ESTABLISHED BY EDWARD L. YOUMANS.

THE

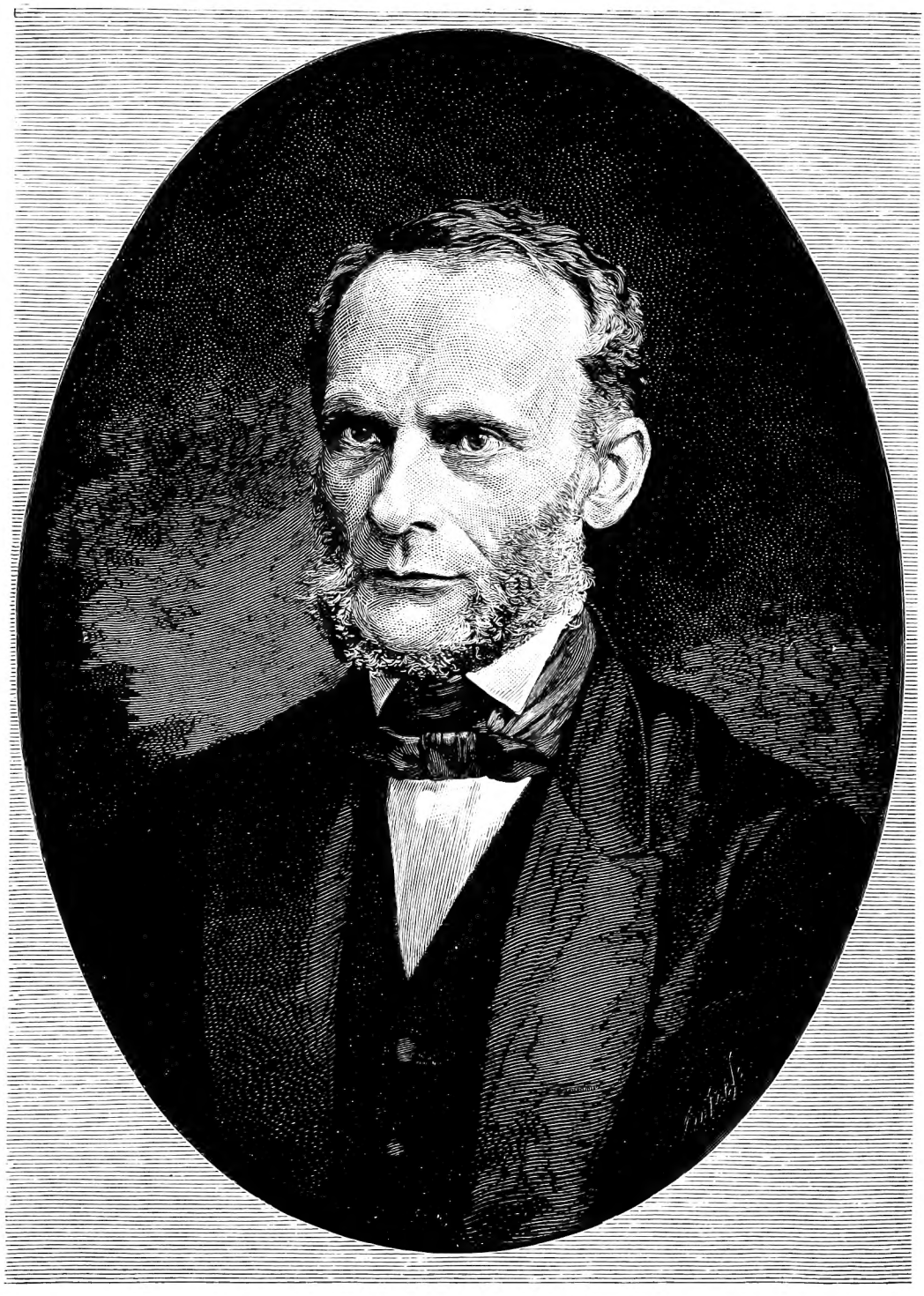
POPULAR SCIENCE MONTHLY.

