boston Herald, was defeated.

‡ Proceedings, Cleveland, 1896, p. 89.

the master plumber as middleman. To the former belong all supplies used in constructive or repair work in a shipyard, and to the latter all supplies used in constructive or repair work outside of a shipyard, and not requiring the special skill of the shipbuilder.*

But the arrogance of this modern trade corporation does not end here. Not content with denying to an American citizen the right to buy gas fixtures, or galvanized iron pipe, or bath tubs, or kitchen boilers from whomever he pleases; nor with telling him that he must not use wooden washtubs in his laundry, and that he must have at least one bathroom for every ten persons in his family; † nor with prescribing a code for the construction of his plumbing as minute and tyrannical as any that Boyleau ever dreamed of; nor with proposing a government inspection and approval of the plans of architects, especially with regard to light and ventilation; ‡ the master plumbers have sought to bring under their wise and benevolent jurisdiction the management of the business affairs of the government of cities, counties, States, and even of the nation. A California law provides that in the specifications for any State building, those relating to the plumbing must, to use their own jargon, be "segregated," and submitted directly to the plumbers for estimates.# The dignity of this noble organization of "professional sanitarians," which is coming to rival that of the feudal corporations, forbids the acceptance of a subcontract. "Master plumbers," said the president of the Texas association, after describing an attempt made in San Antonio to force upon the county commissioners the observance of the same absurd and tyrannical rule, "should never be second fiddlers to any contractor." ‖ The ordinances of San Francisco and other cities provide that no one but a regularly licensed plumber shall touch the sewers, thus compelling the payment of plumber's wages for the work of a laborer. Two years ago, the Master Plumbers' Association of Illinois passed a resolution that the United States Government should be denied the right to buy plumbing supplies from the jobbers.△ Is it any wonder that the Sanitary Committee urged in a report to the Philadelphia convention that "upon every favorable opportunity," the plumbers should "endeavor to disabuse the public of the idea that our legislative duties are selfish"? ◊ Is the idea altogether fanciful?

I have already mentioned how the feudal corporations took

* Proceedings, Cleveland, 1896, p. 141.

† Plumbing Code of Rochester, N. Y.

‡ Proceedings, Philadelphia, 1895, p. 45.

Ibid., 1895, p. 80.

‖ Proceedings, Detroit, 1894, p. 79.

△ Proceedings, Philadelphia, 1895, p. 54.

◊ Ibid., 1895, p. 43.

one of the most effective steps of organization and monopoly to retain power, namely, the selection of patron saints, the adoption of rites and ceremonies, and the use of banners, badges, and distinctive costumes. Most curiously, master plumbers have not neglected to propose a like step to safeguard their rights and privileges. "We would urge upon the Executive Committee," said Mr. James Ryan, the vice-president of the District of Columbia Association, "to make some recommendation that a ritual be adopted. . . . We would also recommend a suitable badge or emblem be adopted for all local associations, making it a universal badge throughout the country." * I have still to learn, however, that they have chosen a fitting patron saint. Is it because they have not heard of Cagliostro?

[*To be continued.*]

EXPERIMENTS ON THE PHYSIOLOGY OF ALCOHOL, MADE UNDER THE AUSPICES OF THE COMMITTEE OF FIFTY.

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II.

IT may be well to call to mind the title of this paper, which is *experiments* upon the *physiological* influence of alcohol. We purpose to adhere closely to "experiments" and to "physiology." Dogs could be killed in a few minutes, or a few days or months, by sufficiently large doses of alcohol. While such experiments might have some interest to toxicology or pathology, they could not have much for physiology, because in such violent procedures the abnormal must greatly overshadow the normal functions of the animal.

April 27, 1895, I obtained two pairs of cocker-spaniel puppies: the males, brothers from the same litter; the females, sisters from a not-closely related litter.† All four happened to have

* Proceedings, Detroit, 1894, p. 72.

† The dogs were obtained from Mr. C. G. Browning, of Worcester, to whom I am under great obligations for assistance and advice as to kennel management. Tipsy and Topsy were bred by him. Nig and Bum he kindly obtained for me from the Swiss Mountain Kennels at Germantown, Pa., bred by Mrs. Smyth. Considerable expense was involved in getting such good stock, but a number of considerations seemed to render it advisable. In no other way could such uniformity and comparability have been attained. The heredity of mongrels could not have been traced, in case anything of interest should crop out in that important field. In this connection I wish to express my thanks to both Mrs. Smyth and Mr. Browning for valuable aid already received, and for their cordial assurances of help in future, should later developments require it. Another consideration, which weighed some-

been born February 22, 1895. They were as nearly alike as it was possible to get them. The males are black, the females red.

It will save time and confusion if we christen them at this point, and use their respective names in our subsequent descriptions. The sisters were named "Topsy" and "Tipsy," the males "Nig" and "Bum." The names are sufficiently suggestive to

Bum. Tipsy. Nig. Topsy.

Fig. 6.—November 27, 1895.

enable the reader to carry easily in mind which ones are given the alcohol and which are normal.

April 29th, they weighed as follows:

Tipsy	2,102 grammes.	Bum	2,179 grammes.
Topsy	2,150 "	Nig	1,556 "

For about two weeks the four were studied with reference to deciding which pair to treat with alcohol. Of the sisters, Tipsy was considerably the more active and playful; of the brothers, Nig was the livelier. Bum, at the time, is noted as being a little "shy and quiet." Otherwise he appeared considerably superior in health, vigor, and "points." Nig's already deficient growth—since dwarfing is one of the important points about which the experiment turns—finally decided the matter, viz., to give the alcohol to Tipsy and Bum.

what with me, was that in the resident part of the city I could hardly expect to have a kennel of mongrel curs tolerated for the necessary length of time. Intelligence, too, was a prime consideration. For this, as well as for good disposition, these dogs could leave nothing to be desired. In selecting this breed I feel that the choice was made more wisely or more fortunately than I knew.

The administration of alcohol was begun May 12th, six cubic centimetres of chemically pure alcohol, diluted to forty per cent with water and mixed with their breakfast, being given to Tipsy and Bum. No appreciable effect was produced. Accordingly, the

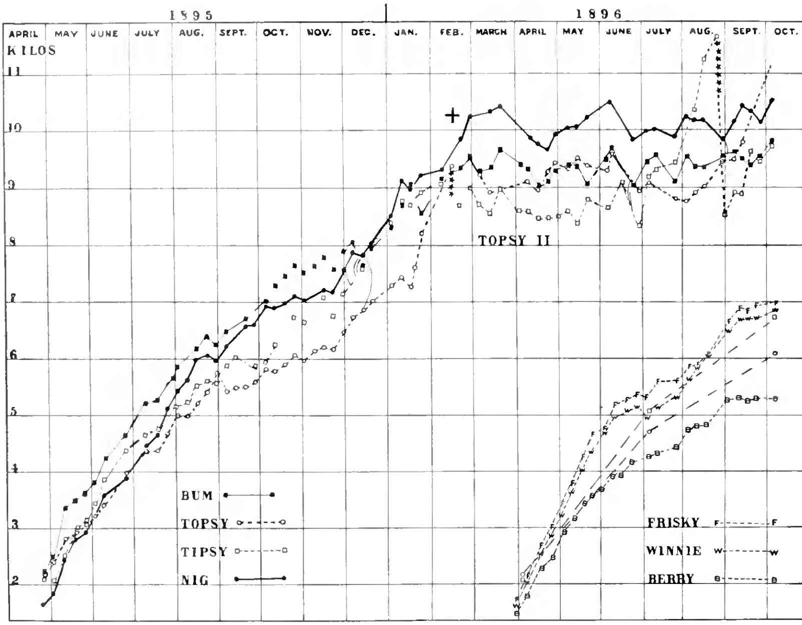

Fig. 7.—Growth of the Dogs.

dose was increased daily until May 24th, when they received twenty-five cubic centimetres apiece. This caused rather pronounced intoxication, but nothing approaching stupor. Both dogs appeared next morning as bright and playful as ever.

My intention at this time was to run the experiment along the line of light daily intoxication, but, with Dr. Billings's concurrence, what seemed to be a better physiological limit was adopted.* It was decided to give as large doses as possible, short of producing noticeable symptoms of intoxication. Accordingly, the amount was reduced to fifteen cubic centimetres, which was increased to twenty cubic centimetres by June 10th, and thereafter, as the dogs grew, up to thirty-five cubic centimetres apiece by the

* For the suggestion as to the proper physiological limit, I am happy to acknowledge my indebtedness to Mrs. Hodge. At the time when Tipsy and Bum were first intoxicated, the only time they have been intoxicated, Mrs. Hodge not only suggested the physiological limit, but went to considerable pains of argument to turn me from my avowed purpose of "getting the greatest physiological (?) effect in the shortest time." This has been a prime defect of similar work in the past, and whatever of value may attach to the present research I consider as mainly due to this suggestion.

following January. As seen from the chart, Fig. 7, they have practically attained their growth at this time. During the following year it was possible to increase the dose only five cubic centimetres—to the amount given at present. February 21, 1897, Bum's weight was 9,950 and Tipsy's 10,060 grammes. It thus appears that the physiological limit for a non-intoxicant dose of alcohol in the case of our dogs is about four cubic centimetres per kilogramme.

It is readily seen that this amount is equivalent for a man weighing seventy kilogrammes to two hundred and eighty cubic centimetres daily and taken at a single dose. This is ten ounces, whereas the physiological limit for man is usually stated as two ounces. This, of course, refers to absolute alcohol, and corresponds to nearly three times the amount of moderately strong whisky. It may be contended that this is too much or too little, but it still seems to me that no better rule could have been fol-

Bum. Tipsy. Nig.

FIG. 8.—April, 1896.

lowed in the matter. While it may not be the golden physiological mean, it would seem to be safely within the physiological extreme, as the perfect general health of the dogs has shown.

As to details of feeding, each dog receives, in a separate dish equal quantities of solid food and milk at six o'clock in the evening. The alcohol is thoroughly mixed with this meal. In the morning, each is given half a Spratt biscuit. This forms the staple diet, but is generously fortified with good meat, both raw and cooked, and plenty of good gnawing bones.

Bum. Nig.

Fig. 9.—October, 1896.

A large, sunny yard, kept clean; a good, dry kennel, and good kennel hygiene, including frequent disinfection; clean, cool water, three times a day in hot weather; dry beds with plenty of clean straw and sawdust; careful and regular attention to parasites, both internal and external—all these things have conspired to render the experiment thus far physiologically ideal.

The dogs were weighed, always before their breakfast, at first daily; later, every week. Their respective lines in Fig. 7 tell the story of their growth at a glance. Until nine months of age, Bum remains heavier than Nig. Topsy is evidently destined to be a much smaller dog than her sister. February 21, 1897, they weighed as follows:

Nig	10,520 grammes.	Topsy II...........	10,630 grammes.
Bum..............	9,950 "	Tipsy..............	10,060 "

Both the alcoholics are thus seen to be a little lighter than their controls, 5·4 per cent. This does give a small margin in favor of the normal animals, but it is doubtful whether four puppies would be found to grow under normal conditions more uniformly and come out more evenly at the end of two years. It would certainly be straining a point to claim any "stunting" effect of alcohol administered as above described.

For the general setting of the experiment, it only remains for me to add that, barring the accidental death of Topsy, and a trifling exception in Bum's case, the health of all the dogs has been perfect from the beginning of the experiment up to the present. Tipsy and Bum have not always eaten all that was offered them, possibly because so much quieter than the normals, but practically none of the dogs has "missed a meal."

Again, by a substantial favor on the part of Mr. Browning, I was able to obtain Topsy II, also Tipsy's sister, from the same litter. While Topsy II has thus had a somewhat different life for a time, in form and weight she makes a much more comparable match for Tipsy—so that, hard as it seemed at the time, "Little" Topsy's death has undoubtedly resulted in a fairer setting for the experiment.

So much, then, for the side of purely physical growth, and there is in it little consolation for those who are wont to recite the "stunting" and the disease-inducing effects of alcoholic indulgence. But we are engaged in a search for truth, and not for consolation.

Still another line of physical evidence remains to be examined, which bears closely upon the deepest psychic functions of animal life.

What is the sexual and reproductive history of our animals?

Sexual periods are indicated upon the chart, and stars occurring in Topsy's and Tipsy's curves of growth signify whelping, the number of stars corresponding with the number of whelps. From the chart we may read that Tipsy failed to conceive at the first season, while Topsy conceived normally. Mr. Browning has investigated the matter for me both in his own and other kennels, and is able to state that failure under these conditions is rare, probably not occurring in ten per cent of the cases. Controlled as the experiment is, this may indicate a tendency in alcoholic animals toward sterility. But, reading further along in the chart, we are forced to yield all benefits of this doubt when we find Tipsy bringing into the world no less than seven puppies. Since completing this draft of the chart, Topsy II has whelped for the first time, October 27th, giving birth to five, and Tipsy has whelped a second time, giving birth again to seven.

Fig. 10.—Tipsy, October, 1896.

Comparing the puppies of the first litters, Tipsy's weighed together 1,470 grammes, averaging 210, and Topsy's 1,080, averaging 216 grammes. Topsy also had the smallest puppy born—120 grammes—Tipsy's smallest weighing 190. Tipsy has also the honor of owning the largest puppy born, 265 grammes, Topsy's largest weighing 260. The last one of Tipsy's whelps was born dead; all of Topsy's were born alive.

Both Demme* for man, by comparing normal with alcoholic families among the Swiss, and Mairet and Combemale† in experiments upon dogs, have attempted to prove that deformity, degeneration, involving especially the brain, and a number of abnormities of a nervous character may be caused by chronic alcoholism of the parents. We have also Morel's‡ account, so often quoted, of degeneration in an alcoholic family to idiocy and extinction in the fourth generation.

Fig. 11.—Topsy, October, 1896.

With these things in mind, it is of interest to note that two of Tipsy's puppies were hare-lipped on both sides, a serious deformity of the face. All of Topsy's puppies were normally developed. This might be interpreted as confirmation of the above authors. However, practically all the value of such complicated experiments depends on repetition and upon adequate controls. The smallest puppy of Topsy II presented the same abnormity in exaggerated degree.

From the first litters each mother has thus to her credit four healthy living puppies, and Tipsy's are in no wise inferior. In Tipsy's second litter, February 1, 1897, three were deformed, two were born dead, and the remaining two proved to be nonviable. This may indicate a progressive deterioration, but any interpretation of it had better be delayed until more evidence is obtained. It is sufficient to indicate that results are likely to increase in definiteness as the experiment proceeds.

At the suggestion of Dr. Billings, a confirmatory experiment was undertaken in which, instead of chemically pure alcohol, the ordinary beverages—whisky, wine, and beer—were administered. The experiment was begun with three female puppies from the same litter, half sisters to Tipsy and Topsy, obtained from Mr. Browning. These were named Frisky (whisky), Winnie (wine), and Berry (beer). It was first attempted to get them to take their respective drinks as beverages, to develop in them a liking

* Demme. Ueber den Einfluss des Alcohols auf den Organismus des Kindes. Stuttgart, 1891.

† Mairet et Combemale. Influence dégénérative de l'Alcool sur la Descendance. Compt. rend., cxi, 667, 1888.

‡ Morel. Traité des Dégénérescences de l'Espèce humaine. Paris, 1857, p. 125.

similar to that sometimes found in man, so that it might not be necessary to give the liquors with their food. About two weeks were lost in this attempt during the first part of April. They practically refused to take enough to make the experiment worth trying. Accordingly, the doses were given, as with the others, mixed with their food at night.

The amount necessary to give in order to make the experiment at all comparable with the others, as to amount of alcohol, was such as to make their meals very wet and bulky. Curves of their growths are included with that of the others in Fig. 7. They are seen to grow well from April to June, Berry falling considerably behind. They then came down with eczema, Berry having it worst, Winnie somewhat lighter, Frisky not quite so bad as either. I do not feel warranted in attributing this to either the liquors employed or to kennel management, for no trace of the disease had made its appearance before or with any of the other dogs. It certainly could not be considered an alcohol effect, for the largest dose of beer, 125 grammes, that Berry could take contained no more than 5·5 grammes of alcohol (the beer contained

Tipsy. Topsy II.

Fig. 12.—October, 1896.

4·3 per cent). I am strongly inclined to think that both the eczema and the scrawny growth of all three puppies is to be attributed mainly to their sloppy food—i. e., a water effect. A number of books on the care of dogs caution strongly against making the food of puppies "sloppy," danger of causing eczema being one of the chief grounds. On the whole, Frisky and Winnie are seen to have grown a trifle faster than Tipsy, which would indicate the absence of deleterious ingredients in the wine and

Frisky. Winnie. Berry.

Fig. 13.—October, 1896.

whisky. They were bright, promising puppies to begin with, but they have grown into a sorry-looking lot, as is witnessed by Fig. 13.

After all, the only true physiological expression of the value of an animal's or a man's life is the total amount of energy developed and utilized during its continuance; and while, in order to attain to a proper relation to the energy material around it, it becomes necessary for the animal to develop a certain mechanism of this or that size and form, and with such and such parts, still as little energy as possible is wasted in forming the machine. An animal dead, in the chemical composition of its body, contains but a small fraction of the energy which it is able to utilize during its lifetime, and even the greater part of this is contained in the food from which its body was formed. This fraction, possibly one one-thousandth, whatever it may be, would give us the first adequate expression ever obtained of the relative values of human anatomy to human physiology, of the physical body and the life work.

Thus, in our purely physical and anatomical analysis of the experiment so far, we have studied only this small fraction of the whole life story even of a dog. In going on to the side of function, the psychic-volitional side of life, we are at once met by the difficulty of lacking terms and measures with which to express in verbal descriptions but a small fraction of the truth.

This has been my reason for supplementing descriptions with as many photographs as possible. And if the reader will study closely the expression of each face through the whole series, especially if he be somewhat familiar with dogs' faces, he will get the best idea that I am able to give by any expression within my power of the difference between the alcoholic and normal dogs in just this important respect, the vigor, the "life," the "go" that is in them. Look at the faces in Figs. 6, 8, and 14, and in all the rest, and come to any conclusion you can or wish. It will not be possible for me to say anything which shall change it.

It was not until alcohol had been given for nearly two months, early in July, that it became quite noticeable that Tipsy and Bum were a little quieter than the others. This became gradually more marked. By September they were rather often caught napping in the shade, while Topsy and Nig were playing actively. They had developed also a cringing, trembling timidity, for which

Bum. Tipsy. Nig. Topsy II.

Fig. 14.—October, 1896.

nothing either in my treatment of them or in their relations to the other dogs could possibly account. Whipping was most carefully avoided from the first, a spat from the open hand being my limit of severity. If a switch was used, it was to strike the ground or the fence and not the dog. Practically they have received nothing but assuring caresses at my hand, and still this unaccountable fear, this cringing and trembling like a Chinese culprit before his executioner. (See Figs. 15, 16, and 17.*)

Some may contend that the dogs were not comparable in the first place. This, of course, is possible, but I do not feel that in this respect the experiment could have been improved upon. The

FIG. 15.—Bum, November, 1895.

presumption is, in fact, very strong against any such interpretation of the facts.

I can conceive of no other interpretation than the evident one, viz., that we have to do here with one of the physiological causes

* For want of space we are obliged to omit the two figures with which it was intended these should be compared. They represent Nig and Topsy sidewise, standing naturally, and with no signs of fear.

A word may not be amiss at just this point as to my method of obtaining the photographs. Mr. C. C. Stewart manipulated the camera, while I controlled the dogs, in procuring the negatives for Figs. 6 and 8. All the rest I took myself, most of them alone, a few with Mrs. Hodge's help. It was recognized from the first that all the dogs must be treated exactly alike, and the rule was laid down at the beginning that, no matter how badly they behaved, no spatting, not even a sharp word, should be indulged in while they were on the photographing stand. The whole procedure was given the character of a frolic, in which, when they "sat still and looked pretty," bits of meat or biscuit were given to all alike, and no punishment or reproof was administered on any account. I may have failed unconsciously, but, if I did, it was with the irrepressibles, Topsy and Nig, and not with Tipsy or Bum.

Furthermore, nothing of the nature of "intoxication effect" was possible in any of the photographs. As stated above, the dogs were given their alcohol at evening, and then not in doses sufficient to produce intoxication, and the pictures were taken about noon. And, further, for several of the pictures, notably 6, 8, 14, and 15), alcohol was purposely omitted the night before.

or conditions of fear. There may, of course, be many others. Magnan * obtained precisely similar results with his alcoholic dog, much more extreme, because he gave much larger doses. The literature of human insanity makes fear a characteristic psychosis in alcoholic insanity, † and delirium tremens is probably the most terrible fear psychosis known. Even with the amounts of alcohol given, Bum has shown several mild paroxysms of fear, with some evidence also of hallucinations.