EDITED BY WILLIAM JAY YOUMANS

VOL. XXXV.

MAY TO OCTOBER, 1889.

NEW YORK:
D. APPLETON AND COMPANY,
1, 3, AND 5 BOND STREET.
1889.



RUDOLF J. E. CLAUSIUS.

THE

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NEW CHAPTERS IN THE WARFARE OF SCIENCE.

VI.—DIABOLISM AND HYSTERIA.

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PART I.

IN the foregoing chapter I have sketched the triumph of science in destroying the idea that individual lunatics are "possessed by devils,"—in establishing the truth that insanity is physical disease,—and in substituting for superstitious cruelties toward the insane a treatment mild, kindly, and based upon ascertained facts.

The Satan who had so long troubled individual men and women thus became extinct; henceforth his fossil remains only were preserved; they may still be found in the sculptures and storied windows of mediæval churches, in sundry liturgies, and in popular forms of speech.

But another Satan still lived—a Satan who wrought on a larger scale—who took possession of multitudes. For, after this triumph of the scientific method, there still remained a class of mental disorders which could not be treated in asylums, which were not yet fully explained by science, and which therefore gave arguments of much apparent strength to the supporters of the old theological view: these were the epidemics of "diabolic possession" which for so many centuries afflicted various parts of the world.

When obliged, then, to retreat from their old position in regard to individual cases of insanity, the more conservative theologians promptly referred to these epidemics as beyond the domain of science—as clear evidences of the power of Satan; and, as the basis of this view, they cited from the Old Testament frequent references to witchcraft, and, from the New Testament, St.

Paul's question as to the possible bewitching of the Galatians, and Simon the magician's bewitching of the people of Samaria.

Naturally, such leaders had a large body of adherents in that class—so large in all times—who find that

> "To follow foolish precedents and wink
> With both our eyes, is easier than to think." *

It must be owned that their case seemed strong. Though in all human history, so far as it is closely known, these phenomena had appeared, and though every classical scholar could recall the wild orgies of the priests, priestesses, and devotees of Dionysus and Cybele, and the epidemic of wild rage which took its name from some of these, the great fathers and doctors of the Church had left a complete answer to any skepticism based on these facts; in their view the gods of the heathen were devils—these examples, then, could be transformed into a powerful argument for diabolic possession.†

But it was more especially the epidemics of diabolism in mediæval and modern times which gave strength to the theological view, and from these I shall present a chain of typical examples.

As early as the eleventh century we find clear accounts of diabolical possession taking the form of epidemics of raving, jumping, dancing, and convulsions—the greater number of the sufferers being women and children. In a time so rude, accounts of these manifestations would rarely receive permanent record; but it is very significant that even at the beginning of the eleventh century we hear of them at the extremes of Europe—in northern Germany and in southern Italy. At various times during that century we get additional glimpses of these exhibitions, but it is not until the beginning of the thirteenth century that we have a renewal of them on a large scale. In 1237, at Erfurt, a jumping disease and dancing mania began and afflicted a hundred children, many of whom died in consequence; it spread through the whole region, and fifty years later we hear of it in Holland.

But it was the last quarter of the fourteenth century that saw its greatest manifestations. There was much reason for them. It was a time of oppression, famine, and pestilence: the crusading spirit, having run its course, had been succeeded by a wild, mystical fanaticism; the most frightful plague in human history—the

* As to eminent physicians, finding a stumbling-block in hysterical mania, see Kirchhof's article, page 351, cited in previous chapter.

† As to the Mænads, Corybantes, and the disease "Corybantism," see, for accessible and adequate statements, Smith's "Dictionary of Antiquities" and Lewis and Short's "Lexicon"; also reference in Hecker's "Essays upon the Black Death and the Dancing Mania." For more complete discussion, see Semelaigne, "L'Aliénation mentale dans l'Antiquité," Paris, 1869.

black death—was depopulating whole regions, reducing cities to villages, and filling Europe with that strange mixture of devotion and dissipation which we always note during the prevalence of deadly epidemics on a large scale.

It was in this ferment of religious, moral, and social disease that there broke out in 1374, in the lower Rhine region, the greatest perhaps of all manifestations of "possession"—an epidemic of dancing, jumping, and wild raving.

The cures resorted to seemed on the whole to intensify the disease; the afflicted continued dancing for hours, until they fell in utter exhaustion. Some declared that they felt as if bathed in blood, some saw visions, some prophesied.

Into this mass of "possession" there was also clearly poured a current of scoundrelism which increased the disorder.

The immediate origin of these manifestations seems to have been the wild revels of St. John's Day. In those revels sundry old heathen ceremonies had been perpetuated, but under a nominally Christian form: wild Bacchanalian dances had thus become a semi-religious ceremonial. The religious and social atmosphere was propitious to the development of the germs of diabolic influence vitalized in these orgies, and they were scattered far and wide through large tracts of the Netherlands and Germany, and especially through the whole region of the Rhine. At Cologne we hear of five hundred afflicted at once, at Metz of eleven hundred dancers in the streets, at Strasburg of yet more painful manifestations; and from the greater cities they spread through the villages and rural districts.

The great majority of the sufferers were women, but there were many men, especially of those whose occupations were sedentary. Remedies were tried upon a great scale—exorcisms first, but especially pilgrimages to the shrine of St. Vitus: the exorcisms accomplished so little that popular faith in them grew small, and the main effect of the pilgrimages seemed to be to increase the disorder by subjecting great crowds to the diabolic contagion. Yet another curative means was seen in the great flagellant processions—vast crowds of men, women, and children who wandered through the country, screaming, praying, beating themselves with whips, imploring the divine mercy and the intervention of St. Vitus. Most fearful of all the great attempts at cure were the persecutions of the Jews. A feeling had evidently spread among the people at large that the Almighty was filled with wrath at the toleration of his enemies, and might be propitiated by their destruction: in the great cities and villages of Germany, then, the Jews were plundered, tortured, and murdered by tens of thousands. No doubt that, in all this, greed was united with fanaticism, but the argument of fanaticism was sim-

ple and cogent—the dart which pierced the breast of Israel at that time was winged and pointed from its own sacred books: the Biblical argument was the same used in various ages to promote persecution, and this was that the wrath of the Almighty was stirred against those who tolerated his enemies, and that because of this toleration the same curse had now come upon Europe which the prophet Samuel had denounced against Saul for showing mercy to the enemies of Jehovah.

It is but just to say that various popes and kings exerted themselves to check these cruelties. Although the argument of Samuel to Saul was used with frightful effect two hundred years later by a most conscientious pope to spur on the rulers of France in extirpating the Huguenots, the papacy in the fourteenth century stood for mercy to the Jews. But even this intervention was long without effect; the tide of popular superstition had become too strong to be curbed even by the spiritual and temporal powers.*

Against this overwhelming current science for many generations could do nothing. Throughout the whole of the fifteenth century physicians appeared to shun the whole matter. Occasionally some more thoughtful man ventured to ascribe some phase of the disease to natural causes, but this was an unpopular doctrine, and evidently dangerous to those who developed it.

Yet, in the beginning of the sixteenth century, cases of "possession" on a large scale began to be brought within the scope of medical research; and the man who led in this evolution of medical science was Paracelsus. He it was who first made modern Europe listen for a moment to the idea that these diseases are inflicted neither by saints nor demons, and that the "dancing possession" is simply a form of disease, of which the cure may be effected by proper remedies and regimen.