I am unable, therefore, to escape the conviction that our experiment has a meaning as deep as the psychology of fear itself. As to how deep that is, we may hope to learn something in studies that are now being prosecuted. ‡

As to temper and disposition, neither the breed nor the individual dogs can leave anything to be desired. Aside from their timidity, I can not recall that either Bum or Tipsy were ever even "impolite" toward me. They have never shown the least

Fig. 16.—Tipsy, November, 1895.

bit of resentment or snappishness. Not so much can be said for either of the Topsys or for Nig. But they are much more cheerful. The tone of sadness, the same as is noted in Magnan's dog,

* Magnan, V. On Alcoholism. London: Greenfield, 1876, p. 18 ff.

† Möbius, P. J. Nervenkrankheiten. Leipzig, 1893, p. 74 ff.

‡ G. Stanley Hall. Children's Fears. American Journal of Psychology, viii, No. 2.

so well shown in many of the pictures, is characteristic for Tipsy and Bum. It can be lightened up at times so as hardly to be recognized, but still it is the prevailing tone.

Neither of the pair, however, even yet lacks spirit, when it comes to maintaining their rights in the kennel; and for months after their characteristic timidity was noticed both Tipsy and Bum were larger and stronger than their mates, and held the balance of power.

Jealousy, amounting almost to frenzy, has been a striking feature in both the Topsys. They both showed great distress, especially when I petted Tipsy. Nig has something of the same kind strongly developed, but is too noble to show any spite toward the other dog. However, if he is around and I stoop to pat Bum on the head, Nig generally manages to get his head there in time to catch the pat. So I am obliged to use both hands, and Bum has never given evidence of the least jealousy even

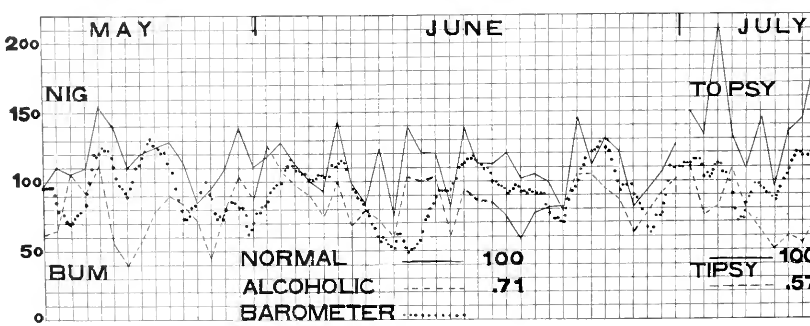

Fig. 17.—Daily Activity.

under Nig's provoking interference. Nor has Tipsy ever evinced a trace of the emotion.

The development of intelligence is a wide field in which it will be possible to touch but a few points.

At first I had intended to test this by ability to learn tricks. The idea was abandoned for two reasons. First, it would absorb too much of my time; and, second, after reading Mr. Russell's* paper on child study, I decided that it was just the thing not to do. By that method we might have learned trick psychology when the thing of real value for us is the spontaneous, uninterfered-with psychic growth of a dog.

Some few things had to be taught, such as coming at call and whistle and individual names, and retrieving was taught for a special purpose to be mentioned later. In addition to this, lit-

* E. Harlow Russell. The Study of Children at the State Normal, Worcester, Mass., Pedagogical Seminary, ii, p. 343.

tle trick specialties began to crop out during the first summer. Tipsy, always the lithest and quickest, became expert in jumping and catching on the fly. Bum, all of his own accord, took to sitting up and "begging." Little Topsy would sit up and "speak." Nig did not develop any specialty, and never really discovered his mission in life until he was taught to "fetch." As to the learning itself, Bum and Tipsy were about as quick and much more docile than Topsy and Nig.

It was stated above that during the second month after administration of alcohol spontaneous activity of both Tipsy and Bum became noticeably impaired. This gradually and steadily increased until, last spring, it seemed to me from daily observation that the alcoholics were not much more than half as active as the normals. How to secure an objective expression of this fact presented some difficulties at first. To put them in large recording cages, such as we use in the laboratory to study the daily activity of rats and mice, would clearly be an imposition on a dog's good nature, and would possibly suppress his activity in proportion to his intelligence. To watch four dogs during the twenty-four hours would require four observers, and their presence would be a disturbing factor.

Pedometers were thought of, but none could be found suitably constructed for use with the dogs. Finally, Waterbury watches were obtained and, by removing the hair springs, weighting the balance wheels unequally, and by proper adjustment of buffing pins so that the balance wheel could move just far enough to release the escapement, a watch resulted which ran only when shaken. After a month of preliminary trials an adjustment was attained so delicate that the watch could hardly be jarred so slightly as not to release the escapement one tooth, and the two could be shaken, violently or gently, and in any position for an hour at a time (fastened firmly together) without showing a variation of more than two seconds on reading the hands.*

The watches are now placed in stout leather pockets in specially constructed collars and the dogs allowed to wear them. The results are graphically expressed in Fig. 17. The watches were read every evening at exactly six o'clock, and the reading plotted so that the angles in the lines for each dog correspond to the number of minutes the dog has ticked his watch during the twenty-four hours. The chart explains itself. Bum is seen to develop seventy-one per cent of Nig's activity, and Tipsy only fifty-seven per cent of Topsy's.

The watches, of course, give us only the total quantity of

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* For valuable assistance in accomplishing this adjustment I wish to express my thanks to Mr. Albert P. Willis, Fellow in Physics, Clark University.

spontaneous daily movement of each dog with no indication as to its quality. Something to give a qualitative expression of strength, ability, and resistance to fatigue was devised, which consisted in a series of competitive tests at retrieving a ball.

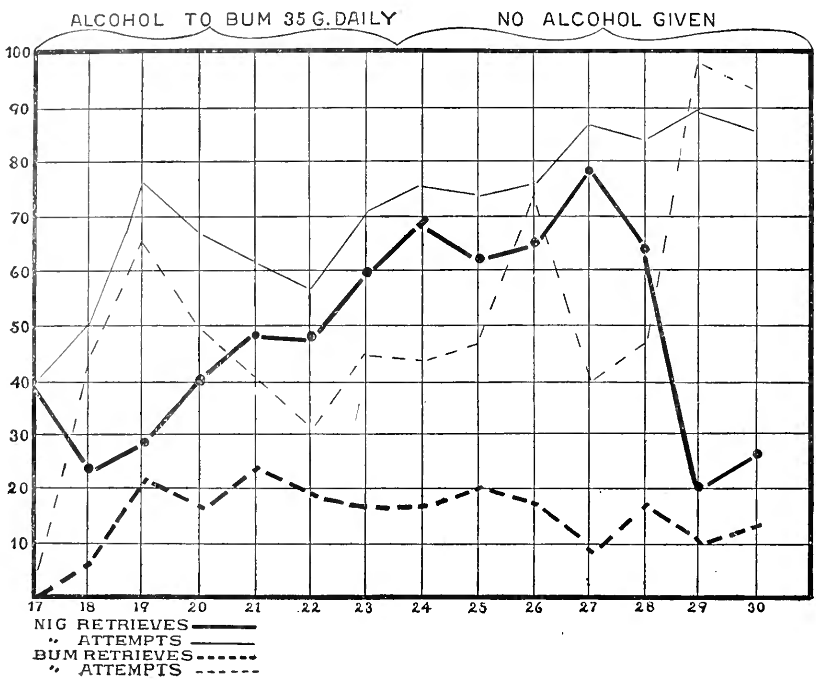

Fig. 18.—Curve of Efficiency (Competitive). In a difficult competitive test calling for endurance, sustained attention, etc., the alcoholic falls much lower relatively than in ordinary daily activity, Bum attaining to only thirty-two per cent of Nig's efficiency.

The balls were thrown in rapid succession across the university gymnasium, one hundred feet, and a record was kept of the dogs that started for it and of the one that succeeded in bringing it back. One hundred balls constituted a test, and to throw them consumed about fifty minutes.

In the first series, consisting of 1,400 balls thrown on successive days, January, 1896, the normal dogs retrieved 922, the alcoholics 478. This gives the alcoholics an efficiency of only 51·9 per cent as compared with the normals. Bum's ability in this series as compared with Nig's is only thirty-two per cent.* (See Fig. 18.) It was also noted that Bum and Tipsy were much more easily fatigued than the normals.

A second series, of 1,000 balls, November, 1896, in which Bum and Nig were tested, gave similar results. The various elements

* The results from Topsy and Tipsy were not comparable, on account of Topsy's condition at the time.

of the experiment are plotted in Fig. 19. The heavy lines, N and B, above the zero level express the relative efficiency of Nig and Bum, and indicate the number of balls retrieved by each dog. The light lines, *n* and *b*, express the number of times each dog attempted to get the ball. Nig's line of achievement is seen to run much closer to his line of attempt than in the case of Bum. Fatigue is expressed below the zero line, and is derived from the number of times each dog lay down to rest. Nig shows fifteen per cent of Bum's fatigue. Expressed in other words, Bum lies down to rest 6·7 times to Nig's once.

It is clear that we must advance beyond the usual anatomical standards of comparison into the field of function, if we are to arrive at any definite settlement of physiological questions. Efficiency, ability to do work, must be the ultimate appeal. While nothing is further from my thought than to claim for the foregoing experiments sufficient comprehensiveness to even approximate to a solution of this important problem, still, as stated at the outset, their results may serve to hint at the possibilities of future work. The experiments are still in progress, their continuance being assured for one more year by the Committee of Fifty. It is to be hoped that they can be carried on much longer, to yield, at least, the complete life story of the original four dogs. The present opportunity should also be utilized to study the next generation in a similar way, if there should appear marked signs of degeneration. Results are certain to increase in definiteness and value as the experiment is prolonged out of all proportion to additional cost.

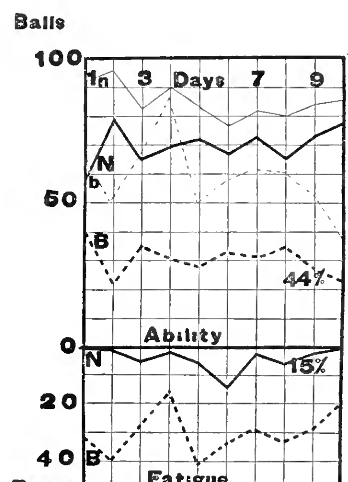

FIG. 19.—CHART OF BALL TESTS.

On the side of physiological activity, while a number of other forms should be studied, and experiments need repetition to guard against individual variations, the results obtained—retardation in growth of yeast, and depression of activity in kittens and dogs—cast a suggestive light on the human experiment. The spontaneous desire and the will welling up within a vigorous organism to be and to do something worth the while seems to me the highest thing in life. Hence knowledge concerning physiological conditions which favor elaboration of this quintessence of existence possesses a human value beyond computation or expression.

Helmholtz has said, in describing his methods of work, that slight indulgence in alcoholic drinks dispelled instantly his best ideas. Prof. Gaule once told the writer, as an experiment during the strain of his "*Staatsexamen*," that he suddenly stopped his wine and beer, and was surprised to find how much better he could work. An eminent professor in Leipsic once said that the German students could do "twice the amount of work" ("*könnten zweimal so viel leisten*") if they would let their beer alone. Dr. August Smith * has found that moderate nonintoxicant doses of alcohol (forty to eighty cubic centimetres daily) lowered psychic ability to memorize as much as seventy per cent. Leixner † observes "*dass der Alcohol den Menschen geistig so herunterbringt, dass er schliesslich nichts mehr kann, wie politisieren.*" Possibly the trouble with a good deal of our politics in this country.

But we must be careful about drawing too sweeping conclusions. A man "in the habit" may be unable to do anything without his usual stimulant. This fact must be recognized. And if, according to the theories of some, acquired characters may descend to the offspring, "inherited" habit may also require consideration. At any rate, we must cease to expect that problems which have baffled human solution for generations can be settled in a day or a year. They can be sanely solved only by the accumulation of wholly impartial evidence, sufficient in amount to determine conviction.

Truly to me
There seems to be
A kinship close
Wherever flows
Life's activity.

LIFE ON THE PLANETS.

By M. J. JANSSEN. ‡

(Having shown how all astronomical discovery, concluding with spectrum analysis, points to a similarity of constitution in the earth and the heavenly bodies, M. Janssen continues:)

All this whole forms a single family, the members of which have a common genesis and have been formed with the destiny of becoming worlds like ours. Their movements around the central star which enchains them by its powerful attraction are subject to the same laws, and that star, by virtue of its high temperature and the immense reserves of force it contains, sheds upon them

* August Smith. Die Alcoholfrage. Tübingen, 1895.

† Leixner. Laien-Predigten für das deutsche Haus. Berlin, 1894.

‡ From his remarks at the annual meeting of the French Academy of Sciences, October 24, 1896.

those influences and radiations which go to place upon their surface the generative elements of life. Yet while these stars present so strict analogies in formation and nature, they do not by any means indicate the same degree of advancement in what may be called geological or rather planetary evolution, or that which tends to the appearance and development of life on their surface. Here the conditions of mass, of distance from the sun, and doubtless other circumstances still unknown, come in to order the epoch and the extent of these developments; but we can affirm, without going beyond the inductions permitted by the condition of science, that if life has not yet been established directly on the surface of any of the planets, we have very strong reasons for assuming its existence on some of them. We may regard this conclusion as gained from the long labors of antiquity and modern discoveries.

We say that, while the problem has not been directly resolved by the eyes, it has been worked out by an aggregate of facts, analogies, and rigorous deductions that leave no room for doubt. This is the mature and perfect fruit of science. It is the view of intelligence, as certain an authority and of even a higher and nobler order than the senses. I say further that what we know of the unity of the chemical composition of the matter of the sun, the stars, and the nebulæ permits us to make new inductions respecting the part performed by the bodies which are on the earth the most important factors of the phenomena of life. It is thus infinitely probable that hydrogen, oxygen, nitrogen, carbon, and especially water, which on the earth are the indispensable constituents of vegetable and animal life, fill a like office not only in the planets of our system, but throughout the universe.

Water in particular, by virtue of its chemical functions and the properties with which it is endowed in the solid, liquid, and gaseous states—properties which are so admirably fit for the accomplishment of physiological processes—is a unique substance, and the search through the whole series of chemical compounds for any body that can take its place has been in vain. The discovery of the spectrum of the vapor of water permits us to deduce and assert its presence in the atmospheres of the planets and in those of a whole class of stars as well. Drawing from these results the fact of the presence of hydrogen, one of the generative gases of water, in nearly all the stars, we are justified in supposing an extreme diffusion of that important element from the point of view of the unity of the phenomena which control the production and maintenance of life.

Thus, the more science advances, the more is that great law confirmed and established of unity in the material elements, in the compounds formed of those elements, and in the constitution of the stars and the parts they perform in the grand whole.

Are we authorized now to assume from this a unity of forms that life may put on not only in the sister planets to ours, but also in the other systems of worlds scattered through the skies? May we especially push our inductions still further and higher, conclude from such material unity upon a mental and moral unity, and say that, as there is only one physics and one chemistry in the universe, there are also only one logic, one geometry, and one moral, and that the beautiful, the good, and the true are identical and of the universal order everywhere?

Science, embracing in its results only immediate and demonstrated facts, does not warrant us in going so far as this, but with the truths it unfolds to us seems to invite us toward it.

There were brilliant minds in antiquity, which upon bases otherwise restricted conceived and proclaimed verities concerning the world and the universe which the most modern science has only been able to confirm.

Let us, then, respect these cheerful speculations. If they are still only of things preconceived, who can affirm that science will not make them real to us to-morrow? By establishing the laws and harmonies of the material world, astronomy prepares us for the conquest of truths of a still higher order.

We can say then plainly that the subjection of natural forces and the reign of man over Nature are only the first fruits of science. It prepares other fruits for its votary of a higher and more precious order. By the beauty of the studies to which it invites him, by the grandeur of the horizons which it opens out to him, and the sublimity of the spectacle it gives him of the laws and harmonies of the universe, it promises to win him away from his present preoccupations, which are perhaps too exclusively positive, and will restore to him under a new form and in an incomparable grandeur that taste for elevated poetry, that enthusiasm for the beautiful, and that reverence for the ideal which are among the most imperious needs of the human soul and which it never abandons without peril.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

It is suggested by a correspondent of Nature as a possible advantage of the want of symmetry in the arrangement of the branches of trees, that the want of synchronism of movement in consequence of it may help prevent their being overturned in times of high wind. He speaks of having watched the branches of a large plane tree during a high gale, when "it seemed incredible that the tree could stand, but for the fact that while one large limb was swaying one way, another would be swaying the opposite way, and so on, all plunging and bending anyhow, with no two in harmony."

SPENCER AND DARWIN.

BY GRANT ALLEN.

IT is a familiar observation with people who have reached middle age that their chronological conception of their own time is often far more defective than their chronological conception of written history in which they have not themselves participated. Men of our own generation may remember exactly the relative dates of Pharsalia and Philippi; they may be clearly aware of just how Raphael stood in time to Perugino or to Titian; they may know precisely how long Napoleon, Byron, and Talleyrand survived the Restoration. But about the events of their own lifetime they are always asking themselves, "In what year did Lord Beaconsfield die?" "How long did the Prince Imperial go on living after Sedan?" "Was Carlyle still among us when Mr. Gladstone was denouncing the Bulgarian atrocities?"—and so forth perpetually. Even the sequence of events in one's own life often similarly deceives one. We forget whether Tom went to Australia before or after Lucy's marriage; whether we had or had not made McFarlane's acquaintance at the time when Hingston was engaged in painting his first Academy picture. We remember events, but not their order. Daily facts of life, crowding in upon us too thickly for due note, defy all accurate chronological organization. We recall them disconnectedly; the occurrences impress themselves more or less upon our brains, but their infinite concatenation with all other circumstances escapes us. Hence we are often more surprised at learning a little later how events really stood to one another in our own time than at anything which comes to us from unremembered periods.

Especially is this the case with slow organic or psychological movements—movements which grow unseen, and gain but gradual recognition. Cataclysmal events—the Déchéance of the Second Empire, the Italians in Rome, the assassination of the Czar—often fix themselves by their very vividness and unexpectedness on the memory, with their date and relations ineffaceably attached. But where we have to deal with the growth of opinion, most people fall into serious mental errors of chronology. Either they believe a movement began when they themselves first happened to hear of it; or else they date it from the appearance of some startling and much-discussed publication.

Mr. Edward Clodd's new volume, Pioneers of Evolution, brings this truth into strong relief. In this interesting and careful work Mr. Clodd has been at the pains to investigate thoroughly the part borne in the evolutionary revolution, both by the early precursors—Buffon, Lamarck, Laplace, and others—and by the three chief actors in the final triumphal stage of the theory, Darwin, Spencer, and Huxley. His analysis is marked by a conspicuous desire for fairness all round: he has honestly endeavored to assign to each of these three great thinkers his own true share—no more, no less—in the genesis of the modern evolutionary concept. Yet, though the book contains, strictly speaking, little on this head that was not already implicitly within the reach of special students of the evolution of evolutionism, it will probably prove a great surprise to that large section of the reading public which habitually confines the idea of evolution to organic development alone, and which still believes that Darwin "invented" the theory of descent with modification. To all such people—and they include the mass of the averagely well-read—Mr. Clodd's revelation will come with all the charm of a sudden surprise. He has been enabled through the kindness of Mr. Herbert Spencer to give fuller and more authoritative details of the fundamental facts than have yet been published; and he shows more fully perhaps than any one else has hitherto done the central importance of Mr. Spencer's position in the evolutionary advance.

May I begin with a passage which I quoted from one of Mr. Spencer's own early works no less than eleven years since, in my little monograph on Charles Darwin? It occurs in an essay on The Development Hypothesis, in that long-defunct paper, the Leader. (The Italics are in the original.)