Paracelsus appears to have escaped any serious interference—it took some time, perhaps, for the theological leaders to understand that he had "let a new idea loose upon the planet"; but they soon understood it, and their course was simple. For about fifty years the new idea was well kept under, but in 1561 another physician, John Wier, of Cleves, having revived it, he was ruined and narrowly escaped with his life.

* See Wellhausen, article "Israel," in the "Encyclopædia Britannica," ninth edition; also the reprint of it in the "History of Israel," London, 1885, p. 546. On the general subject of the demoniacal epidemics, see Isensee, "Geschichte der Medicin," vol. i, pp. 260 *et seq.*; also Hecker's essay. As to the history of Saul, as a curious landmark in the general development of the subject, see "The Case of Saul, showing that his Disorder was a Real Spiritual Possession," by Granville Sharp, London, 1807, *passim*. As to the citation of Saul's case by the reigning pope to spur on the French kings against the Huguenots, I shall give a line of authorities in my chapter on "The Church and International Law." See also Maury, "La Magie et l'Astrologie dans l'Antiquite et au Moyen Age."

In the following century the Protestants of Holland were no less severe toward Balthasar Bekker, an eminent divine of the Reformed Church, who doubted some of the statements regarding possession.*

Although the new idea was thus resisted, it must have taken some hold upon thoughtful men, for we find that in the second half of the same century the St. Vitus's dance and forms of demoniacal possession akin to it gradually diminished in frequency and were sometimes treated as diseases. In the seventeenth century, so far as the north of Europe is concerned, these displays of "possession" on a great scale had almost entirely ceased; here and there cases appeared, but there was no longer the wild rage extending over great districts and afflicting thousands of people. Yet it was, as we shall see, in this same seventeenth century—in the last expiring throes of this superstition—that it led to the worst acts of cruelty.†

While this satanic influence had been exerted on so great a scale throughout northern Europe, a display strangely like it, yet strangely unlike it, had been going on in Italy. There, too, epidemics of dancing and jumping seized groups and communities; but they were supposed to arise from a physical cause, the theory being that the bite of a tarantula in some way provoked a supernatural intervention, of which dancing was the accompaniment and cure.

In the middle of the sixteenth century Fracastoro made an evident impression on the leaders of Italian opinion by using medical means in the cure of the possessed; though it is worthy of note that the medicine which he applied successfully was such as we now know could not by any direct effects of its own accomplish any cure—whatever effect it exerted was wrought upon the imagination of the sufferer. This form of "possession," then, passed out of the supernatural domain, and became known as "tarantism." Though it continued much longer than the corresponding manifestations in northern Europe, by the beginning of the eighteenth century it had nearly disappeared; and, though special manifestations of it on a small scale break out occasionally, even in these days, its main survival is the "tarantella," which the traveler sees danced at Naples as a catchpenny assault upon his purse.‡

* For Paracelsus, see "Isensee," vol. i, chap. xi; also Pettigrew, "Superstitions connected with the History and Practice of Medicine and Surgery" (London, 1844, introductory chapter. For Wier, see authorities given in my previous chapter. For Bekker, see citations in my chapter on "Witchcraft."

† As to this diminution of wide-spread epidemic in the seventeenth century, see citations from Schenk von Grafenberg and in Hecker, as above; also Horst.

‡ See Hecker's "Epidemics of the Middle Ages," pp. 87–104; also extracts and ob-

But, long before this form of "possession" had begun to disappear, there had arisen new manifestations, apparently more inexplicable. As the first great epidemics of dancing and jumping had their main origin in a religious ceremony, so various new forms had their principal source in what were supposed to be centers of religious life—in the convents, and more especially in those for women.

Out of many examples we may take a few as typical.

In the fifteenth century the chroniclers assure us that an inmate of a German nunnery having been seized with a passion for biting her companions, her mania spread until most, if not all, her fellow-nuns began to bite each other; and that this passion for biting passed from convent to convent into other parts of Germany, into Holland, and even across the Alps into Italy.

So, too, in a French convent, when a nun began to mew like a cat, others began mewing, and the desire spread and was only checked by severe measures.*

In the sixteenth century the Protestant Reformation gave new force to witchcraft persecutions in Germany. The new Church endeavored to show that in zeal and power she exceeded the old. But in France influential opinion seemed not so favorable to these forms of diabolical influence, especially after the publication of Montaigne's "Essays," in 1580, had spread a skeptical atmosphere over many leading minds.

In 1588 occurred in France a case which indicates the growth of this skeptical tendency even in the higher regions of the French Church. In that year Martha Brossier, a country girl, was, it was claimed, possessed of the devil. The young woman was to all appearance under direct satanic influence. She roamed about, begging that the demon might be cast out of her, and her imprecations and blasphemies brought consternation wherever she went. Myth-making began on a large scale; stories grew and spread. The capuchin monks thundered from the pulpits throughout France regarding these proofs of the power of Satan. The alarm spread, until at last even jovial, skeptical King Henry IV was disquieted, and the reigning pope was asked to take measures to ward off the evil.

Fortunately, there then sat in the episcopal chair of Angers a prelate who had apparently imbibed something of Montaigne's skepticism—Miron; and, when the case was brought before him, he submitted it to the most time-honored of sacred tests. He first brought into the girl's presence two bowls, one containing holy water, the other ordinary spring-water, but allowed her to draw a

servations in Carpenter's "Mental Physiology," London, 1888, pp. 312–315; also Maudsley, "Pathology of Mind," p. 73 and following.

* See citation from Zimmermann's "Solitude," in Carpenter, pp. 34, 314.

false inference regarding the contents of each: the result was that at the presentation of the holy water the devils were perfectly calm, but when tried with the ordinary water they threw Martha into convulsions.

The next experiment made by the shrewd bishop was to similar purpose. He commanded loudly that a book of exorcisms should be brought, and, under a previous arrangement, his attendants brought him a copy of Virgil. No sooner had the bishop begun to read the first line of the "Æneid" than the devils threw Martha into convulsions. On another occasion a Latin dictionary, which she had reason to believe was a book of exorcisms, produced a similar effect upon the devils.

Although the good bishop was thereby led to pronounce the whole matter a mixture of insanity and imposture, the capuchin monks denounced this view as godless. They insisted that these tests really proved the presence of Satan, showing his cunning in covering up the proofs of his existence. The people at large sided with their preachers, and Martha was taken to Paris, where various exorcisms were tried, and the Parisian mob became as devoted to her as they had been twenty years before to the murderers of the Huguenots,—as they became two centuries later to Robespierre,—and as they are at the present moment to General Boulanger.

But Bishop Miron was not the only skeptic. The Cardinal de Gondi, Archbishop of Paris, charged the most eminent physicians of the city, and among them Riolan, to report upon the case. Various examinations were made, and the verdict was that Martha was simply a hysterical impostor. Thanks, then, to medical science, and to these two enlightened ecclesiastics who summoned its aid, what fifty or a hundred years earlier would have been the center of a wide-spread epidemic of possession was isolated, and hindered from producing a national calamity.*

But during the seventeenth century a theological reaction set in, not only in France but in all parts of the Christian world, and the belief in diabolic possession, though certainly dying, flickered up hectic, hot, and spiteful through the whole century. In 1611 we have a typical case at Aix. An epidemic of possession having occurred there, Gauffridi, a man of note, was burned at the stake as the cause of the trouble. Michaelis, one of the priestly exorcists, declared that he had driven out sixty-five hundred devils from one of the possessed. Similar epidemics occurred in various parts of the world.†

Twenty years later a far more striking case occurred at Loudun, in western France, where a convent of Ursuline nuns was "afflicted by demons."

* See Calmeil, "La Folie," tome i, livre 3, c. 2.

† See "Dagron," chap. ii.

The convent was filled mainly with ladies of noble birth, who, not having sufficient dower to secure husbands, had—according to the common method of the time—been made nuns, without any special regard to their feelings.