"Even could the supporters of the development hypothesis merely show that the origination of species by the process of modification is conceivable, they would be in a better position than their opponents. But they can do much more than this. They can show that the process of modification has effected, and is effecting, great changes in all organisms, subject to modifying influences. . . . They can show that any existing species—animal or vegetable—when placed under conditions different from its previous ones, *immediately begins to undergo certain changes of structure fitting it for the new conditions.* They can show that in successive generations these changes continue, until ultimately the new conditions become the natural ones. They can show that in cultivated plants, in domesticated animals, and in the several races of men, these changes have uniformly taken place. They can show that the degrees of difference, so produced, are often, as in dogs, greater than those on which distinctions of species are in other cases founded. They can show that it is a matter of dispute whether some of those modified forms *are* varieties or modified species. They can show too that the changes daily taking place in ourselves—the facility that attends long practice, and the loss of aptitude that begins when practice ceases—the development of every faculty, bodily, moral, or intellectual, according to the use made of it, are all explicable on this same principle. And thus they can show that throughout all organic Nature there *is* at work a modifying influence of the kind they assign as the cause of these specific differences, an influence which, though slow in its action, does, in time, if the circumstances demand it, produce marked changes; an influence which, to all appearance, would produce in the millions of years, and under the great varieties of conditions which geological records imply, any amount of change."

Now, by most readers at the present day, this passage would undoubtedly be at once set down as "Darwinian." But when was it written? "Would you be surprised to learn" that it was published by Herbert Spencer in the Leader newspaper no less than *seven years* before the appearance of The Origin of Species? The essay which contains it was first printed in 1852; The Origin of Species was published in 1859. As I have already remarked in my Charles Darwin, "This admirable passage . . . contains explicitly almost every idea that ordinary people, not specially biological in their interests, now associate with the name of Darwin. That is to say, it contains, in a very philosophical and abstract form, the theory of descent with modification, *without* the distinctive Darwinian adjunct of natural selection, or survival of the fittest." To put it briefly, most people at the present day, now that evolutionism has practically triumphed, now that the evolutionary method is being applied to almost every form of scientific subject-matter, go doubly wrong as to the origin of that method. In the first place, they attribute mainly or exclusively to Darwin ideas which were current long before Darwin wrote; in the second place, they also attribute to Darwin ideas which were promulgated, in some cases before, and in other cases after Darwin, by independent thinkers who accepted his theories as part only of their own systems. Mr. Spencer has been by far the greatest sufferer from this curious human habit of finding an ostensible figurehead for every great movement, and then attaching everything in the movement to that figurehead alone—Luther for the Protestant Reformation, Rousseau or Robespierre for the French Revolution, Pusey for the Anglo-Catholic revival, and so forth. I am glad that Mr. Clodd has undertaken definitely to combat this doubly erroneous view, and that his book has allowed me the opportunity of adding my mite to this question of ascription.

At the same time, I should like to premise that I write this article in a spirit of the profoundest loyalty to Darwin's memory and opinions. No man could have a deeper respect than I have for the character and the life work of that great man of science. But loyalty, as I understand the term, consists in giving your hero credit for what he really was and what he really did; it does not consist in attributing to him the work actually done by others, while suppressing the very facts which form his chief claim to the gratitude and consideration of posterity. Now there is one invaluable piece of work which Darwin really did do, and do effectively—he discovered and proved to the hilt the theory of natural selection, as a cause, and probably the chief cause, both of the diversity of species and of their adaptation to the environment. And there are two important pieces of work which Darwin did not do, but with which he is generally credited—he did not originate the idea of descent with modification in plants and animals; and he did not originate the general idea of evolution, as a cosmical process. These last two ideas come to us from elsewhere. That of descent with modification we derive from Erasmus Darwin, Lamarck, and others, following in the footsteps of still earlier vague guessers. That of evolution as a pervading cosmical process we derive from Herbert Spencer, and I venture to say from Herbert Spencer alone. Even the word is Mr. Spencer's; before his time, it was never used, I believe, in that particular sense; and after him, it was seldom employed by Darwin, who used it (when he used it at all) in reference to Mr. Spencer's general concepts. So, too, the phrases, "survival of the fittest," "adaptation to the environment," and others, due entirely to Mr. Spencer, are regarded as a rule by the averagely well-read man as purely "Darwinian." It seems to me, therefore, that to do justice to Mr. Spencer in this matter is also incidentally to do justice to Darwin. For in this place, Darwin, with his inflexible sense of equity, his perfect generosity, his admirable self-effacement, would have been the last man to put forward a claim to what belonged of right to others; and in the second place, with his cautious, experimental English mind, he would never have desired to have his name associated with many of Mr. Spencer's most brilliant and powerful *a priori* achievements.

Nevertheless, before the appearance of Mr. Clodd's book, there were, I believe, but two works extant which endeavored to put this question in its true light, and even there mainly as regarded the theory of natural selection. One of those two books was Mr. Samuel Butler's Evolution Old and New; the other, if I may venture to mention it, was my own small volume on Charles Darwin. But Mr. Butler, both in the work I have just named, and still more in Luck or Cunning, while doing full justice to the precursors and contemporaries of Darwin, has suffered himself to be carried away by a most singular preconception as to Charles Darwin himself, and has represented that most modest and self-effacing of *savants* as deliberately endeavoring to filch for himself the discoveries and achievements of biologists who went before him. Mr. Butler's books, therefore, though useful as antidotes in the hands of those who understood the facts, could only mislead and puzzle outsiders. Nevertheless, they did actually do this piece of good service: they brought out in strong relief the true nature of Charles Darwin's magnificent life work, as consisting entirely in the establishment of the principle of natural selection —a principle which made the previously discredited notion of descent with modification immediately commend itself to the whole biological world of his time, and more particularly to the younger generation. As to my own little book on Charles Darwin, if I dare to allude to it here, though it also insisted (from the opposite and sympathetic standpoint) upon this same cardinal fact, and likewise dwelt to a somewhat less degree upon the central importance of Mr. Spencer's position, it was published only in a popular series, and did not perhaps reach the eyes of those who mostly required to have these facts impressed upon them. I rejoice, therefore, that Mr. Clodd should have reopened this serious question, and especially that the discussion to which his work is likely to give rise may result in putting Mr. Spencer's true place in the evolutionary movement before the eyes of his contemporaries while he is still among us to be gratified by a recognition too long withheld him.

The needful rectification of public opinion on this subject, it seems to me, embraces two points. In the first place, as regards organic evolution, Darwin was not in any sense the orginator of the idea; he was anticipated by his own grandfather, by Lamarck, by Herbert Spencer (at least so far as priority of publication is concerned), and by several others. In the second place, as regards evolution in general, the idea was not Darwin's at all; it was entirely and solely Herbert Spencer's. Each of these two points I shall treat briefly but separately.

Everybody now knows that the idea of organic evolution—the conception that plants and animals were not miraculously created, but developed by natural causes from a common original —was far older than Charles or even than Erasmus Darwin. In a certain vague way it was anticipated by several early philosophers, and somewhat more definitely, though still nebulously, by Lucretius. In modern times, however, it first took a regularly scientific shape with Erasmus Darwin. Most people believed that the theory never progressed beyond that somewhat amorphous stage up to the time when Charles Darwin published The Origin of Species. This is a serious mistake. The concept, once set on foot, grew rapidly in definiteness and in fullness of scientific basis up to the moment of Charles Darwin's cardinal discovery. With Erasmus Darwin, it was little more than a brilliant though pregnant *aperçu;* with Lamarck, it became a powerfully supported scientific concept; in Herbert Spencer's hands, it grew to be a probable and rational theory, based upon a serious array of confirmatory facts, and fulfilling all the conditions of a sound working hypothesis. If the reader will turn once more to Mr. Spencer's pronouncement, published seven years before The Origin of Species, he will see that there Mr. Spencer has brought together almost all the chief arguments which still weigh in favor of the theory of descent and modification. Mr. Clodd has collected a large number of passages from Mr. Spencer's early works—especially passages from scattered articles *prior* to the first public hint of Darwin's idea—which amply prove Mr. Spencer's claim to rank as an entirely independent author of the doctrine of organic evolution. The fact is, before Darwin's book appeared, the argument from variation, the arguments from plants and animals under domestication, the argument from embryology, the argument from geographical distribution, the argument from distribution in geological time, had all of them been brought forward, and some of them had been treated with great skill and effect, by Mr. Spencer. Indeed, it was above all von Baer's law of embryological development which led Mr. Spencer both to his first clear conception of the method of biological evolution, and to his first incomplete conception of evolution in general as fundamentally a progress from the homogeneous to the heterogeneous.

Why, then, if so many minds had already grasped the doctrine of descent with modification, did Darwin's immortal treatise produce so immediate and noteworthy a mental revolution? Why did the world which turned a deaf ear to Lamarck, and even to Spencer, listen gladly to Charles Darwin? Clearly, because Darwin had something new and important to add to the concept; and that "something new" was the theory of natural selection. This was Darwin's real contribution to the world's thought. He arrived at it at first as a stray *aperçu;* he followed it up, with Darwinian patience, with astonishing wealth of knowledge and instance, with single-hearted devotion to the particular subject, through the whole of his life; and he left it at the end as nearly certain as such a thesis can ever be made by human intelligence. The weak point in the hypothesis of organic evolution, before Darwin, was the difficulty of understanding the nature and cause of adaptation to the environment. That weak point, when supplemented by theological preconception, made many or most biologists hesitate to accept the nascent theory, in Lamarck's and Spencer's presentment. It is true, minds like Lamarck's and Spencer's could never for a moment, on the other hand, have accepted the crude and unthinkable dogma of separate creation; but the mass of biologists, incapable of high philosophic reasoning, held their judgment suspended, and waited for some other explanation of the origin of species. Darwin's discovery converted them *en bloc*. It was easy to understand, by means of the clew he afforded, not merely *that* organisms had been naturally evolved from simple primitive forms, but also *how* and *why* they had been so evolved. Darwin's great work, then, consisted in this—that he made credible a theory which most people before him had thought incredible; that he discovered a tenable *modus operandi* for what had before been rather believed or surmised than definitely imagined.

I do not mean to say that Darwin did no more than this. He supplied the great key of natural selection; but he also added much in other ways to the doctrine, especially in the direction of piling up facts and meeting objections. His work had thus a double value. On the one hand, it is not probable that the general biological public would have been converted to evolutionism half so quickly if it had not been for the enormous mass of confirmatory evidence adduced by Darwin. In the second place, even those who, like Spencer, were already evolutionists—evolutionists in fiber, incapable of taking any supernaturalist view of the universe in which they lived—gladly availed themselves of Darwin's discovery of natural selection, as an explanation of one important set of features in organic evolution, thitherto most imperfectly and inadequately explained. Or, let us put it another way. From the point of view of contribution to thought, it is natural selection that forms Darwin's great glory. But from the point of view of mere effective persuasion, it is the weight of evidence he brought up in favor of the older principle of descent with modification that told and still tells with the average mind. Hence it has happened, and perhaps will always happen, that Darwin has received more credit for that part of his theory which was not of his own invention than for that part of which he can justly claim the almost exclusive glory. Almost, I say, because the modifying adverb is demanded by justice to Mr. Alfred Russel Wallace, whose partial coincidence with Darwin in the discovery of natural selection now needs no advertisement.

As thinker, then, it is on natural selection as a *vera causa* of specialization and adaptation among plants and animals that Darwin most securely rests his claim to celebrity. As prophet and apostle, on the other hand, it must be frankly admitted that he ranks first as a preacher of organic—but only of organic—evolution. In this respect, his importance, in England especially, can hardly be overrated. For it is a peculiarity of the practical English mind that it is more moved by a vast array of evidence, a serried mass of cumulative instances, than by any possible cogency of logical reasoning. Darwin's own mind was in this way intensely English. He piled up fact after fact, added case to case, till men whom no power of abstract argument could convince were convinced by pure force of successive witnesses. They were borne down by numbers. Your ordinary Englishman, indeed, is never quite satisfied by Euclid's demonstration that in a right-angled triangle the square on the hypotenuse is equal to the sum of the squares on the two opposite sides; he honestly believes it when he sees it tried a hundred and twenty times by careful measurement, and still more when he finds that engineering works which take it for granted as a basis succeed in paying a satisfactory dividend. Proof that in the nature of triangles this truth is involved he does not regard; experimental verification, or what seems to be such, in a few concrete cases, amply satisfies him. Hence it came about that a world which would have listened coldly to Herbert Spencer's *a priori* reasonings or splendid generalizations was converted at once when Darwin brought up with inexhaustible patience and extraordinary keenness of insight his profound array of confirmatory facts about bees and cuckoos, about the fertilization of orchids and the movements of tendrils.

Nobody has better summarized than Mr. Clodd the exact point which evolutionary theory had reached as regards plants and animals *before* the publication of The Origin of Species. Whoever wishes to learn just how much was surmised by the predecessors of Darwin, and just how much Darwin added to their ideas, can not do better than consult his luminous exposition.

Once, indeed, no less than seven years before the publication of The Origin of Species, Mr. Spencer even trembled for a moment on the verge of the actual discovery of natural selection. This was in the essay on population in the Westminster Review in 1852. The passage at full is too long to extract; but I will quote the last words of it. "All mankind subject themselves more or less to the discipline described; they either may or may not advance under it; but in the nature of things only those who *do* advance under it eventually survive. For, necessarily, families and races whom this increasing difficulty of getting a living which excess of fertility entails does not stimulate to improvements in production . . . are on the high road to extinction; and must ultimately be supplanted by those whom the pressure does so stimulate. . . . And here, indeed, it will be seen that premature death, under all its forms, and from all its causes, can not fail to work in the same direction. For as those prematurely carried off must, in the average of cases, be those in whom the power of self-preservation is the least, it unavoidably follows that those left behind to continue the race must be those in whom the power of self-preservation is the greatest, must be the select of their generation." Now, this is the doctrine of natural selection, or, as Mr. Spencer himself afterward called it, survival of the fittest. Only, it is limited to the human race; and it is not recognized as an efficient cause of specific differentiation. As Mr. Spencer himself remarks, the passage "shows how near one may be to a great generalization without seeing it." Moreover, Mr. Spencer here overlooks the important factor of spontaneous variation, which forms the corner-stone of Darwin's discovery, and which was also clearly perceived by Mr. Wallace. In short, in Mr. Spencer's own words, the paragraph "contains merely a passing recognition of the selective process, and indicates no suspicion of the enormous range of its effects, or of the conditions under which a large part of its effects are produced."

It is thus obvious not only that Mr. Spencer was a believer in organic evolution long before the publication of Darwin's first utterance on the subject, but also that he almost succeeded, like Wallace, Wells, and Patrick Matthews, in anticipating the discovery of natural selection.

But, besides the misconception about Mr. Spencer's relation to Darwin as regards organic evolution, there remains the far deeper and more fatal misconception about his relation to Darwin as regards evolution in general, viewed as a cosmical process. Most people imagine, I gather, that Mr. Spencer is a philosopher who has put into a higher and more abstract form Darwin's discoveries and theories. In short, they regard him as a disciple of Darwin. And this brings me to the second of the two rectifications of public opinion which I promised above to attempt. Nothing could be more absurdly untrue than to regard Mr. Spencer as in any way or in either department a disciple of Darwin's. In the first place, as regards organic evolution, he was an avowed evolutionist long before the publication of Darwin's first hint on the subject. He continued an evolutionist, in the main on the same lines, after Darwin had brought out The Origin of Species and its ancillary volumes. He adopted, it is true, the theory of natural selection, as did every other evolutionist of his time (except Mr. Samuel Butler), but he adopted it merely as one among the factors of organic evolution, and, while valuing it highly, he never attributed to it the same almost exclusive importance as did Darwin himself—certainly not the same quite exclusive importance as has since been attached to it by the *doctrinaire* school of Neo-Darwinians, who employ it as the sole key which unlocks, in their opinion, all the problems of biology. On the contrary, he has always steadily maintained the existence and importance of other factors in organic evolution, and has combated with extraordinary vigor and acuteness the essentially Neo-Darwinian views of Weismann which make natural selection alone into the *deus ex machina* of organic development.

In the second place—and this is the more important point—as regards evolution at large, Mr. Spencer is not in the remotest degree beholden for the origin of his ideas to Darwin. So far as those ideas are not quite original with him—and no human idea is ever wholly original—they are derived from the direct line of Kant, Laplace, and the English geologists. For many years previous to Mr. Spencer's philosophic activity the progress of human thought had been gradually leading up to the point where a cosmic evolutionism such as Mr. Spencer's became almost of necessity the next forward step. But to say this is not to detract in any way from Mr. Spencer's greatness; rather the other way; for it needed a man of cosmic intellect and of cosmic learning to make the advance which had thus become inevitable. The moment had arrived, and waited for the thinker; Mr. Spencer was the thinker who came close upon the moment. The situation is this: Kant and Laplace had suggested that suns and stars might have grown and assumed their existing distribution and movements by the action of purely natural laws without the need for direct creative or systematizing effort from without. The geologists had suggested that the crust of the earth might have assumed its existing stratification and sculpture through the agency of causes at present in action. Erasmus Darwin and Lamarck had suggested that plants and animals might have been developed and specialized from a common original by the direct action of the environment, aided in part by their own volition, where such existed. But all these thinkers, great and able in their day, had addressed themselves—as Charles Darwin later addressed himself—to one set of phenomena alone; had regarded the process which they pointed out, in isolation only. It remained for a man of commanding intellect and vast grasp of generalizing faculty to build up and unify these scattered evolutionary guesses into a single consistent concept of evolution. Herbert Spencer was that man. He gave us both the concept and the name by which we habitually know it. The words "theory of evolution" occur already, seven years before Darwin, in the Leader essay.

This point, again, Mr. Clodd has excellently elaborated. "Contact with many sorts and conditions of men," he says, "brings home the need of ceaselessly dinning into their ears the fact that Darwin's theory deals only with the evolution of plants and animals from a common ancestry. It is not concerned with the origin of life itself, nor with those conditions preceding life which are covered by the general term, inorganic evolution. Therefore it forms but a very small part of the general theory of the origin of the earth and other bodies, 'as the sand by the seashore innumerable,' that fill the infinite spaces." It is evolution in general, both the concept and the word, that we owe to Mr. Spencer; and Mr. Clodd's book brings into strong relief the actual relations existing in this respect between Herbert Spencer himself and his predecessors or contemporaries.

The genesis of the idea in his own mind Mr. Spencer has illustrated by a series of extracts from his original volume of Essays, published previously to The Origin of Species, and therefore necessarily independent of any Darwinian impulse. The series of extracts thus selected he has permitted Mr. Clodd to print entire, and with them the abstract supplied to Prof. Youmans. These summaries I will not still further summarize; it must suffice here to note, for the benefit of those who have never considered dates in this matter, that the chronology of the subject is roughly as follows: In 1859 (almost 1860, for it was in the end of November) Darwin brought out The Origin of Species. Before that period Mr. Spencer had published (among others) the following distinctly evolutionary works: In 1850, Social Statics, in which the idea of human evolution was clearly foreshadowed; in 1852, an article in the Leader on The Development Hypothesis (from which I have quoted a passage already), where the evolution of species of plants and animals was definitely set forth; in 1854, an article in the British Quarterly Review, on The Genesis of Science, where intellectual evolution was distinctly mapped out; in 1855, The Principles of Psychology (first form), where mental evolution is fully formulated, and the development of animals from a common origin implied at every step; in 1857, an article in the Westminster Review, on Progress, its Law and Cause, where the conception of evolution at large was finally attained (though not quite in the full form which it afterward assumed). From all of these, but especially the last, grew up the idea of the System of Synthetic Philosophy, the first programme of which was drawn up in January, 1858, nearly two years before the appearance of The Origin of Species. Thus so far is it from being true that Mr. Spencer is a disciple of Darwin that he had actually arrived at the idea of organic evolution and of evolution in general, including cosmic evolution, planetary evolution, geological evolution, organic evolution, human evolution, psychological evolution, sociological evolution, and linguistic evolution, before Darwin had published one word upon the subject.

To some people, in saying all this, I may seem to be trying to belittle Darwin. Not at all. You do not belittle a great man by giving him full credit for what he did, and none for what he did not do. You do not belittle Virgil by showing that he was not the powerful magician the middle ages thought him; nor do you belittle Bacon by proving that he did not write Othello and Hamlet. Nobody has a greater respect for Bacon, I believe, than Dr. Abbott;

but Dr. Abbott does not think respect for Bacon compels him to father Macbeth and Julius Cæsar upon the author of the Novum Organum. Nobody has a greater respect for Darwin than I have; but I do not think that that respect compels me to credit Darwin with having originated the ideas due to Lamarck and to Herbert Spencer. Nay, more; I have so deep a respect for the work Darwin actually performed that I consider it quite unnecessary to filch from others in order to enrich him. He can well do without such disloyal friends. Indeed, it is Mr. Samuel Butler's peculiar belief that Darwin did so attempt to filch on his own account. I can not agree with Mr. Butler that the honestest and most candid of our biological thinkers ever made any such endeavor himself; nor can I believe one honors him by making it for him.

If I were to sum up the positions of these two great thinkers, Darwin and Spencer, the experimentalist and the generalizer, the observer and the philosopher, in a single paragraph each, I should be tempted to do it in somewhat the following fashion:

Darwin came at a moment when human thought was trembling on the verge of a new flight toward undiscovered regions. Kant and Laplace and Murchison and Lyell had already applied the evolutionary idea to the genesis of suns and systems, of continents and mountains. Lamarck had already suggested the notton that similar conceptions might be equally applied to the genesis of plant and animal species. But, as I have put it elsewhere, what was needed was a solution of the difficulty of adaptation which should help the lame dog of Lamarckian evolutionism over the organic stile, so leaving the mind free to apply the evolutionary method to psychology, and to what Mr. Spencer has well called the supraorganic sciences. For that office Darwin presented himself at the exact right moment—a deeply learned and well-equipped biological scholar, a minute specialist as compared with Spencer, a broad generalist as compared with the botanists, entomologists, and ornithologists of his time. He filled the gap. As regards thinkers, he gave them a key which helped them to understand organic evolution; as regards the world at large, he supplied them with a codex which convinced them at once of its historical truth.

Herbert Spencer is a philosopher of a wider range. All knowledge is his province. A believer in organic evolution *before* Darwin published his epoch-making work, he accepted at once Darwin's useful idea, and incorporated it as a minor part in its fitting place in his own system. But that system itself, alike in its conception and its inception, was both independent of and anterior to Darwin's first pronouncement. It certainly covered a vast world of thought which Darwin never even attempted to enter. To Herbert Spencer, Darwin was even as Kant, Laplace, and Lyell

—a laborer in the special field who produced results which fell at once into their proper order in his wider synthesis. As sculptors, they carved out shapely stones, from which he, as architect, built his majestic fabric. The total philosophic concept of evolution as a cosmical process—one and continuous, from nebula to man, from star to soul, from atom to society—we owe to Herbert Spencer himself, and to him alone, using as material the final results of innumerable preceding workers and thinkers.—*Fortnightly Review.*

ANTS AS THE GUESTS OF PLANTS.

By Prof. M. HEIM.

THE relations of ants with aphides and other insects have been studied by several authors, and constitute a field of interesting observation. The best known are those with the aphides and the cochineals, from which ants derive a food of honeydew. Where these do not abound, certain hemipterous insects take their place. Thus the caterpillar of the *Lycæna* is said to bear on its latter abdominal segments three or four pairs of projecting pimples with a central opening whence little drops of a special liquid exude under the caresses of *Formica fusca*. It is believed, further, that ants assist these insects in their molting by helping them get rid of their old skin. It seems to be established that ants protect some insects injurious to vegetation against the attacks of their enemies; in some cases, however, it is probable that they often take juice-sucking insects from young and tender parts to other, older parts of the plant, where they will do less harm, and thus in a measure protect the plant. Ants have been observed thus transporting aphides.

All insects producing nectar may be regarded, as a whole, as ambulatory nectaries. They are more powerful causes of attraction to ants than the extrafloral nectaries. Scattering themselves nearly all over the surface of the plant, they determine the coming and going of the ants, which indirectly protect the whole plant. Yet the damage done by the "ambulatory nectaries," which extract the nutritive juices from the plants and cause deformities in their organs, can hardly be said to be compensated by the incidental and uncertain protection which the ants may afford them in other respects.

The ants which are really protective to plants are not those which obtain their food (indirectly for the most part through the aphides) from the vegetable kingdom, but those which are really carnivorous. These are numerous in temperate climates, and their usefulness to agriculture and sylviculture is incontestable.

Thus the field ant is a great insect destroyer. A nest of this species is capable of destroying as many as twenty-eight caterpillars and grasshoppers a minute, or sixteen hundred an hour; and such a colony is at work day and night during the pleasant season. In the arid plains of America the beneficent work of ants is revealed in the isles of verdure around their hills.

There are plants hospitable to ants, which furnish them shelter and often food, within the cavities of which the instincts of the ants prompt them to take their abode. This is the case with several ferns, among them the *Polypodium nectariferum*, the sterile fronds of which bear nectaries on their lower face, and are, moreover, of a shape favorable to sheltering the insect.

Some palm trees, whose young shoots are very tender and insufficiently defended by their only half-hardened thorns, furnish shelter to ants and receive protection from them: the *Calamus*, in its spathe; some species of *Dæmonorops*, in a sort of galleries on the surface of the stem, formed by the intercrossing of the incurved thorns with which the stalk is invested. In this case the sheltering organ forms only a part of the walls of the cavity inhabited by the ants; but in the large majority of cases the cavity is entirely formed by the organs of the plant.

From the examination of a large number of cases of sheltering trees frequented by ants, we draw the conclusion that the biological relations between plants and these insects were primitively as simple as possible, being those of plants devoured and insects devouring. Such are the real relations of the harvesting ants and the leaf-cutting ants with the plants which they ravage. It is, however, important to observe that the plants harvested from by ants do not suffer without drawing a kind of advantage from the harvesting. Numerous seeds are sacrificed; but a large number, escaping the voracity of the ants, are scattered by them and owe them for a veritable assistance in the struggle for existence with rival species.

In the complete industry of ants they do not content themselves with the simple harvesting of vegetable products, but devote themselves to agriculture; and the plants cultivated by them are, by means of the care they receive from them, favored in their struggle with rival species in the same way as the cereals cultivated by man, which have no longer to contend with indigenous species. Numerous ants content themselves with sweet, liquid substances, as honey and nectar. Primitively, they had to satisfy themselves with gathering the honey scattered over the surface of the leaves; then their suction, localized at special points on the leaves, may perhaps have determined the formation of extrafloral nectaries. These are susceptible of rendering the plants two sorts of services. Ants attracted by them to the surface of the plant protect it against the attacks of leaf-eaters; and, further, the extranuptial nectaries divert the ants from the reproductive organs, where they might, in some flowers, rob winged insects, aids to fertilization, of the nectar, without themselves aiding in the pollination.

The protection of the floral nectaries may, however, perhaps be assured by other arrangements still more efficacious and more economical to the plants. The plant, becoming myrmecophobic and protecting its floral nectaries against ants, achieves an economy of nutritive forces. *Chevaux de frise*, gliding surfaces, bent peduncles, and viscous hairs are the principal defensive provisions against ants.

The sweet extract of aphides, cochineals, and some other insects may be likened to a real animal honey. Hence the origin of the pastoral customs of ants, the establishment of underground and open-air stables, and the effective protection of aphides against their enemies, with the real injurious action of ants to a number of plants.

The instinct of ants leads them to lodge themselves in cavities capable of offering them shelter. Such cavities will be more advantageous to them as they are within reach of the food they seek. Thus, a nectariferous plant visited by ants will soon become a host-plant to them, if it offers a cavity suitable for their accommodation. Such is also the case with a plant not nectariferous, but inhabited by insects that can supply ants with an animal nectar. Ants will then devote themselves to the rearing of those insects in the hospitable cavity. In some cases also, the plant, finding a real advantage in the presence of ants on its surface, differentiates *food bodies* adapted to furnish them a more abundant nourishment.

The services rendered to plants by ants are of various kinds. In numerous cases ants effectually protect the host-plant against the attacks of parasitical insects or the teeth of herbivorous animals; in host-plants with cavities converted into stables ants may attenuate the damage committed by aphides or cochineal insects by removing them from the young organs when their presence would be injurious to a point where it is more compatible with the life of the plant. There is established a kind of symbiosis of these—the ants protecting their cattle which furnish them food, and diminishing the damage occasioned by the herds to the plant on which they feed. Sometimes, but rarely, the refuse material accumulated by the ants in the sheltering organs of the plant seems capable of furnishing it with nutritious matter; but this has yet to be proved in most cases.

The irritation produced by the ants upon the sheltering organ may, by determining a more or less notable increase of that organ, aid the host-plant in the struggle which it has to sustain, either against rival species or against physical agents.

The prime origin of the host-organ is really variable, according to the types considered. Sometimes ants take advantage of cavities wholly or incompletely closed which are a part of the morphological plan of the plant, and the function of which can only be mechanical, such as hollow internodes; sometimes they convert into ants' nests organs that serve to protect plants against herbivorous animals—thorns; or against physical agencies—reservoirs of water.

In other cases the parasitical origin of the host-organ does not seem doubtful. In some types it may be contrived by the ants in view of their wants—perforation of the wall, formation of galleries; in other cases primarily abnormal dispositions determined by the presence of ants in the host-organs seem to become, through heredity and selection, normal organs; ants then find host-organs all ready to receive them, without their having to perform any labors preliminary to putting them to use. Dispositions favorable to ants are therefore of multiple origin, varying according to the case.

The biological relations between plants and ants come thus, by insensible degrees, to affect the complex characteristics of life in common, to reciprocal advantage—symbiosis.

If we examine the phenomena of the world with the eyes of the ancient naturalist we shall not fail to admire greatly the various means employed by Nature to reach its ends. Regarding the relations of ants and plants with reference to the reason for the existence of biological peculiarities, we shall not be able to appreciate too much the providence which gives ants access to nourishing plants, and furnishes some plants with guests capable of giving them protection in exchange for some small services.

Does it not seem as if each species was created for the destruction of some other one, and that the life of so many individuals of opposing tendencies should ultimately result in the destruction of all that is living on the surface of the globe? Yet strangely from the struggle itself is born accord; the antagonism of beings culminates in symbiosis, instability in equilibrium, death in life. Chaos engenders order. The resultant of these extensive contests, although most usually not appreciable to the eye not forewarned, may be summarized in the word harmony. Perfect accord is established between beings that have nothing in common, precisely in consequence of the diversity of their wants; for in this accord none of the concordants has an interest in despoiling its associate.

By this the law of progress is certainly confirmed as to what concerns general life. Aside from the sufferings and the death of individuals, evolution tends to establish among beings primarily rivals—a *modus vivendi* which insures the free expansion of their species—an expansion progressive, but which will eventually find its limits in the new struggle which species, triumphant through their union, will have to sustain against adjacent species.

What horizons does the study of ants open to the mind of the naturalist! The scrutiny of their relations with plants is sufficient to procure for the investigators who devote their efforts to it the most lively enjoyment which the naturalist's mind can ask for. Those who have succeeded in raising this little corner of the veil of Nature should be ever grateful to the ants for it.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE LANGUAGE OF CRIME.

By A. F. B. CROFTON.

THE language of criminals—the *argot* of Paris, the "patter" of London—has been carefully investigated by numerous writers, with very variant results.

Its origin is difficult to explain. Criminals, say many authors, have found it necessary to adopt a technical language for their own protection, that they may be able to converse in public without being understood. "They have been forced to do this, and have made a language as sinister and as vile as themselves." This theory can not be admitted. Certainly the *argot* is sinister and vile and thoroughly representative of the class that uses it, but further than this we can not go.

The theory that the use of this dialect is of any assistance to the criminal is inadmissible. Most policemen and all prison officers know this slang, sometimes better than the thieves. To speak it in the hearing of a detective is to invite arrest; to speak it in the presence of the general public would arouse suspicion and attract attention—two things which are especially to be avoided. Why, then, does it exist? Dr. Laurent, of the Santé prison in Paris, has given an explanation which has at least nothing to contradict it: The persons engaged in every trade form a species of dialect or technical phraseology which is spoken and understood only by themselves. Criminals, who practice a trade as old as any, have gradually acquired a language more adapted to their wants, more in keeping with their ideas and thoughts. Miserable, heartless, engaged in a perpetual struggle against morality, law, and decency, they have acquired a language of debased words and cynical metaphors, a language of abbreviated expressions and obscene synonyms.

Many authors have found it analogous to the elementary language of primitive peoples, and the frequent onomatopes give some apparent solidity to this theory. The describing of a subject by one of its attributes is characteristic of all early races and even to-day of children. The child who describes a dog as a "bow-wow" is following a primitive instinct. The infant may call a train a "poo-poo," an onomatopoetic expression for its puffing; the thief calls a train a *rattler*. The analogy is not complete but suggestive. Its very incompleteness illustrates exactly the objection to the theory stated above. The child creates, but the thief adapts. The slang of the criminal is not a creation of a primitive language; it is the attempt to reduce a matured language to an elementary stage. It is a destructive and not a creative process.

Notwithstanding the able arguments of the theorists referred to, the observer can not but remark the very serious difficulties that arise when we attempt to consider the *argot* of the thief as a primitive language, tongues "which are always serious, never ironical, never mirthful, never seeking to sully the object of the thought, simple in their metaphor, abundant in grammatical forms." Every language has a syntax peculiar to itself, but in the *patois* of the criminal no attempt is made of changing anything but the lexicon. It bears the same resemblance to the parent language that a pile of cogwheels does to a watch. They are not a watch, but neither are they a new machine. Thus we must regard the *argot* only as a dialect in which debased terms replace the words of the parent tongue, in which the innate laziness of the criminal has effaced all words of any length and has simplified the pronunciation wherever the correct form requires anything but an elementary combination of sounds.

Let us examine some of these transformations and synonyms.

The general tendency of the criminal to reduce the abstract to the concrete, to denote the substantive by one of its attributes, is shown very clearly in his synecdochical phraseology. Thus a purse is a *leather;* a street car is a *short,* comparing its length with a railroad car; a handkerchief is a *wipe;* and a pair of shoes *a pair of kicks.*

Again, some of the terms appear to be purely arbitrary, and, were it not that the creative power is absent in criminals as in women, I should not hesitate to state it as a fact. But it seems wiser to conclude merely that the origin of these terms has become obscured. To suppose that they were created would be in too distinct contradiction to all obtainable evidence, indirect though it may be. Such expressions are *to kip,* meaning to sleep; *to spiel,* to make a speech; *jerve,* a waistcoat pocket; *thimble,* a watch; *to do a lam,* meaning to run.

Some of the expressions are very descriptive. To run from a police officer is *to do a hot foot*. A person who is always listening to other people's conversation is called a *rubber-neck*. The word *push*, meaning a crowd, is occasionally seen in the newspapers. To be arrested is to be *pinched;* to be convicted is to *fall*. To refuse a person's appeal is *to give him the marble heart*. Such expressions require no explanation.

There is a disposition among all uneducated people to use a single verb both in a transitive and an intransitive sense. The verb "to learn" is used very commonly for "to teach." "To set" is used for "to sit," and "lay" for "lie." In the *argot* the same rule applies. The verbs to kill and to die are both expressed by the one term "*to croak*," and the grim humor of the class appears in the word *croaker*, which means doctor. The *argot* has no syntax; in the verbs there is scarcely any distinction of tense. The present tense is used for the imperfect and for the past. "I win a dollar" may mean I am winning a dollar, but it is equally probable that it means I won a dollar or I have won a dollar. There seems to be an effort to eliminate everything possible from the language, to reduce its vocabulary to the minimum. It is a natural endeavor for a listless and enervated people. In some cases there may be an attempt to use the past form of the verb, but the formation is very apt to be incorrect, although regular. Thus the grotesque terms used by children as "bringed," "catched," and even strange plurals and comparatives as "foots" and "worser," are very commonly found.

This dialect has, as we have been shown, mutilated the mother tongue; it has also borrowed liberally from other languages, but without method or etymology. Criminals are not grammarians. Neither are they linguists, and at first sight it would seem strange that they should import words from other countries. We will find, however, that in any prison the percentage of inmates of foreign birth will be large; in America it is about fifteen per cent. A foreign expression which seems apt or an improvement on the one in present use is rapidly diffused through the prison. In cases where it is especially descriptive it may become permanent, but its life is usually short. The *argot* of the crime class changes materially every two or three years. It is ephemeral, as shifting as its users. Victor Hugo exaggerates only slightly when he says, "The *argot* changes more in ten years than the language does in ten centuries."

This mutability is common to all languages, but recognized tongues change more slowly—in a generation, not in a year. Words are born, live, and die as we do. They have their youth, their virility, their old age, and their second childhood. They have a reason, there is an element of reflection which precedes their introduction, while in the *argot* the birth of a new word is a chance. Thus in the last three years there have been three different words for watch—*super, thimble,* and *yellow and white*—each of which was, in its turn, the only term used.

Every writer on the subject has noticed that the *argot* is very rich in expressions to denote certain common actions. This is a peculiarity shared by all primitive languages, the only difference being in the selection of the common acts. Thus in Sanskrit there are nearly one hundred roots which express the idea of killing or wounding, without counting secondary derivations. Some of these roots are embodied in our language to-day. In the dialect of the thieves there are nearly one hundred expressions to signify theft. It was necessary for the pickpocket to describe the various pockets in a man's clothing and in a woman's dress. The average man does not often need to specify a particular pocket; when he does, he lays his hand on it to assist the poverty of his language; the thief has a separate name for each separate pocket.

It is a curious and instructive study, full of interest to the metaphysician, the philosopher, or the scientist.

But in spite of this richness in synonyms, which is in itself a very marked sign of degeneracy, for the tendency of a language is to eliminate its synonyms, giving to each a different shade of meaning, the *argot* is a poor language. It has not a single expression for abstract emotion; to attempt to render a philosophic thought, a moral emotion, a synthetic or æsthetic idea into the dialect of the thief would be like attempting to translate "electricity" or "steam engine" into Latin. It is impossible, because the words do not exist. They are not needed. The criminal has no more conception of abstract emotion than a blind man has of color.

A fact which does seem to ally the *argot* to a primitive language is its ability to form additional words from its own resources, a power of self-development which we find in the old Anglo-Saxon and especially in the German of to-day. This trait is the more striking, as it seems in direct contradiction to the impotence of the English language in this respect. The English has little formative power; it relies on the Greek and Latin languages for the extension of its vocabulary.

Dr. Laurent states, in his work on the French criminal, that some authors have claimed that the slang of the criminal was a kind of international language for thieves, a Volapük of crime. It is unfortunate that the names of these authors were not given. Were it not for the reputation of the learned doctor it might be suspected that he was creating men of straw that he might forthwith demolish them. The claim is almost too absurd to discuss. Even in different parts of the same country the dialect of the local criminals will differ very materially, while in all cases it would be totally incomprehensible to a foreign thief.

SKETCH OF STEPHEN J. PERRY.

THE Roman Catholic priesthood of the present century bears upon its rolls the names of several men who have distinguished themselves in scientific research; among them are those of two who were eminent in the study of solar physics. One of these was Father Secchi, of Rome; the other was Father Perry, S. J., who for several years maintained the position of Stonyhurst College and Observatory as a leading institution in the investigation of the sun spots, the aurora borealis, electric and magnetic currents, and the phenomena associated or supposed to be associated with them.

Stephen Joseph Perry was born in London, August 23, 1833, and died on the steamer Comus, of the British Eclipse Observing Expedition, near Demerara, December 27, 1889. He was taught at Gifford Hall School, and trained for the priesthood of the Roman Catholic Church in the colleges at Douai and Rome. Returning to England, he became, in November, 1853, in accordance with a resolution which he had formed while in Rome, a member of the Society of Jesus, British Province. At the end of the second year of his novitiate he went to France. Returning to the seminary of Stonyhurst, at Blackburn, England, he began a course of philosophy, but, showing a marked predilection for mathematics, his studies were, with the advice and consent of his superiors in the order, turned especially in that direction. He took a high rank in mathematical honors at the University of London, attended lectures by De Morgan, and completed his mathematical studies in Paris. He was then appointed Professor of Mathematics and Director of the Observatory in Stonyhurst; taught a class there for one year; took a course in divinity at St. Bueno's College, North Wales; was ordained priest in 1866; and two years afterward resumed his professorship and the direction of the observatory at Stonyhurst, where he spent the whole of the rest of his life except when absent upon some scientific expedition.