It is not difficult to understand that such an imprisonment of a multitude of women of different ages would produce some woful effects. Any reader of Manzoni's "Promessi Sposi," with its wonderful picture of a noble lady kept in a convent against her will, may have some idea of the rage and despair which must have inspired such assemblages in which pride, pauperism, and the suppression of the instincts of humanity wrought a fearful work.

What this work was is to be seen throughout the middle ages; but it is especially in the sixteenth and seventeenth centuries that we find it frequently taking shape in outbursts of diabolic possession.*

In this case at Loudun, the usual evidences of satanic influence appeared. One after another of the inmates fell into convulsions; some showed physical strength apparently supernatural; some a keenness of perception quite as surprising; many howled forth blasphemies and obscenities.

Near the convent dwelt a priest—Urbain Grandier—noted for his brilliancy as a writer and preacher, but careless in his way of living. Several of the nuns had evidently conceived a passion for him, and in their wild rage and despair dwelt upon his name.

In the same city, too, were sundry ecclesiastics and laymen with whom Grandier had been engaged in various petty neighborhood quarrels, and some of these men held the main control of the convent.

Out of this mixture of "possession" within the convent and malignity without it, came a charge that Grandier had bewitched the young women.

The Bishop of Poictiers took up the matter. A trial was held, and it was noted that, whenever Grandier appeared, the "possessed" screamed, shrieked, and showed every sign of diabolic influence. Grandier fought desperately, and appealed to the Archbishop of Bordeaux, De Sourdis. The archbishop ordered a more careful examination, and, on separating the nuns from each other and from certain monks who had been bitterly hostile to Grandier, such glaring discrepancies were found in their testimony that the whole accusation was brought to naught.

But the enemies of Satan and of Grandier did not rest.

* On monasteries, as centers of "possession," and hysterical epidemics, see Figuier, "Le Merveilleux," page 40 and following; also Calmeil, Längin, Kirchhof, Maudsley, and others. On similar results from excitement at Protestant meetings in Scotland and camp-meetings in England and America, see Hecker's "Essay," concluding chapters.

Through their efforts Cardinal Richelieu, who appears to have had an old grudge against Grandier, sent a representative, Laubardemont, to make another investigation. Most frightful scenes were now enacted; the whole convent resounded more loudly than ever with shrieks, groans, howling, and cursing, until finally Grandier, though even in the agony of torture he refused to confess the crimes that his enemies suggested, was hanged and burned.

From this center the epidemic spread; multitudes of women and men were affected by it in various convents. Several of the great cities of the south and west of France came under the same influence; the "possession" went on for several years longer, and then gradually died out, though scattered cases have occurred from that day to this.*

A few years later we have an even more striking example among the French Protestants. The Huguenots, who had taken refuge in the mountains of the Cevennes to escape persecution, being pressed more and more by the cruelties of Louis XIV, began to show signs of a high degree of religious exaltation. Assembled for worship in wild and desert places, an epidemic broke out, ascribed by them to the Almighty, but by their opponents to Satan. Men, women, and children preached and prophesied. Large assemblies were seized with trembling. Some underwent the most terrible tortures without showing any signs of suffering. Marshal de Villiers, who was sent against them, declared that he saw a town in which all the women and girls, without exception, were possessed of the devil, and ran leaping and screaming through the streets.

Cases like this, inexplicable to the science of the time, gave renewed strength to the theological view.†

Toward the end of the same century similar manifestations began to appear on a large scale in America.

The life of the early colonists in New England was such as to give rapid growth to the germs of the doctrine of possession brought from the mother-country. Surrounded by the dark pine forests; having as their neighbors Indians, who were more than suspected of being children of Satan; harassed by wild beasts apparently sent by the powers of evil to torment the elect; with no varied literature to while away the long winter evenings; with few amusements save neighborhood quarrels; dwelling intently on every text of Scripture which supported their gloomy

* Among the many statements of Grandier's case, one of the best in English may be found in Trollope's "Sketches from French History" (London, 1878). See also Bazin, "Louis XIII."