The observatory at Stonyhurst, where good work in meteorological and magnetic observation had already been done, was chosen as one of the first-class English meteorological stations in 1867. With the new instruments that were acquired from time to time, giving the observatory an excellent equipment, Father Perry strove to make the station one of the most efficient, particularly in the study of solar physics. "His first communication to the Royal Astronomical Society," says Nature, upon whose obituary notice of Father Perry we rely for most of our material, "indicates the policy he pursued—to undertake no work which was a mere duplication of that done at other places." It appears, from a summary of his solar work during the ten preceding years, given at a lecture at the Royal Institution in May, 1889, that it was carried on by means of drawings and spectroscopic observations. "For the drawings an image of the sun ten inches and a half in diameter was projected on a sheet of drawing-paper affixed to a sketch board carried by the telescope, and all markings on the sun traced. The drawing finished, the chromosphere and prominences were examined with the spectroscope. About two hundred and fifty drawings were made every year from 1880. The results of these observations were published annually in a neat little volume, and in various publications." Regular observations of Jupiter's satellites and of comets were also made, and spectroscopic observations of comets and stars. In the year 1888, for instance, the chromosphere was completely examined on eighty-four days and partly on three other days. The Rev. Aloysius L. Cortie, S. J., in his biography of Father Perry (London, Catholic Truth Society), describes the work at Stonyhurst as having included the daily drawing of the sun when possible, the measurement of the depth of the chromosphere, the heights of prominences, and observations of sun-spot spectra—a programme which was faithfully adhered to up to the time of Father Perry's death. The drawings of the sun spots, as they appeared in the Memoirs of the Royal Astronomical Society, reproductions of two of which are given in Father Cortie's book, show how much can be effected by means of the pencil. The main object of making these drawings, which are of great importance and supplement the solar photographs, was to throw light upon the theories of the mode of formation of spots, and to find, if possible, the clew to the connection between terrestrial magnetism and solar activity.

Father Perry's industry and strict attention to his work of observation are further attested in his contributions to Nature and other journals. In Nature, the only journal of which we have complete files at hand, we find from one to three communications each in twenty-three of the forty volumes which were published previous to his death, recording phenomena of weather, magnetism, the aurora borealis, meteors, the sun, and earthquakes. The first volume, for instance, has a communication describing the cyclone of January 13, 1870, as it prevailed at Stonyhurst. In the third volume are letters speaking of his having missed on some observation a particular faint yellow line in the chromosphere, on the November meteors, and describing minutely the successive phenomena of the earthquake of March 17, 1871. A communication in the second volume sets forth a method of magnetic surveys of limited districts in which investigators might employ themselves during their vacations, and which he had practiced satisfactorily during two successive vacations. These were probably the survey of the west of France, made in 1868 in company with Father Sidgreaves, and that of the east of France, made in 1869. A detailed account of such a survey made by him in Belgium one autumnal season was communicated to the Royal Society, with the magnetic elements of twenty stations and the secular variation. Other studies on this subject are recorded; one comparing the curves as shown by the photographs in terrestrial magnetism at Stonyhurst and Vienna, which was spoken of as remarkable in that the curves offered a striking illustration of the simultaneous action of the disturbing forces of two magnets many miles apart; and observations by him and Prof. Balfour Stewart on the regular fluctuations of declination at Stonyhurst and Kew, of which the authors remarked that "such fluctuations almost always occur as couplets or groups of couplets—a couplet meaning first a descent and then an ascent, or the reverse"; and the paper offered an explanation of the phenomena. A communication on the magnetic storm of October, 1872, calls attention to the importance of observations of such manifestations, in view of the coincidences discovered between them and other important natural phenomena.

In an address delivered in 1872 or 1873 to the Liverpool Polytechnic Society, after explaining what was known of terrestrial magnetism and remarking upon the observed coincidence of magnetic disturbances with the passing of earth currents, "their never-failing appearance at all auroral displays, their simultaneous appearance at places the most remote from each other, and their agreement in various periodic features with outbursts of sun spots," were spoken of as most powerful aids to the solution of the problems connected with them; and he suggested that it was not unreasonable "to expect that some light may be thrown upon the question, if we examine with careful attention the not impossible connection of magnetic storms with solar outbreaks, or with volcanic eruptions and violent earthquakes, with the variations of the wind, or even with the showers of fallen meteors." Further, he asked, if the connection supposed by certain students between the period of solar spots and the relative position of the planets can be maintained, "if the solar disturbances are in any way due to the combined action of the planets, and these again are found to be coincident with the great perturbations of terrestrial magnetism, shall we not be inclined to attribute a wider range to the magnetic force than is in general assigned to it? May not that which has long been allowed to rank among the most extensively diffused of Nature's agents find a home in each individual member of the solar system, causing them to act and react upon each other as well by their magnetic energy as by the force of gravity? The perfect solution of such a problem would well repay many a year of persevering observation and of assiduous study, and well will those be rewarded by whose labor the general cause of terrestrial magnetism ceases to be one of the unsolved mysteries of cosmical physics."

In connection with the eclipse of December 22, 1870, Father Perry was made chief of the expedition to watch the phenomenon at Cadiz, Spain. Unfavorable weather prevailing during most of the time of the sojourn of the party at the station, the observers were spread out as much as possible, in hopes of not failing altogether, and the results justified expectations. The clouds were not so thick as to cut off all the observations, and some fairly good views were obtained.

For the observation of the transit of Venus of 1874 Father Perry offered his services for the expedition to Kerguelen Island, and was appointed chief of the observing party, to be stationed at Christmas Harbor. Importance was attached to this expedition in British scientific circles aside from its astronomical purposes, because this lonely "island of desolation," as Father Perry afterward called it, had been but little explored, and not much was known of the region in which it was situated; and a natural history party was sent out with the transit company by the Royal Society to investigate the botany, etc., of the island. The undertaking to go on this voyage was a serious adventure with Father Perry, and illustrates as much as anything else, perhaps, his self-sacrificing devotion to his favorite science. He was peculiarly sensitive to suffering from seasickness, and was not spared on this, one of the longest and roughest voyages the ocean affords; and his sufferings on this occasion, Nature says, "were so fearful that every one wondered that he cared to venture on even the most promising trip." His patience in suffering "helped to win for him the esteem of the officers with whom he came in contact. Not one word of his discomfort is to be found in any of the journals kept by him." He was guided, as he expressed it, by a determination "that no consideration should make us flinch where the astronomical interests of the expedition were at stake." In addition to the work of the expedition, he took magnetic observations at the Cape of Good Hope, Kerguelen, Bombay, Aden, Port Said, Malta, Palermo, Rome, Naples, Florence, and Moncalieri, and lectured on the transit of Venus at the Cape and Bombay, and, on his return, at the Royal Institution. He also communicated a paper on the subject to the British Association of 1875, illustrating his remarks by diagrams of the sun and the planet as seen from various stations, and was attentively listened to. The Americans had anticipated his party and taken the position they had intended to occupy, but they found a better one; and the three British detachments and the Americans co-operated, making four stations on the island. The weather was finer than they had anticipated from the accounts of the climate of Kerguelen, and from his station they were able to get observations of the internal and external contacts at egress. He was also a member of the observing party of the transit of Venus of 1882, in Madagascar, which was selected as one of the ingress stations. In 1886 he observed the eclipse of August 29th, at Carriacou, a small island to the north of Grenada; and in 1887 the eclipse of August 19th, in Russia.

In November, 1889, he sailed for the Isles de Salût to witness the solar eclipse of December 22d, and died soon after the observation. According to the account given of these, his last days, by Father Strickland, S. J., in The Tablet, he suffered much during the voyage from seasickness, and was in rather an exhausted condition when he reached the island. He nevertheless, intent upon his work, went ashore at once to inspect the proposed point of observation and introduce himself to the authorities. He was advised and urged to continue to live on the vessel (the Comus), going ashore only in the day. Father Strickland expressed the belief that if he had done this "his life would not have been sacrificed to the one anxious desire to do everything for the best for the success of the work confided to him." He preferred, however, to abide in the hospital, and said nothing of the illness which he felt. The road from the hospital to the observatory was steep and difficult, but he traversed it on foot four times a day. He complained the Friday before the eclipse of sickness, but worked till nearly three o'clock in the morning; lay down in a hammock in the tent to get a little rest where he was; was up again before six o'clock to take the position of the sun at rising; and superintended at half past seven a careful and successful rehearsal of the operations and duties that were to be performed in the observation of the eclipse the next morning. "Every one was surprised at Father Perry's exactitude in contributing to carry out his own orders, and his courage in facing fatigue. His readiness to sacrifice himself and his own convenience in order to save trouble to others endeared him to all who worked with him, and challenged their utmost efforts to secure success for their work in spite of the oppressive climate and surroundings." About noon on Saturday he was found much exhausted by a ship's officer who visited him, but was again at his post in the observatory at three o'clock, where an important photograph was secured. In the evening he went to the ship for dinner, but was only able to lie on one side, and took some chlorodyne. He then persisted in going ashore and to his own quarters to sleep, in a violent rain. He passed a bad night, and was very ill on the following morning, the time of the eclipse, and permitted himself to be assisted over the half mile to the observatory, but would not be carried in a stretcher. Though very much exhausted when he reached the observatory, "as the important moment approached he seemed to rally, and during the minutes of the eclipse seemed to be himself again, and showed no signs of illness or exhaustion. There were two photographic instruments in use —one, an old one, which had often been in use before; the other was the special corona graphic instrument prepared for the occasion, of which Father Perry himself took charge. He was so alert and self-possessed during the eclipse that his friends about him hoped he was not so ill, but he gave way immediately after, and with much difficulty reached his quarters in the hospital." On Sunday night the critical nature of his disease, dysentery, became evident. On Wednesday he was better, and the ship set sail for Demerara. Friday afternoon his mind began to wander, and in an hour and twenty minutes afterward he died. Before he quite lost consciousness "he thought himself again engaged in 'the supreme moment of the scientific mission which had so long filled his thoughts,' and 'began to give his orders as during the short moments of the eclipse.'"

Steps were taken a few months after Father Perry's death to establish a memorial of him, to consist of a new fifteen-inch telescope, which, with the house in which it stood, should be called the Father Perry Memorial, the works done with which should be published under his name.

A THEORY of "partial impact" is suggested by Prof. A. W. Bickerton, of the New Zealand University, to explain the sudden appearance and rapid disappearance of "new stars." Recognizing the fact that enormous masses of incandescent matter can not cool in a few weeks, the author observes, as quoted in Nature: "A typical new star is probably a thousand times as bright as our sun; it appears suddenly and disappears in a year. . . . The formation of such a body is difficult to explain on any theory except that of impact, but to explain its disappearance is more difficult still. It is estimated that it will take the sun ten million years to lose half of its luster. Think of a sun a thousand times as bright cooling in a year! The idea is absurd." But if we accept Mr. Lockyer's theory that some stars are not coherent bodies like our sun, but masses of meteorites which in the case of new stars and variables collide with one another, the difficulty is much less. We have no longer an enormous mass all aglow, but numerous scattered masses, vastly smaller, and capable of rapid cooling.

Editor's Table.

SAFEGUARDS OF NATIONAL PROSPERITY.

THERE are two very sharply contrasted views of the conditions on which national prosperity depends, and we do not know how they can be better described than by naming them the scientific and the unscientific view, respectively. The scientific view of this and of every subject takes its start from Nature and the operation of natural law. The unscientific view takes its start from the idea of human intervention. The one finds the basis of all prosperity in the fruitful application of labor; the other thinks that nothing can be done well without incessant watchfulness to control and frequently to counteract the operation of natural forces and processes. According to the latter view, men and nations have to be guided, protected, and nursed into prosperity; according to the former, man is an animal who *wants* to be prosperous, and who has wit enough to attain his desires if he is only sufficiently let alone. So far as this country is concerned, no one can deny that what we have called the scientific view is sustained by facts, at least to this extent that, undeniably, the years when the most rapid advances were made in wealth and general prosperity were precisely those in which industry was least protected, and the principles of paternalism in government least developed.

An important characteristic of the scientific view is that it makes for national unity and for good will among men; while a most unfortunate characteristic of the other is that it tends to separate class from class and man from man in the most invidious manner. There is no one scheme by which the whole of a nation can be "protected." Protection is necessarily a piecemeal business, and what is accorded to one class becomes a pretext for similar or equivalent privileges to another class. In this way each class is led to watch with jealousy what is done for every other, in order to see that it is not left out in the distribution of state favors. The land is thus filled with countless law-made causes of rivalry and contention, and the minds of men grow small through the study of narrow and selfish interests, instead of being enlarged by the thought of one great onward movement in which, under the *régime* of liberty, all would participate.

Every protectionist system is dominated by the sentiments of fear and enmity—fear of and enmity toward those against whom protection is sought. That such sentiments are at war with and tend to depress and weaken the more generous instincts of a community who can doubt? When party orators talk of the "pauper labor" of the Old World, is it with any accent of sympathy for the hard lot of the alleged pauper laborers? Is it not always with a fierce accent of contempt for the laborers and hatred toward the countries to which they belong? We can truly say that we have no recollection of ever having seen or heard the term employed except with a distinct implication of contempt and hostility. Why is our country even to-day, when arbitration treaties are under discussion, so prone to anger and bitterness toward foreign countries, but particularly toward Great Britain, if not that protective policies steadily and powerfully keep alive such sentiments in the hearts of the people? We are not at this moment discussing this question from an economic point of view. It would be quite possible to grant, from the latter standpoint, that what is called commercial protection is a national necessity; and yet to admit and lament the fact that the moral result of such a policy was most unfavorable to the national character, and, above all, unfavorable to those broad, liberal, and humane sentiments which ought to characterize a nation which habitually regards itself as leading the van of civilization.

An illustration of the pettiness to which what we have called the unscientific view of the means by which national prosperity is promoted naturally leads is found in the recent legislation which imposes an educational test upon foreigners wishing to make this country their home. The immigrant, if over sixteen years of age, must be able to read and afterward write from twenty to twenty-five words of the Constitution of the United States; otherwise he is sent back to the country whence he came. The individual may be physically sound, and may be a capable and patient worker, prepared, even with the drawback of illiteracy, to take his chances in this new land; but he is refused admission. Why? The main reason, as we believe, is that the throwing of such difficulties in the way of the foreigner is in line with the sentiments which, as a people, we have been carefully nourishing for a long time past. It is a phase of "protection." But surely do we need to be protected from foreigners who come here to do the hard work of the country? Is it not in our power to teach them respect for the law, if they need such teaching? And might it not be expected that the "free air" of this continent and the free play of American institutions would do something for their intellectual and political development? In times past, when our own illiteracy showed a larger percentage than it does to-day, and our whole population was much smaller, we admitted illiterate immigrants by the thousand without question and gave them a hearty welcome. To-day, when the volume of immigration is much less than it used to be, and when our own educational level is alleged to have materially risen, we must turn back the able-bodied foreigner unless he can show that he has been to school. In those days we made no question about our ability to absorb the vast hordes that presented themselves, and we did it. To-day, when our population is much larger and the number of strangers arriving much smaller, we impose a scholastic test.

Looking at the law as a proposed safeguard of national prosperity, we must say it has a most fatuous appearance. The ability to read and write shows that the individual has so far been cared for by others, but affords little evidence as to his own intelligence or character. A great many vicious and socially dangerous persons are to be found among the educated, so called, while among the wholly uneducated are large numbers of faithful and honest workers. It would be interesting, but perhaps a little disquieting, to know just how many persons in this country who could write out, if necessary, the whole Constitution of the United States are supporting themselves by more or less predatory modes of life; and it would be further interesting to know what proportion of their dupes they find among those who can read and write, and what among the wholly uneducated. The fact is that "education" throws open to the vicious means of fraud they would not otherwise have possessed, and brings another class within the reach of dangers from which they would otherwise have stood entirely aloof. The man who can neither read nor write generally has a feeling of his own weakness, and is thrown back on his natural shrewdness and knowledge of things for self-protection, while a little school education, though of the shallowest kind, often puffs up its possessor to an amazing sense of self-sufficiency.

No one, we trust, will misunderstand the drift or purpose of these remarks. We wish in the first place to express our disapproval of the illiberal policy which would shut the door of this vast country, with its immense resources, in the face of a healthy, able-bodied immigrant, simply because he has not learned to read and write; and in the second place, to emphasize the position we have so often taken, that the mere ability to read and write is no safeguard whatever of character, no guarantee of the course in life which the individual will afterward pursue. There is in it the potentiality of further growth in knowledge, but there is also the potentiality of a life of scheming, of a life of sensuality, of a life of lawlessness. For one who can read there are useful books and papers to be had with very little trouble; but there are pernicious ones to be had with even less. The problem today is far less what to do with our illiterates than what to do with a considerable body of our literates, applying that term to all who can read and write; and to pretend that the welfare of the state is threatened if an almost imperceptible percentage of illiterate foreigners is added yearly to our seventy millions of population is hardly less than hypocritical.

The true safeguards of national prosperity have little to do with legislation of this character. They lie in respect for law, in a sense of justice between man and man, in a sense of responsibility on the part of those who through wealth possess power and social influence. They lie also in the faithfulness of public officers in the discharge of their duties, and in the recognition by every citizen of the truth that his actions count in the general sum of influences by which the fortunes of the state are molded for good or for evil. They lie, we need hardly say, in the right discharge by parents of their duties toward their children, and in the general soundness and purity of family life. They lie, finally, in a liberal, humane, and righteous public opinion, by which public policy is guided into right channels, and the evils which spring from diseased parts of the body politic are kept in check. These are the things we need to be concerned about, and which we must be concerned about if the nation is to prosper. Then, sooner or later, we must come to that *régime* of liberty which gives free scope to the activities and better sentiments of all. We must come to a belief that a vast amount of our intermeddling with the laws of supply and demand and the natural tendencies of things has been vain and hurtful. Until we reach this point our national prosperity will be on a more or less precarious basis, and our national character will not attain its best development.

A NATIONAL DEPARTMENT OF SCIENCE.

The proposal has been seriously made in the columns of our contemporary Science that all the different scientific bureaus under the Government at Washington should be gathered into one great department of science under a ministerial head. The proposition is professedly made in the interest of economy and efficiency. It is alleged that several of the bureaus now duplicate one another's work, partly through sheer want of system and partly through not knowing what one another are doing. The writer, Dr. Charles W. Dabney, Jr., thinks it is amazing that the Government has accomplished so much excellent scientific work through the agency of so unscientific an organization. The remedy he prescribes is "a general co-ordination of the scientific work of the Government"; but just what would be the effect of such a co-ordination he does not describe further than to hint that it would save money.

On the other hand, a writer in the same journal, who signs "Washingtonian," does not believe in Dr. Dabney's scheme at all. He inclines to the opinion that "consolidation would diminish results, impair efficiency, and do away to some degree with individual responsibility." He thinks that, as things are at present, practical objects are better kept in view and more effectually pursued than they would be under a department that had the whole field of scientific investigation for its province. "The chemical laboratories," says Washingtonian, "being consolidated, the chief chemist would be a greater man than any of his colleagues. No director of a bureau could control his own chemical work. With demands for particular jobs from several bureaus on hand it would be wholly uncertain when any of them would be finished. Complaints would be met by playing off one against another. Responsibility, and to a large extent efficiency, would be lost."

In this dispute we are disposed to hold with Washingtonian. A general department of science would in our opinion be altogether too vague in its objects, and too little governed by a sense of the practical, to render satisfactory service to the public. It would be almost impossible to prevent it from wandering off into purely theoretical work and into all the fads of specialist research, and in a very few years taking up a position and assuming a character never contemplated when it was established. We hold, moreover, that it would be quite worth while to move the previous question: whether, already, the Government does not engage in various lines of scientific activity which might perfectly well be left to private effort. Government work has this peculiarity, that it is never done; just as "infant industries" have the peculiarity, of never outgrowing the tariff bottle. If a geological survey is undertaken, it must go on *ad infinitum*. If a private company had a piece of land which they wanted surveyed geologically or otherwise, and employed certain persons judged to be competent to take the work in hand, they would expect them to finish it, and that within a reasonable time. They would not expect them to camp everlastingly on the ground, and never hint at any finality to their alleged labors. With Government work it is different; it goes on for its own sake, or for the sake of the salaries connected with it; and the rustic voter who expects to see it some day completed will have an experience like that of the more ancient rustic, who stood by the river side expecting to see the stream run itself dry.

What we want, of course, far more than a national department of science, is an intelligent and honest Congress, out of which can be formed intelligent and honest committees capable of criticising the work of government, and intent on reducing it within the limits indicated by considerations of public utility. It ests with the people to say when we shall have such a Congress. It is all a question, as we lately pointed out, of disinterestedness in the exercise of the franchise. Whenever the time comes that the people as a whole, or a preponderant majority of the people, desire good and honest government, and are willing to take a little trouble to secure it, many things will be possible of which at present we can only dream.

MR. WELLS ON METHODS OF FEDERAL TAXATION.

It is one of the most serious evils of the methods of political discussion current among us that petty, local, and temporary considerations are given predominance, and graver, broader views, looking to the general public welfare and to ultimate results, are very little regarded.

We have a government, according to the well-worn phrase, of the people, for the people, by the people; but what "the people" do not always see is, that the government which they actually call into being is not a government of the people *as a whole*, for the people *as a whole*, and by the people *as a whole*, but a government in which rival interests, class and sectional, more or less check, thwart, haggle with, and corrupt one another, and in which the real interests of the community as a whole are too often lost sight of. The standing difficulty under our system is how to get important interests duly attended to, how to get great questions adequately discussed. Matters of minor importance, particularly such as may become the subject of a "deal," can always secure attention; but, when the wider and more lasting interests of the nation are concerned, our legislative bodies show only too plainly that these are not the matters they care to deal with. The truth is they are not, speaking broadly, the matters they were elected to deal with, each constituent body having regard mainly, in choosing its representative, to local and special interests, not to those of the country as a whole.

The article which we publish in this number from our valued contributor, the Hon. David A. Wells, entitled How can the Federal Government best raise its Revenues? furnishes an admirable example of the manner in which great questions of public policy should be approached and treated.

Mr. Wells indicates what might be done if our statesmen would only deal with the question of taxation disinterestedly, casting aside the mischievous prejudice engendered by partisan rivalries and squabbles, and solely with a view to the public good. He points out that some of his suggestions would involve going counter to certain popular prejudices, but he makes it clear that these prejudices have nothing to do with the public good except to thwart and obstruct it. His appeal is to the reason and patriotism of Congress and of the country at large, and it will so far help, we have no doubt, to raise the tone of political discussion. To this end we cite his article as an example of earnest and thoughtful argument—the kind of argument that is too seldom addressed to popular audiences and too seldom heard in our legislative bodies.

The question of protection and free trade is very slightly if at all touched upon in Mr. Wells's article. But we can not refrain from saying that, in our opinion, this great nation can never be right with itself or with the world so long as the protection sentiment rules the thought of the people. To say that the way to make ourselves prosperous is to shut out the products of the rest of the world, even when offered to us at the most advantageous prices, is on the face of it an absurdity. The fundamental idea of trade, whether domestic or foreign, is that you get an article that is of more value to you than the thing you part with; and how a nation can benefit itself by greatly restricting the number of its profitable exchanges is something that no unsophisticated mind can understand. Add to this the bitterness of feeling toward foreign nations and the consequent littleness of mind which the protective system breeds; add to it also the political demoralization which tariff arrangements always involve, the corrupt relations they tend to create between the party in power and the privileged interests, and the conclusion will be inevitable that the system in question can not be a permanent policy for a self-respecting nation.

There are other questions pressing forward in our national affairs which need to be treated with sole regard to the welfare of the nation as a whole, and with views looking to the future rather than being confined to selfish interests and the emergencies of the present. Whatever may be said of the validity of Mr. Wells's arguments, his breadth of view and his method of presenting them may well be commended to all whose work it may be to deal with these subjects.

Scientific Literature.

SPECIAL BOOKS.

THE object of the *Ancient Ideals* of Mr. *Henry Osborn Taylor* * is to present a new historical survey of the mental and spiritual growth of mankind in the light of the recent progress of historical research and the modifications of opinion that have been occasioned thereby. The attempt is made to treat human development from the point of view of the ideals of the different races as these ideals disclose themselves in the art and literature, in the philosophy and religion, and in the conduct and political fortunes of each race. The author has endeavored to preserve a unity of plan in setting forth the part taken by each race in the history, to make clear the nature of the contribution made by each to the stages of growth attained before the Christian era, and to indicate in what respects their contributions became permanent elements of humanity and thus elements of its further possibilities—possibilities which he believes find in Christianity the perfect conditions for their final realization. The life of the peoples, if we comprehend the author's thought correctly, is a striving after ideals, which are never quite reached directly by the strivers ; and "the complete story of human progress is the story of ideal conception and of endeavor, and the unfailing realization of ideals in the growth of human beings with ideals uplifted and enlarged." This makes the narrative of the enlargement and upraising of human life ; it is a history of the growth of human personality; of the age-long development of the characters of men and women. Accordingly, we have in this book the story of the life and

* Ancient Ideals : A Study of Intellectual and Spiritual Growth from Early Times to the Establishment of Christianity. By Henry Osborn Taylor. New York : G. P. Putnam's Sons. In two volumes, 8vo. Price, $5.50.

works of each of the greater ancient nations looking toward something it could not quite attain ; taken up and carried on by some other people, which still fell short of the yet higher aim set before it, and so on. "Egyptian thought was characterized by crass confusion," analyzed nothing, had no clearness or consistency or power to discriminate and classify. Its ethics consequently remained unsystematized precept, and, "with all the picturesque elaborateness of a future life, no thought of spiritual immortality was reached." All its art and literature and religion, as we have them, point to this conclusion. In Babylonia the earliest Sumerian and Accadian peoples were subdued by the stronger but less cultivated Semites, who acquired their civilization and built upon it one distinguished by the strength and practical intelligence of its toil, which was sustained for twenty centuries. Then came the Assyrians, whose ideal was power and who created nothing. The Chinese had a mighty power of industry, with docility to national government, and the faculty of ethical formulation which produced their classics and their distinctive modes of thought. The Aryans of India possessed qualities of mind and spirit out of the reach of all these peoples, with a turn to philosophic thought, and were able to produce the Vedas, the Brahmanic philosophy, and its reaction, Buddhism. Those of Iran developed the ideas of a dual warfare between good and evil, with the final triumph of the good and of life over death, with the "grand and spiritual" conception of the supreme Lord of Good revealing himself to his prophet. The Greeks sought logical consistency, the highest beauty in things physical and mental, to make the most of life in its manifold aspects, and to get the most out of it. The Romans consolidated and exalted the family and the state, built up institutions, systematized the law, and constructed enduring public works, but originated little. The Hebrews held the conception of God, "one living personal, righteous, immediate in his governance of the world he made ; and the supplementing thought of man created in his image, bound to obey his will and imitate his ways. The development and the greatening of the Hebrew personality was to lie in the enlargement of the thought of God, and in the endeavor to conform human conduct to his will and ways ever more largely known." Finally came Christianity, including and setting forth the highest and farthest possibilities of life ; affording scope for the inclusion of all qualities and capacities of mankind, and for the development of the whole man in the service of God ; predicating veritable relations between God and man ; and touching and ordering all things in man's daily life.

All the world admires an adventurous spirit, and no one to-day holds a higher place in the world's esteem on this account than Fridtiof Nansen. The personality of this young man of thirty-five, who has already accomplished the only crossing of Greenland by a European and has at one leap advanced the farthest north point of arctic explorers by nearly three degrees, could not fail to be of deep interest, and the interest increases the more one knows of him. A fittingly picturesque account of his life and labors has been brought out in a handsome volume by the Messrs. Longmans.* His biographers show us clearly that Nansen has always had

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* Fridtiof Nansen, 1861–1893. By W. C. Brögger and Nordahl Rolfsen. Translated by William Archer. London, New York, and Bombay : Longmans, Green & Co. Pp. 402, 8vo. Price, $4.

most strongly developed the Norseman's wild delight in conquering difficulties. As a boy he struggled with cold and ice and with other boys hardy like himself. He spent his money for tools and chemicals when he was expected to yield to the seductions of toys and gingerbread. A hard problem was his delight, whether it was mathematics, the mechanism of a sewing machine, or how to make the longest leap on snowshoes and he never rested till he got to the bottom of it. Then he threw all thought of it to the winds and attacked another. After he had developed a decided taste for science and chosen zoölogy for his specialty, almost his first training in descriptive research was gained in a sealing voyage undertaken by the advice of Prof. Collet. In the seal hunting and bear hunting on the ice he acquired training for his famous feats of exploration and his first decided bent in that direction. After his return he studied first at the Bergen Museum and then at the Zoölogical Station at Naples. There are several contributions in the volume by other hands than those of the principal authors. One of these, by Gustav Retzius, tells what Nansen has done as a biologist, showing that he has performed good service in several directions. The account of the Greenland expedition is prefaced by two chapters giving a general description of the country and of the great ice age which, one may say, still persists there. The authors tell us how he made known his plan to Nordenskiold, Rink, and others, how earnestly he answered all objections, and, after making careful preparations, set out on his dangerous undertaking and brought it to a successful issue. Nansen's home must be an eagle's nest, and his wife a fitting mate to the intrepid explorer, if we are to trust the glimpse of her given by one of the authors, Nordahl Rolfsen. He describes humorously a visit to Mrs. Nansen for the purpose of interviewing her about her husband at the time the rumor was current that Nansen had reached the pole. The interviewer found her gay and severe by turns, but uncommunicative through it all. "Like a figure from the Sagas," he describes her, proud, high-strung, and as strong in her way as her husband. A special historical value is given to the book by the sketch of arctic expeditions from the earliest times, contributed by Aksel Arstal, and the chapter by Prof. H. Mohn summarizing the contributions of Norwegian seamen to arctic geography. A geological description of the New Siberia Islands is contributed by the Baron Edward von Toll. The remaining chapters are devoted to Nansen's plan of his polar expedition, his preparations, and his start. With the main features of these matters the world is now well acquainted, but the details have an absorbing interest, especially when told with the vim and color of our northern authors. The volume is illustrated with many portraits of Nansen, his family and companions, and many views of scenes connected with his doings. There are also three folded maps of northern regions.

The questions which have been raised by the experimental investigation of automatic movements, recently carried on in France and England, are among the most interesting with which contemporary science has to deal. In this sphere, as in so many others, the naïve belief in the essential simplicity and reasonableness of Nature, which in the scientist is the counterpart of the child's faith in the native goodness of grown folk, has suffered a shock. Although at present we can scarcely do more than say that the relation of the human consciousness to the apparently intelligent, purposive movements which the body executes is by no means as simple as we thought, any attempt to discuss the problem from the empirical point of view will be welcomed. With the exception of Mr. F. W. H. Myers's papers and reviews, in the publications of the Society for Psychical Research, and of the series by Prof. W. R. Newbold, which recently appeared in this magazine, no discussion of the matter at all commensurate with its importance has appeared, and Mrs. Baldwin's translation of M. *Binet's* book* will therefore be doubly welcome.

M. Binet adopts the conception of double personality—that is, coexistent personalities—and makes use of it consistently for the explanation of all forms of motor automatism, from the most rudimentary twitchings of an anæsthetic hand to the fully developed automatic script which manifests memories, emotions, and desires unknown to the primary self. All alike, he holds, evince the existence of a "little consciousness by the side of a greater—a small luminous point by the side of a great focus of light." The precise character of the secondary consciousness he does not try to determine for all cases, recognizing that it probably varies indefinitely; and he agrees with Pierre Janet, as against Myers, in regarding it as essentially a pathological phenomenon. On the whole, he avoids the pitfall of regarding evidence for the existence of dissociated states as in the same sense and to the same degree evidence for the existence of a fully equipped secondary self, but in one curious passage (p. 210) he seems fairly to fall into it.

Especially interesting are Chapters VI to VIII, in which M. Binet tries to determine the relation of the subconscious field to the upper self. The evidence which he has collected—the greater part of it, indeed, being based upon tracings taken by himself of the movements of an anæsthetic hand under varying conditions—is of the highest importance, and bears directly upon the relation of the margin to the focus in the normal consciousness. Chapter VIII, on Ideas of Subconscious Origin, gives a brief account of the brilliant series of experiments by which M. Binet proved that in some patients touch stimuli which were not felt by the patient gave rise nevertheless to visual hallucinations representing to some degree the object touched, and in one case at least (page 213) extraordinary subconscious hyperæsthesia seems demonstrated.

M. Binet does not treat of the cognate questions involved in the phenomena of normal suggestibility, trance, ecstasy, and hallucination, nor does he endeavor to develop psychological principles of universal application. In conclusion, he points out how unsatisfactory the common notions of association, of unconscious cerebration, and of personality become when viewed in the light of these facts, but, with that exception, he does not show the bearing of the latter upon the more profound problems of mind and brain. Perhaps he feels that the time has not yet come for that; but he marshals the facts with discretion, and if his conceptions are not always as clear as they might be, there are few of us who would wish to cast the first stone at him.

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* Alterations of Personality. By Alfred Binet. Translated by Helen Green Baldwin, with Notes and an Introduction by J. Mark Baldwin. New York: D. Appleton & Co. Pp. 356, 12mo. Price, $1.50.

GENERAL NOTICES.

Mr. *R. P. Halleck's* recent book was not written for scientists, and scientists as such will find nothing in it.* The author undertakes merely to make a practical application of the results which others have attained by patient investigation. His book is written for teachers and parents, and every teacher or parent who reads it from an educational standpoint will be amply repaid. The author aims to emphasize the facts that a large element in education consists in the physical modification of brain and nerve cells; that these cells are more easily modified at one age than at another; that the effects of wrong training or lack of training can never be eliminated in later life; that every person, in order to live a full life, must have all his senses and the corresponding brain-cells developed in his youth. The first chapters give a summary of our present knowledge of the nervous system and the changes that have been found to occur as results of growth, fatigue, and training. Then follow discussions of the effect of environment on training, and on development as related to age. Various definite suggestions are given for training the different senses in the classroom, both by immediate objects and by the formation of memory images. The chapter, How Shakespeare's Senses were Trained, is interesting and intensely practical. The great value of motor training is clearly demonstrated; and the final plea for the early symmetrical development of all the senses as a preparation for fuller, more joyous life in later years is another expression of the present hope for a brighter future in education. Our scientific knowledge of the facts in the case, the changes in brain-cells which are correlated with education, how these vary under different conditions, and how far they may be varied by training, is meager enough as yet; and many scientists would have hesitated to construct such a book on the basis of our present knowledge, while recognizing the far-reaching importance of the investigations which are now going on. Owing to the widespread interest in these questions, we expect in the near future numerous contributions to pedagogy from experimental and physiological psychology. Scores of books similar in scope will doubtless be written, more complete and more valuable to the teacher. Meanwhile we already know far more than we practice, and thousands of children will be indebted to this book for a broader, deeper, and more sensible education.

A text-book of physiology for medical schools has been prepared by ten collaborators under the editorship of *W. H. Howell*, Professor of Physiology in the Johns Hopkins University.* The physiology of the muscles is treated by Prof. Warren P. Lombard; secretion, digestion, the blood, and some allied topics, by Prof. Howell; the circulation, by Profs. John G. Curtis and W. T. Porter; respiration and animal heat, by Prof. Edward T. Reichert; the central nervous system, by Prof. Henry H. Donaldson; vision, by Prof. Henry P. Bowditch; the other special senses and the voice, by Prof. Henry Sewall; reproduction, by Prof. Frederic S. Lee; and the chemistry of the animal body, by Prof. Graham Lusk. The preparation of such a work by collaboration is unusual, and the editor names as advantages of this method that it enables each author to base his account upon a comprehensive knowledge of the part of the subject assigned to him, and that the student gains by it the points of view of a number of teachers, especially where the various topics overlap. References to literature are given, and some of the authors have used them so freely as to afford fairly complete bibliographies of their respective subjects.

The purpose of Mr. *Woglom's Parakites* † is to place before the public the result of the

* The Education of the Central Nervous System. By Reuben Post Halleck. New York: The Macmillan Co. Pp. 258, 12mo. Price, $1.

* An American Text-Book of Physiology. Edited by William H. Howell, Ph. D., M. D. Fully illustrated. Philadelphia: W. B. Saunders. Pp. 1052, royal 8vo. Subscription price, cloth, $6; sheep or half morocco, $7.

† Parakites. By George Totten Woglom. New York: G. P. Putnam's Sons. Pp. 91, 4to. Illustrated. Price, $1.75.

investigations and of the practical experience of the writer in the construction of tailless kites—parakites is the awkward, half-Greek, half-English name he gives them—and in the perfection of methods for flying them in various conditions of the atmosphere. Mr. Woglom is a business man well occupied, and has given attention to the making and flying of kites only as an avocation and recreation, without laying any claim to be a student in the scientific bearings of the subject, or in aërodynamics. Nevertheless, he never forgets the possibilities of a scientific outcome from experiments with kites, and keeps them well in the mind of his reader. His treatise opens with a view of Oriental kite-flying, its history, so far as it is recorded, from its use in Malaysia a thousand years before the Christian era, and the possible religious significance of its origin—to carry prayers to the divinities above. Descriptions of Japanese, Chinese, Javanese, and other Oriental patterns follow; then the author's experiments in kite making and flying, in photographing from kites, etc., are given, and the principles of the construction and management of kites as embodied in Oriental forms and discovered in the author's own experience are recorded, and the possible scientific applications are glanced at. The whole forms an interesting and instructive treatise.

The main object of Mr. Holden's paper on mountain observatories * is to study the conditions suitable for astronomical work at high levels, while meteorological and physiological conditions enter into consideration in a subordinate degree. The author's studies bearing on the subject began during the summer of 1873 in the mountains of central Colorado. His observations were repeated at intervals till he was called to Mount Hamilton in 1888, where he has had opportunities to compare the conditions with those at nearly every observatory in the United States and with stations in other countries. His purpose in this paper is to collect and study the many scattered notices of the conditions of good vision at mountain stations all over the globe. We have thus notices or descriptions of the experiment at Teneriffe, and of the observatories at Nice, Mont Blanc, Ben Nevis, the Santis, the Sonnblick, Arequipa, El Misti, and many others abroad, and of the mountain observatories in the United States —illustrated by many photographic reproductions—concluding with a few remarks on scientific ballooning and kite-flying, from which Mr. Holden expects even greater results, at least in meteorology, than from mountain-top observation. A copious bibliography of the subject is given.

* Mountain Observatories in America and Europe. By Edward S. Holden. Washington: Smithsonian Institution. Pp. 77, 8vo, with Plates.

Plants and their Children, by Mrs. *William Starr Dana* (American Book Company, 65 cents), is a child's reading book, designed, while it entertains and instructs, to create an interest in children in botany. It consists of a series of easy lessons or readings on the wonders of plant life written in such a manner as to make them entertaining as stories. The various forms and curious features of familiar plants and trees, including their roots and stems, buds and leaves, fruits, seeds, and flowers, are thus described. The book is so arranged as to correspond both with the course of the school year and the seasons of development of plant growth.

The Division of Forestry of the United States Department of Agriculture has done a creditable service in issuing its bulletin on *The Timber Pines of the Southern United States*. This publication consists of separate chapters by Dr. *Charles Mohr*, on the species known as the long-leaf, Cuban, short-leaf, loblolly, and spruce pines, together with a brief description of the wood of these five pines, by Filibert Roth. The distribution and botanical characters of each species are given, the products obtained from it, conditions necessary to its growth, its enemies, and the forest management required by it. The information under each of these heads is full and practical. In an introduction, B. E. Fernow, chief of the Division of Forestry, calls attention ro the facts that the Southern States abound in those sandy soils which afford sufficient sustenance for the pines but are practically useless for anything else, and that the forest wealth of this section is being seriously impaired by wasteful methods of cutting timber, by the repeated conflagrations that follow the lumbering, and by the operations of the turpentine gatherers. Contrary to a common belief, however, the tests made by the Division show that timber that has been bled for its resin is as strong as unbled, if of the same weight. Some attempt has been made to perform the difficult task of estimating the remaining resources of the Southern pine forests, and no pains have been spared to impress upon the owners of timber lands and the operators of mills a knowledge of the treatment required to preserve the value of their investments. The volume is illustrated with many plates and cuts.

Fifty of the biographical sketches that have appeared in this magazine have been revised by the editor and issued in a volume under the title *Pioneers of Science in America* Appletons, $4). As the title denotes, the book includes only Americans, and is devoted to the earliest of these who were prominent in the field of science. In revising and completing each of the sketches Dr. *Youmans* has had the aid of some descendant or pupil of the subject in all cases but a few of the earliest. Some of the accounts have been much extended for the book. That of Benjamin Franklin, which opens the volume, is entirely new, and is the first systematic account of what Franklin did in science. That of S. F. B. Morse also has not appeared in the Monthly. Among those that have been largely rewritten are the sketches of Silliman, Torrey, Henry, Coffin, and Agassiz. New portraits have been substituted for a few made in the early days of the magazine that were not uniform in style with the rest. Steel portraits accompany the articles on Franklin and Morse, and there is a heliotype of W. B. Rogers. The latest subject included in the volume is David Dale Owen, who was born in 1807.

A handy little book embodying *The Elements of Commercial Law* has been prepared by *Albert S. Bolles*, lecturer on law in the University of Pennsylvania (Holt, $1). Under twenty heads, such as Parties, Assent, Seller and Buyer, Partnership, Negotiable Paper, Insurance, Shipping, Deeds and Leases, and Corporations, it gives systematically and briefly the substance of what the business man needs to know in order to secure contracts that can be enforced, if necessary, in the courts, and to avoid improperly jeopardizing his own interests. The volume is indexed, and the topics treated in the several numbered paragraphs of each chapter are given at the head of the chapter.

A first memoir on *The Bombycine Moths of America North of Mexico*, by Prof. *Alpheus S. Packard*, has been issued by the National Academy of Sciences. It is devoted to the *Notodontidæ*, and includes descriptions of the insects in their larval, pupal, and adult forms, with notes on their habits, food plants, geographical distribution, etc. This is the first installment of what Prof. Packard intends to be a general account, systematic and developmental, of our North American bombycine moths. He has aimed to describe these moths in the light of Weismann's suggestive and stimulating Studies in the Theories of Descent (1882), being convinced that additional knowledge of their ontogeny will lead to a comprehension of the phylogeny of the higher *Lepidoptera* in general. From the facts connected with the transformations of the bombyces, also, he believes much may be learned with reference to the transmission of acquired characters. The monograph is accompanied by forty-nine plates, many of them colored, and ten maps showing the distribution of genera. There are also about ninety figures in the text.

Part IV, Vol. X, Second Series, of the *Journal of the Academy of Natural Sciences* is devoted to papers on the crania, implements, and other objects found by Mr. Clarence B. Moore in certain mounds in Florida. In the first paper, Harrison Allen, M. D., describes five crania from mounds on the St. Johns River, comparing them with crania from other parts of North America. In three papers which follow this Mr. Moore describes a large number of implements of stone, earthenware, and bone, and some of shell and copper. The papers are accompanied by thirty-eight plates and many figures showing the crania and other objects of full size.

The first part of a comprehensive work by *David Starr Jordan* and *Barton Warren Evermann* on *The Fishes of North and Middle America* has been issued as Bulletin No. 47 of the United States National Museum. It is a descriptive catalogue of the species of fishlike vertebrates found in the waters of North America, being in a sense a revision of Jordan and Gilbert's Synopsis of the Fishes of North America, but with the text entirely rewritten and covering a greater geographical range than the Synopsis. By the extension of range, which brings in the faunas of Mexico, Central America, and the West Indies, the number of species included has been more than doubled. The fact to which the authors call attention, that over a hundred species have been added to the list within the time taken for printing the present volume, shows that there is still work to be done in the same field. The classification and sequence of groups adopted for this catalogue is essentially that of Dr. Theodore Gill, freely modified to suit the present purposes of the authors. In the arrangement of the families and genera they have endeavored to avoid unnatural associations and incoherent groups, even at the risk of what may seem an excessive subdivision. Among the forms commonly called fishes the authors recognize three classes—*Leptocardii*, *Marsipobranchii*, and *Pisces*. The present part of the work extends to twelve hundred and forty octavo pages, and contains descriptions of sixteen hundred and twenty-seven species, of which four are *Leptocardii* and eleven are *Marsipobranchii*. An atlas is to accompany the work when completed.

Mr. *James Bryce* has prepared an abridged edition in one volume of his able and popular work on *The American Commonwealth* in order to make the book more available for the unexpected demand that has arisen for it as a text-book in American colleges and high schools (Macmillan, $1.75). The abridgment is divided into three parts, dealing respectively with the National Government, the State Governments, and Political Methods. In selecting the parts of the original work to be used in the single volume the author has been aided by Jesse Macy, Professor of Political Science in Iowa College. The Constitution of the United States is appended, and the volume contains lists of the Presidents, the States, and important events, together with a full and carefully made index.

The method of *Cairns's Manual of Quantitative Chemical Analysis*, which has now reached a third edition, is, by explaining some of the more serious obstacles to successful analysis, to teach thoughtfulness and caution, and, by giving very explicit directions in the earlier part of the course, to induce habits of precision and enable the student to proceed without further leading. The important changes that have been made in the practice of analytical chemistry since 1880, when the book was first published, has rendered a thorough revision necessary, and this has been given to it by Dr. *Elwyn Waller*. The editor has aimed to give descriptions and directions for such methods as are generally pursued in most analytical laboratories, with brief references to the theory of other methods, that the student may have presented to him one or two plans of procedure which find acceptance to-day, and at the same time suggestions of other plans which may lead to modifications of our present methods. Radical changes having been made in the science and practice of quantitative proximate analysis since the death of the author, all the chapters relating to that subject have been cut out, leaving only what was always the chief feature of his work, namely, mineral analysis. Both the author and the editor have been instructors in analysis at the Columbia School of Mines. (Holt, $2.)

An addition to the number of journals representing the science of chemistry in this country has been made by the establishment of *The Journal of Physical Chemistry* at Cornell University. It is to be issued monthly, except in July, August, and September, under the editorship of Profs. *Wilder D. Bancroft* and *Joseph E. Trevor*. The first number contains papers on Irreversible Cells, by A. E. Taylor; Chemistry and its Laws, by F. Wald; and a second paper on Ternary Mixtures, by Wilder D. Bancroft. There are also several book notices and a department of reviews, conducted by a board of six reviewers, in which are given critical digests of recently published papers bearing on physical chemistry. (The Editors, Ithaca, N. Y., $2.50 a year.)

The treatise on *The Magnetic Circuit in Theory and Practice*, by Dr. *H. du Bois*, which has been translated by Dr. Atkinson (Longmans, $4), is designed to be a systematic and critical account, from the physical point of view, of the more important developments in its field. Electro technology, which in the last decade has exerted an important action on those branches of physics which form its base, "seems at present," says the author, "to have entered on a phase of quieter development; and from the scientific point of view the time appears suitable to survey the position, critically to investigate results of very unequal value, often hastily brought to light amid the bustle of practical work, and to blend the older as well as the more recent results into one consistent exposition." He has not included much historical matter except in the seventh chapter, where he gives the history of the analogy between the magnetic circuit and various other kinds of circuits. The first five chapters of the work are devoted to Theory, and the last six to Applications. In stating the theory of the magnetic circuit, a knowledge of the results of investigations into ferro-magnetic induction is assumed. In Chapters III and IV the outlines of the theory of "rigid" magnets on the one hand and of absolutely "soft" cores on the other are summarized, the mode of treatment being similar to that of Maxwell. The topics falling within the second part of the book—magnetic circuits of dynamos or electromotors and of various kinds of electromagnets and transformers, the experimental determination of field intensity, magnetization, induction, etc.—are treated more from the point of view of applied physics. Wherever the more important results of allied branches of mathematical or experimental physics are assumed to be known, the author has referred to the original passages in accessible text-books. There are also many references to original papers in which details may be further studied.

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Crosby, W. E. Our Little Book for Little Folks. American Book Company. Pp. 106. 30 cents.

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Euroclydon, The. A Journal of Economic, Social, and Moral Science. J. T. McColgan, Editor. Monthly. Nashville, Tenn. Pp. 22. 10 cents; $1 a year.

Expositor, The. A Theological Magazine. Vol. I, No. 1. February, 1897. American edition. New York: Dodd, Mead & Co. Pp. 104. 25 cents; $3 a year.

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Jordan, David Starr, and others. Observations on the Fur Seals of the Pribylof Islands. Washington: Government Printing Office. Pp. 69, with maps.

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Fragments of Science.

The Library of Prof. Du Bois-Reymond.—The library of the late Prof. Emil Du Bois-Reymond, a collection of extraordinarily high value, is for sale by Gustav Fock, Neumarkt 40 and Magazingasse 4, Leipzig, Saxony. It comprises more than fourteen thousand volumes and pamphlets, nearly all the books being bound, while the smaller writings are mostly arranged in collecting boxes, partly alphabetically and partly systematically. It contains sets, more or less complete, of about forty-five scientific journals and transactions of societies of all scientific countries and nearly every scientific work that has been written on physiology, physics, and philosophy. Almost every volume bears Prof. Du Bois-Reymond's own signature; and a very large number of the books, especially of his own works, are enriched by additions, memoranda, notices, appendices, and remarks in his own handwriting—of unique value. Prof. Du Bois Reymond's heirs desire that the library be kept unseparated; and, to promote this object, will give preference to bidders who will guarantee preservation as a whole. In the case of duplicates reasonable arrangements will be made for the repurchase by Herr Fock of such volumes in that category as may not be wanted. The library, valued at 30,000 marks, or $7,500, is offered for 22,000 marks, or $5,500. Cable messages regarding the purchase may be sent to the cable address, "Buchfock," Leipzig; "Du Bois," if the proposition is to purchase the complete set on the terms offered; "Reymond," if a catalogue is wanted before giving a decision.

Tides of the Bay of Fundy.—The real character and height of the famous tides of the Bay of Fundy, as given by Prof. W. M. Davis in Science, from the Canadian Geological reports, are as follows: "From the mouth of the bay, forty eight miles wide and from seventy to one hundred and ten fathoms deep, the bottom rises at the rate of four feet a mile over a distance of about one hundred and forty-five miles to the head. On the coasts adjacent to the mouth the spring tides vary from twelve to eighteen feet. Within the bay the spring and neap tides are as follows: Digby Neck, 22·18; St. John, 27·23; Petitcodac River, 46·36; Cumberland Basin, 44·35; Noel River in Cobequid Bay, 53·31; the last named being the greatest tidal oscillation in any part of the bay. The flood tide rises about twenty feet above mean sea level; the ebb falls the same amount below, leaving the branch bays empty or nearly so. The tidal bore is seen in Maccan River, entering Cumberland Basin, but is stronger in Petitcodac River, entering Shepody Bay. At the head of this river, by Monctin twenty miles from the bay head, the bore is seen to best advantage; it rushes in 'as a foaming breaker, five or six feet high, with a velocity of five or six miles an hour.' The spring and neap tides have forty-five and thirty-eight feet range. The ebb tide runs like a mill race; the water rapidly sinking, and the river is reduced to a small meandering stream. It so remains about two hours, when the rushing waters of the bore are heard again, and the river is soon filled with their sweeping flood."

Necessities of Geological Time.—One of the questions considered by Prof. E. B. Poulton, in his presidential address before the Geological Section of the British Association, related to the length of time required for the development of animal life on the earth to its present condition—"whether the present state of paleontological and zoölogical knowledge increases or diminishes the weight of the opinion of Darwin, Huxley, and Spencer, that the time during which the geologists concluded that the fossiliferons rocks had been formed was utterly insufficient for organic evolution." The arguments of the physicists, derived from the supposed effect of tidal action upon the length of the day, and from the estimated length of the time occupied by the earth in cooling from an assumed temperature to its present condition, are shown to have been proved invalid as bases for calculatmg the probable age of the earth as a life-bearing body. The argument derived from the supposed life of the sun has not yet been ruled out, and that gives a maximum of five hundred million years. The computation of the time required for depositing the geological strata gives a minimum of seventy-three million and a maximum of six hundred and eighty million years—possibly four hundred million years. The author's inquiry as to how much of the whole scheme of organic evolution has been worked out in the time during which the fossiliferous rocks were formed does not deal with the time required for the origin of life or for the development of the lowest beings with which we are acquainted from the first formed beings, of which we know nothing; but only with so much of the process of evolution as we can infer from the structure of living and fossil forms. The comparison is made from a study of the evolution of the phyla. All available evidence points to the extreme slowness of progressive evolutionary changes in the cœlenterate phyla, although the protozoa are even more conservative. When we consider further on the five cœlenterate phyla that occur fossil, we shall find that the progressive changes were slower, and indeed hardly appreciable in the echinoderms and gephyrea, as compared with the mollusca, appendiculata, and vertebrata. Within these latter phyla we have evidence for the evolution of higher groups, presenting a more or less marked advance in organization. As a whole, the comparison is quite enough to necessitate a very large increase in the time estimated by the geologist. We can hardly escape the conclusion that, for the development of the arthropod branches from a common chetopodlike ancestor and for the further development of the classes of each branch, a period many times the length of the fossiliferous series is required. The evolution of the ancestor of each of the higher animal phyla probably occupied as long a period as that required for the evolution which subsequently occurred within the phylum. But the consideration of the higher phyla which occur fossil, except the vertebrata, leads to the irresistible conclusion that the whole period in which the fossiliferous rocks were laid down must be multiplied several times for this later history alone. The period thus obtained requires to be again increased and perhaps doubled for the earlier history.

The New Zealand Alps.—The "Alps" of the Southern Island of New Zealand are described by Mr. Fitz-Gerald as being more like the Pyrenees than the Swiss Alps in structure, in that they are a single range rather than constituted of parallel folds. The highest peak, Aorangi, or Mount Cook, is 12,349 feet high, but not many of the others rise above 10,000 feet. The snow line is, however, 2,000 feet lower than in Switzerland, and the glaciers descend much nearer to the sea level, the great Tasman Glacier coming down to about 2,350 feet, several to 1,200 feet, and the Fox Glacier to 700 feet. Nearly twice as much snow falls upon some of their slopes as at corresponding positions on the

Alps. The peaks and glaciers are in many respects harder to climb than those of Switzerland. Besides serious deficiencies in roads and accommodations, and the absence of guides so complete that the explorer has to bring his own with him from Europe, they are actually more dangerous than peaks of corresponding elevation in Switzerland, the rock being very incoherent and slippery. Mr. Fitz-Gerald had many narrow escapes, the most serious accident being caused by the unexpected fall of a great block of stone. He ascended four peaks—Mount Tasman, 11,475 feet; Mount Sefton, 10,350 feet; Mount Haidinger, 10,054 feet; and Mount Sealy, 8,631 feet—and crossed three new glacier passes. One of these, to which the author's name has been given, is practicable and valuable, in that it makes possible direct communication between the eastern and western coasts, where none had been before except by sea.

Bees as Weapons of War.—History records two instances, according to Mr. Whiteley Stokes in the London Athenæum, in which bees have been used in warfare as weapons against besieging forces. The first is related by Appian, of the siege of Themiscyra in Pontus, by Lucullus in his war against Mithridates. Turrets were brought up, mounds were built, and huge mines were made by the Romans. The people of Themiscyra dug open these mines from above, and through the holes cast down upon the workmen bears and other wild animals, and hives or swarms of bees. The second instance is recorded in an Irish manuscript in the *Bibliothèque royale*, at Brussels, and tells how the Danes and Norwegians attacked Chester, which was defended by the Saxons and some Gallic auxiliaries. The Danes were worsted by a stratagem; but the Norwegians, sheltered by hurdles, tried to pierce the walls of the town—when, "what the Saxons and the Gaeidhil who were among them did, was to throw down large rocks, by which they broke down the hurdles over their heads. What the others did to check this was to place large posts under the hurdles. What the Saxons did next was to put all the beer and water of the town into the caldrons of the town, to boil them and spill them down upon those who were under the hurdles, so that their skins were peeled off. The remedy which the Lochlans applied to this was to place hides outside on the hurdles. What the Saxons did next was to throw down all the beehives in the town upon the besiegers, which prevented them from moving their hands or legs, from the number of bees which stung them. They afterward desisted and left the city."

Artistic Decoration.—Two theories of decoration were recognized by Walter Crane in a recent lecture: the organic, in which the decoration is an essential and integral part of the structure; and the inorganic, in which it is considered merely as so much superadded or surface ornament. With the development of Gothic architecture, sculpture, as indeed decoration of all kinds, became more and more important. It was strictly organic, being used to emphasize structural necessities. The sculpture of the Doric temple was also organic, though on a different principle. In the course of social and architectural evolution we have become more mixed and composite in our architectural styles. With complexity of life, complexity of form has increased, with the result that modern buildings have lost to a great extent that impressiveness which was due to simplicity and the organic relation between structure and decoration. Decoration may be considered from three points of view: from that of public sentiment and national characters and ideals, as the expression of the design, object, and purpose of particular buildings; from the technical point of view of methods and materials; and with regard to adaptation to climatic conditions. The decoration of buildings should be the highest form of art, as it was in the middle ages. The history and legends of localities should be carefully preserved in and identified with buildings. Churches have from time immemorial been the recipients of untold treasures of art and craftsmanship, and still seem to afford the largest field for the designer; but there is another sort of public buildings of ever-increasing importance—the school, in which permanent mural decoration might fill an important part in stimulating the imagination and forming the mind. In decoration attention should be centered upon some leading and distinctive feature. If sculpture is the method, interest should be centered upon it. We can not go outside our own times. If we do not care for beauty and harmony in our public buildings, if we are entirely absorbed in seeking our individual prosperity and are oblivious of the social bond, we are not likely to get noble buildings and impressive decorations.

Labor's Share of Profit.—The purpose of a paper by Mr. S. N. D. North, on Some Fallacies of Industrial Statistics, is to point out the false uses that are made of these statistics and the "grotesquely erroneous" deductions that are based upon them. A study of them without thorough consideration of the relations of the various factors of which they are composed necessarily leads to wrong conclusions, and even when these elements are duly regarded, disturbances and variations are constantly interfering, and "fallibility lurks everywhere." Thus, the value given by the census of 1890 of $9,370,107,624 for the annual products of manufacture in the United States is a fictitious total, representing a vast conglomeration of duplications and reduplications of the finished products of one industry which become the raw materials of the next in the ascending industrial scale, and is about double the real value. There is no way, the author contends, of measuring, with any approximation to accuracy, what are the relative shares of labor and of capital from the results of their joint operation, as revealed in the census returns. The most essential factor for such a calculation—the prime value of all the raw materials in their first crude form—is missing. We do know, however, that the total return of wages by the eleventh census is more than fifty per cent of the aggregate amount added to the value of raw materials. Out of its less than half, moreover, capital has to pay its expenses, and this very seriously reduces its share, while it further has to suffer the loss by wear and tear. The return on capital invested in manufacturing enterprise and on the labor and brains required to manage and direct that enterprise is no larger than, if it is indeed as large as, the return upon the same amount of capital in mercantile and other commercial occupations. Rightly compiled and analyzed, the statistics show that labor gets the lion's share of the net product of industry; reduced to percentages, a share of not less than eighty per cent on the direct return in the form of wages paid to the operative class. Save in rare and exceptional cases, the share which the workingman receives is, as a broad general rule applicable to present business conditions, all that the industry can stand without driving the capital that operates it into some other and more lucrative channel.

Congratulations to Prof. Young.—A remarkable observation was made by Prof. C. A. Young during the solar eclipse of 1870. The dark lines of the solar spectrum are really luminous, and appear dark only by contrast with the much brighter vapors that lie back of those vapors of which they are the signs. At one moment of the eclipse—lasting only a second or two—these brighter vapors on the edge of the sun's disk are hidden, while the less luminous ones giving the dark lines are still in view. During that instant these usually dark lines should appear bright. During the eclipse of 1870 Prof. Young caught this happy moment, and saw this reversed, "flash" spectrum of bright lines. "All at once," he says, "as suddenly as a bursting rocket shoots out its stars, the whole field of view was filled with bright lines more numerous than one could count. The duration of the bright lines was only about two seconds, and the layer of vapors must have been under a thousand miles in thickness." At total eclipses since 1870 observations have been made going to confirm Prof. Young's views in a general way, but in none of them was a permanent record obtained till the eclipse of August, 1896, at Novaya Zemlya, when Mr. Shackelton, seizing the right moment, secured a photograph of the phenomenon. It consists of a very narrow spectrum of bright lines, which are indeed the Fraunhofer lines reversed just as Prof. Young had described them. "The congratulations of astronomers," says the London Times, "are due to Prof. Young on this complete, though late, confirmation of his observation of 1870, and of his views, speaking broadly, of solar absorption founded upon it." It is a curious circumstance that only three days before this eclipse Prof. Lockyer wrote to Nature that "to my mind the reversing layer is dead and buried already, but may the Fates be propitious on the 9th and enable us to place a wreath on its tomb!" "The Fates," the London Times observes, "were indeed propitious in furnishing a funeral wreath, which, however, it would seem, must be placed upon the tomb of Prof. Lockyer's own theory."

At the Top of the Andes.—An attempt was made in December and January last by Mr. Edward Fitzgerald, a native of New York, and the Swiss guide Zurbriggen, to ascend Mount Aconcagua, supposed to be the highest peak of the Andes. They started on the 25th of December, and at the height of 21,000 feet found the card of Gussfeldt, the German explorer, in a tin box. The climbers were obliged to descend into the valley, but beginning a second attempt, December 30th, reached a height of 22,500 feet January 2d. On a third attempt the two reached the *arête*, 23,000 feet, January 14th. Mr. Fitzgerald had to turn back, but Zurbriggen continued on and reached the summit, the height of which has been variously estimated at from 22,422 to 23,910 feet. This competes with the height of Sir Martin Conway's ascent of Pioneer Peak in the Himalayas, which is also about 23,000 feet, in being the loftiest mountain ascent yet made. The previous highest ascent in recent years was that of Mr. Mummery and Mr. Hastings of 21,000 feet, on Nanga-Parbat, Himalayas. Mr. Fitzgerald has recently made an exploration of what are called the New Zealand Alps, and has published a book on the subject.

The Ideal of a Frieze.—Discussing Grecian architecture, Mr. H. O. Taylor observes, in his Ancient Ideals, that a frieze, on account of its shape, is adapted to represent a continuous matter. It can not well have a center toward which the rest tends, or even a center of supreme interest to which all the rest is accessory. It must rather, to vary the threatening monotony of its long line, show rising and falling waves of interest—quiet here to rest the spectator, vivid action there to excite his interest, and through all a rhythm of movement and a harmony of composition excluding everything which by disproportionate interest or size might detract from what precedes and follows. The Parthenon frieze effects this rise and fall of interest by the succession of groups taking part in the Panathenæa procession which forms its subject. We see stately maidens moving quietly, eager horses and their riders, magistrates and onlookers, till our eye finally rests with the seated gods. No one could see the whole frieze at once, but successive portions of it, as he walked beneath it. Hence it was fitting that the whole frieze should not present the same moment of time, but give the idea of a procession making ready, starting, and in motion—a plan which readily affords a rise and fall of interest. Some of the youths are not yet mounted; ahead of them are others on horses starting at slow pace, preceded by yet others in rapid gallop. Waves of rhythm appear in the rise and fall of the horses' limbs and bodies, while their heads, and still more the heads of the riders, remain more nearly on a line. This last conformity to the shape of a frieze gives a general tone of control and order to the squadron, and excludes all fear of the eager horses mastering their riders.

A Slavic Deity and St. Elias.—Peron, the thunder god, was an important divinity in the calendar of the Slavs of a thousand years ago and is a conspicuous figure in their folklore. An idol erected in his honor at Kiev about A. D. 980 had a silver head, a golden beard, and a wooden body. He was also commemorated in a famous idol at Novgorod. His name has been incorporated into a great many names of places, as is shown in a list compiled by M. N. Barsov. He was worshiped with human sacrifices. In 988 the Czar Vladimir, having been converted to Christianity, ordered all the figures of Peron to be pulled down, scourged, dragged at the tails of wild horses, mutilated, and thrown into the rivers or burned; yet his name abode among the people in many widespread legends, in which he figures as master of the thunder and the storms. As Christian and Hebrew saints were introduced to take the place of the heathen heroes, he became confounded with Elias, who is described in the Bible as having also a sort of command of the air and its phenomena. Elias was the first saint accepted by the Russian Christians, and was invoked to heal wounds caused by firearms. As the Slavic Peron and the Scandinavian Thor traverse the sky during storms in chariots drawn by two horses or two bucks, and as Elijah ascended to heaven in the midst of lightnings and thunders in a chariot drawn by two horses, the Russian, Servian, and Bulgarian peasants hear in the thunder the rolling of Elias's chariot wheels and imagine him chastising God's enemies with thunderbolts. A solemn festival to Elias is held in Russia at the season when droughts usually occur, in which the saint is invoked to let the rain fall. There were at Novgorod in the middle ages two churches, one dedicated to Elias humid and the other to Elias dry, to which processions marched according to the kind of weather that was wanted. Other ceremonies of devotion to Elias as the saint of the storm, and legends giving him the attributes of their old thunder god and associating him with meteorological phenomena characteristic of the Slavic countries, are described by M. Henri Galiment in the *Revue de l'École d'Anthropologie*, all going to illustrate how hard it is to eradicate the ideas and customs of their olden times from the minds of the people, and how the old persists in living by the side of the new; and teaching that when two forms of religion are standing in rivalry with one another, the younger, even with the aid of the secular arm, can never supplant the older except by making concessions to it.

Asiatic and African Explorations in 1896.—The long list of geographical explorations accomplished during 1896, some of the most important features of which have already been mentioned in the Monthly, includes the exploration of a large region pertaining to the upper Yang-tse-Kiang River, Chinese Empire, by M. Bonin, a French officer in Tonkin, who visited countries not previously traversed by Europeans, and has been able to make important corrections in the map of the Yang-tse-Kiang and its tributaries. Dr. Sven Hedin, in exploring the Takla Makan, a continuation of the Desert of Gobi, has found the ruins of two of the towns said to be partly buried in the desert, and has made interesting investigations on the past and present hydrography of the Lob Nor region. M. D. Kiements, sent out by the Siberian Geographical Society to the Khengai Mountains of northwest Mongolia, found a great glacier on the western slope of the mountain, and everywhere signs of former volcanic activity. A Russian expedition has been exploring the course of the Amu Daria, with a view to ascertaining if it would be possible to divert its waters by means of a canal into the Caspian Sea. The exploration of Asia Minor, predominantly archæological, has been continued by young men of the University of Oxford.

Antiquity of Writing.—It is observed by Dr. Bühler, in his book on Indian Palæography, that a very remote period is indicated for the beginning of writing by the fact that in a Jain text of about 300 B. C. its origin is forgotten and its invention attributed to the creator Brahma. Indian imitations of Greek drachmas prove that the Greek alphabet was employed in northwestern India before the time of Alexander the Great. Knowledge of the art of writing is established for the earliest Vedic period by one of the great works; and the grammarian Panini, who is assigned to the fourth century, mentions Greek writing and the words signifying writer. The evidence of the canonical books of Ceylon indicates that the knowledge of writing was pre-Buddhistic; and passages in the Jataka and in the Maha Vagga prove the existence, at the time of their composition, of writing schools and of a wooden slate, such as is still used in Indian elementary schools. Writing, as a subject of elementary instruction, is also mentioned in an inscription of the second century before Christ. The palæographical evidence of the Asoka inscription clearly shows that writing was no recent invention in the third century before Christ; for most of the letters have several, often very divergent, forms, sometimes nine or ten.

The St. Lawrence Drainage System.—The drainage system of the St. Lawrence River is characterized by Mr. G. K. Gilbert, in his paper on Niagara Falls and their History, as of exceptional character, in that it has no such continuous slope from the primary rill through the brook and succeeding tributaries and the river itself to the sea as mark the drainage systems of most other regions; but "the district is composed mainly of a group of great basins, like hollows, in each of which the surface slopes toward some central point, and not toward the mouth of the river. Each basin is filled with water to the lowest point of its rim, and each of the lakes thus formed is a storage reservoir receiving a group of streams from the surrounding country, and pouring an even discharge over its rim to one of its neighbors." The Niagara River is thus, from one point of view, a strait connecting the two inland seas of Erie and Ontario occupying two of these basins; from another point of view it is a part of the St. Lawrence River—the part connecting the two expansions. "Viewed either way, it departs so widely from the ordinary or normal river that its name is almost misleading." Further, "a normal river receives most of its water directly from rain or melting snow and varies with the season, swelling to a flood in time of storm or at the spring snow melting, and dwindling to relative insignificance in time of drought. The water of Niagara comes only remotely from storm and thaw. The floods of the tributaries are stored by the lakes, to whose broad surface they add but a thin layer. The volume of Niagara depends only on the height of Lake Erie at Buffalo, and from season to season this height varies but little. On rare occasions a westerly gale will crowd the lake water toward its eastern end, and the river will grow large. On still rarer occasions a winter storm will so pile up or jam the lake ice at the entrance to the river as to make a dam, and for a day or two the river will lose most of its water." The wastings of soil and gravel that are usually carried along by the streams in their course are carried by the tributaries of the St. Lawrence system only to the lakes, where they settle to the bottom. Hence, "Niagara is ever clear. Sometimes, when a storm lashes the shores of Erie, a little sand is washed to the head of the river and carried down stream; sometimes a little mud is washed into the river by the small creeks that reach its banks. Thus Niagara is not absolutely devoid of load, but its burden is so minute that it is hard to detect."

Himalayan Tea Porters.—Darjeeling tea, said Mr. George W. Christison, in a lecture before the British Society of Arts, is all carried by the hardy hill-men up the steep mountain roads to the nearest railway station on the way to market. It is no unusual day's work for a coolie to carry a tea chest, weighing from one hundred and ten to one hundred and thirty pounds, a distance of five or six miles, making at the same time an ascent of from twenty-five hundred to thirty-five hundred feet in sheer vertical elevation. There can be no deception about a task like that, and we can not but have an admiration for the powers of endurance of those who perform such a feat. Of course, these people are trained to load-carrying and mountain-climbing from their very infancy, and hence the peculiar set of muscular faculties required for them are fully developed, if not actually called into existence at the cost of others—so much so that walking on a level, after a few miles, becomes positively painful to them. In the prosecution of their own trade, or in domestic affairs, they frequently undertake long, arduous journeys over ridges and along and across hot valleys, varying many thousands of feet in elevation, occupying many days, carrying heavy loads of from one hundred and fifty to two hundred pounds, and over and in addition to their food and bedding most cheerfully lighting a fire, cooking and eating their scanty meal, and going to sleep by the wayside. There is a story still current of a Bhootean in old times having carried a grand piano up the hill to Darjeeling, a distance of fifty miles forward, and involving a rise of more than five thousand feet in elevation by the old road. These hill tribes are a hardy people, capable of performing marvelous journeys without partaking of food, or on the most meager fare.

Progress in Botanical Study.—In connection with the history of the Botanical Gazette, Prof. C. E. Bessy has given in a paper on the Evolution of a Botanical Journal, read at the University of Nebraska and published in the American Naturalist, a view of the growth of interest in botany in the United States. The Gazette was started in November, 1875, by Prof. John M. Coulter, of Hanover College, Indiana, as the Botanical Bulletin, a monthly publication of four pages. Its name was changed in the second year to the Botanical Gazette. Its editorial force was increased from time to time, it went through several enlargements, and improvements were made in it; in ten years it had won an established position. The twentieth volume, instead of 52 pages of short, mostly local notes, had 568 pages of structural, physiological, ecological, systematic, and paleontological matter. Now a further enlargement has been found necessary, under which the numbers will average 65 pages each, and the magazine becomes one of the publications of the University of Chicago, with a still further increased editorial force, to which it is contemplated to add one or more European botanists. The magazine, Prof. Bessy says, "has grown and developed as the science of botany has grown and developed in this country. When we look over the earlier volumes with surprise at the little notes which fill the pages, we must not forget that American botany had not then generally risen above such contributions. It is true that we had a few masters in the science, but these masters wrote little for general readers, and their technically systematic contributions were mostly published in the proceedings of learned societies. The one thing which stands out to-day in sharp contrast with the botany of two decades ago is the very great increase in the number of masters in the science who are making liberal contributions from many different departments."

MINOR PARAGRAPHS.

Alfred Nobel, the inventor of the application of dynamite as an explosive, left a bequest for the institution of five equal prizes, to be awarded yearly to the persons who shall have made the most important discoveries or inventions in the domains respectively of physics, chemistry, and physiology or medicine; who shall have produced the most important work, in the ideal sense, in the domain of letters; and to the person who shall have exerted the greatest or the best action for the fraternity of peoples, for the suppression or diminution of permanent armies, and for the formation or spreading of peace congresses. The literary prize is to be awarded by the Swedish Academy, and the prize for the promotion of peace by a committee of the Norwegian Storthing. It is the testator's expressed wish that no consideration of nationality may enter into any of the awards. The prizes are supposed to be worth sixty thousand dollars each.

A new flying machine, similar in principle to that of Lilienthal, has been devised by Herr Arthur Stenzel, of Altona, Germany. It has parabolic wings in imitation of birds' wings, is driven by the power of compressed carbonic acid, and has been made to "go" when attached for safety to a guiding cable. With a force of one horse power it has advanced three metres at each beating of the wings, of which there are one and three tenths per second. With a horse power and a half the machine may be made to fly free from the cable. The wings are remarkably elastic, and the inventor thinks that this is one of the factors of his success. They are made of unsoldered steel tubes and bamboo, and are covered with a specially prepared India-rubber cloth. The apparatus is directed by a rudder which is not unlike a bird's tail. As yet no passengers have been carried on the machine.

A sum of ten thousand francs was bequeathed a few years ago by M. Edouard Mailly, of the Royal Academy of Belgium, as the foundation of a prize to be awarded to a Belgian who has contributed most to the progress of astronomy or to the spread of the taste for it and knowledge of it. The prize "Mailly" has been fixed at one thousand francs, to be awarded every four years. The Belgian Academy in December, 1896, made the first award of the prize, and bestowed it, most worthily, on the editorial committee of our contemporary, *Ciel et Terre.*

The oldest known measurement of the height of clouds is asserted by M. Schreiber, of the Belgian Astronomical Society, to be the work of the two Jesuits Riccioli and Grimaldi, near Bologna, in 1644. They used the trigonometrical method, with two stations, which is still preferred, and which Kamtz, in his treatise on meteorology, calls Riccioli's method. They found 3,222 metres as the altitude of a bright white cloud; Riccioli relates that another Jesuit, of Metz, who measured a large number of clouds, told him that none of them was more than 7,400 metres above the earth. He speaks of another method, proposed by Simon Stevin, of measuring by means of the shadow. For thunder clouds the time between the lightning and the report was calculated. Riccioli also mentions the luminous clouds seen late at night, which have again begun to attract attention within a few years past.

The two expeditions, one French and one American, which are at work unearthing antiquities in Babylonia have, it is stated in the London Daily News, recently made some valuable "finds." The first and most notable result of the excavations is that the history of the Babylonian people as recorded in cuneiform writings on tablets is carried back at least twenty-two hundred and fifty years further than it had yet been known. In other words, there is now abundant written evidence that the Babylonian people existed and were civilized enough to be able to write at least seven thousand years B. C.

The British consul at Funchal is authority for the following regarding banana cultivation in Madeira. There are two varieties generally grown, the dwarf banana (*Musa Cavendishii*, of the order *Scitamineæ*) and the silver banana. The latter is much the more delicate in flavor and only about half the size of the dwarf variety, but is seldom exported, as the total quantity grown in the island is scarcely sufficient to supply the home consumption; but if this variety of the fruit were generally known it would be in greater demand, as it has so much better an appearance and is more delicate in flavor than the dwarf variety that those who have once eaten it seldom use the latter except for cooking purposes. The greater part of the bananas are grown on the south side of the island. The season lasts practically the whole year, but the fruit is in its greatest perfection from July to December.

The archæological map of Ohio of the Archæological and Historical Society of that State, although only about one third complete, has already upon it twenty-one hundred marks, representing between fifty-five hundred and fifty-six hundred remains. Some interesting facts, Dr. Brinton says in Science, have been brought to light in the surveys: that the mounds, earthworks, village sites, etc., generally followed the streams; that in the Scioto Valley there are very few stone monuments, but that in the Muskingum Valley, along the Ohio River, and in Brush Creek Valley, Adams County, stone monuments predominate over those of earth. Seven counties in the State have yielded nine hundred and eighteen monuments. The counties in northeastern Ohio average five or six mounds or village sites each. It is estimated that the number of recorded monuments may reach eight thousand.

A comparative review of the composition of a number of American kaolins makes it evident that the wide difference in the proportions of clay and silica in them renders it imperatively necessary that the variations be taken into account in the selection of materials for the manufacture of ware; and that the United States is not wanting in an abundance of material for making porcelain equal to the best foreign production. The kaolin used in the Royal Berlin Factory at Charlottenburg is taken as the standard of comparison. One of the purest kaolins is found in Indiana, and clays of similar quality exist at Hockessen, Delaware; Northampton County, Pennsylvania; and Middlesex County, New Jersey.

The wood of the *jarrah*, or *Eucalyptus marginata*, of southern Australia, is said to be very valuable for use where wood is to be brought into contact with soil and water. A tree fifty years old may furnish logs two feet in diameter at the base. The wood is red, takes a good polish, and is easily worked. Another eucalyptus, the *karri*, or *Eucalyptus diversicolor*, producing marketable timber in from thirty to forty years, has a red wood, hard and heavy, tough and not easily dressed, and is adapted to bridge flooring, planking, and beams. It is largely used in London for street pavements, as its surface is not easily rendered slippery.

An interesting investigation has been undertaken by the British Marine Biological Association of the exact nature of the sea bottoms at Plymouth, with the groupings of the fish and their food animals upon them. It has been recognized for some time that the localities frequented by many marine species are very definite and extremely limited in extent, and that the nature of the sea bottom and the creatures that live there exhibit as much variety as we are accustomed to find on land. Detailed charts will be made to show the variations that take place from point to point. Such investigations of the kind as have been made heretofore have had regard chiefly to the fishes, while comparatively little attention has been paid to the other features.

NOTES.

A CORRECTION.

To the Editor.

Dear Sir: I beg leave to call your attention to a mistake in my article on The Malarial Parasite, which I regret to say must have been in the original manuscript and which escaped me when reading the proof. On page 635, thirteenth line from the top, the word "quartan" should have been "tertian." It is evident that when a daily paroxysm occurs this is due to the alternate development of two groups of tertian parasites, in which the cycle of development is forty-eight hours, and not to two groups of quartan parasites, the cycle of development of which would be seventy-two hours.

Very truly yours,
George M. Sternberg.

The summer lectures in botany of the Torrey Botanical Club and the College of Pharmacy of the City of New York will be given at the college, 115 West 65th Street, in two weekly courses: the first, on the General Morphology of Plants, Fridays, at 4 P. M., by W. Arthur Bastedo, beginning March 26th and closing June 11th; and the second course, on the Summary of Cryptogamic Botany, with practical work on the microscope, Thursday evenings, by Dr. Smith Ely Jelliffe, March 25th to June 10th. The prices of tickets are $5 to the first course and $10 to the second course. The eight Saturday excursions (stormy Saturdays excepted) will begin April 24th. Tickets for either course may be obtained now at the college.

The American trout—"rainbow trout" as the French call it—is found by M. Hugues Oltramare to be of very much more rapid growth than either the European lake or river species, and therefore presumably a more profitable kind to raise. The fry of the species of the same age are very readily distinguished by the superior size of the Americans. The latter are also more active, more constantly in motion, and eat more.

The results of experiments made some time ago by Dr. Lösener on the effect of the conditions of burial on the microbes and germs of disease are reassuring. Infected carcasses were buried under conditions like those of ordinary burials. The duration of the vitality of the pathogenic organisms was various, but all were dead within a year except the anthrax bacilli, which retained their full complement of virulence during the whole period. None of the organisms either, except those of anthrax, found their way to the adjacent soil and water; but so admirable a barrier is provided by the soil that the earth close beneath the bottom of the hole containing the infected carcass was in every case found quite devoid of pathogenic germs. Experiments made in Massachusetts with sewage have shown that filtration through soil is effective to purify from bacteria.

Three deposits of volcanic ash in Nebraska are described by Prof. Rollin D. Salisbury in Science: at Ingham, Edison, and Orleans. At all these places several more or less associated exposures of the ash appear; and in all the cases it is found in the side or near the head of a cañonlike ravine. It varies in color from white to yellow cream or light gray, and in grain from the grade of coarse sand to that of white flour. In some places the bed is more than twenty feet thick. Such ash has been found in other places in Nebraska, and it has already become an important article of commerce, under the name of pumice.

Prof. Max Wolf has continued with success the method, which he began in 1861, of discovering new minor planets by the small shift of their images, due to orbital motion, on a photographic plate exposed behind a large portrait lens. Since 1890, Prof. Wolf has discovered fifty-six new planets, of which thirteen were found in 1896. The whole number of small planets which have been calculated is now four hundred and twenty-two.

A new breed of fowl has been systematically created in France by a M. Gourgaud—dwarfs of the breed called there Gâtinais, or gâtinais bantams. Associating with a gâtinais hen an ordinary white double-crested bantam cock with blue toes, M. Gourgaud obtained a nest of half-dwarf chickens having single crests and double crests, and some blue and others rosy toes. He then went to work to eliminate the double crests and blue toes, directing the association of pairs to that ideal, and approaching it more nearly with each successive generation. In 1895 he had obtained a fixed dwarf breed, with rosy toes and single crests.

The primitive relations between Europe and the East Mediterranean countries were a prominent subject of discussion in the Anthropological Section of the British Association. The sectional presidential address of Mr. Arthur J. Evans related to it, and papers bearing upon it were read by Dr. Montelius, Prof. Petrie, Mr. J. L. Myres, and others.

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INDEX.

ARTICLES MARKED WITH AN ASTERISK ARE ILLUSTRATED.

Books Noticed :

THE END.