† See Bersot, "Mesmer et le Magnétisme animal" (third edition, Paris, 1864, pp. 95 *et seq.*).

theology, and adopting its most literal interpretation—it is not strange that ideas regarding the darker side of nature were rapidly developed.*

The fear of witchcraft, thus developed, received a powerful stimulus from the treatises of learned men. Such works, coming from Europe, which was at that time filled with the superstition, acted powerfully upon conscientious preachers and were brought by them to bear upon the people at large. Naturally, then, throughout the latter half of the seventeenth century we find scattered cases of diabolical possession. At Boston, Springfield, Hartford, Groton, and other towns, cases occurred, and here and there we hear of death-sentences.

In the last quarter of the seventeenth century the fruit of these ideas began to ripen. In the year 1684 Increase Mather published his book, "Remarkable Providences," laying stress upon diabolical possession and witchcraft. This book, having been sent over to England, exercised an influence there and came back with the approval of no less a man than Richard Baxter. By this its power at home was increased.

In 1688 a poor family in Boston was afflicted by demons. Four children, the eldest thirteen years of age, began leaping and barking like dogs, or purring like cats, and complaining of being pricked, pinched, and cut. An old Irishwoman was finally tried and executed.

All this produced a deep impression on the mind of a man of great natural abilities, of most earnest and conscientious desire to do good in his generation, mixed with pride, vanity, ambition, and love of power; in short, a typical specimen of the high ecclesiastic as he has so often afflicted the earth. This man was Cotton Mather, the son of Increase Mather, and both father and son gave all their great powers to deepening and extending this theological view as sanctioned by Scripture.

In 1692 began a new outbreak of possession, which is one of the most instructive in history. The Rev. Samuel Parris was the minister of the church in Salem. No pope ever had higher ideas of his own infallibility, no bishop a greater love of ceremony, no inquisitor a greater passion for prying and spying.†

Before long Mr. Parris had much upon his hands. Many of his hardy, independent parishioners disliked his ways. Quarrels arose. Some of the leading men of the congregation were pitted against him. The previous minister, George Burroughs, had left the germs of troubles and quarrels, and to these were now added

* For the idea that America before the Pilgrims had been especially given over to Satan, see the literature of the early Puritan period, and especially the poetry of Wigglesworth, treated in Tyler's "History of American Literature," vol. ii, p. 25 *et seq.*

† For curious examples of this, see Upham's "History of Salem Witchcraft," vol. i.

new complications arising from the assumptions of Parris. There were innumerable wranglings and lawsuits; in fact, all the essential causes for satanic interference which we saw at work in and about the monastery at Loudun, and especially the turmoil of a petty village where there is no intellectual activity, and where men and women find their chief substitute for it in squabbles—religious, legal, political, social, and personal.

In this darkened atmosphere thus charged with the germs of disease it was suddenly discovered that two young girls in the family of Mr. Parris were possessed of devils; they complained of being pinched, pricked, and cut, fell into strange spasms and made strange speeches; showing all the signs of diabolic possession recognized in the works of experts or handed down by tradition. The two girls, having been brought by Mr. Parris and others to tell who had bewitched them, first charged an old Indian woman, and the poor old Indian husband was led to join in the charge. This at once afforded new scope for the activity of Mr. Parris. With his passion for magnifying his office, he immediately began making a great stir in Salem and in the country round about. Two magistrates were finally summoned. With them came a great crowd, and a court was held at the meeting-house. The scenes which then took place would have been the richest of farces had they not led to events so tragical. The possessed went into spasms at the approach of those charged with witchcraft, and when the poor old men and women attempted to attest their innocence they were overwhelmed with outcries by the possessed, quotations of Scripture by the ministers, and denunciations by the mob. The mania spread to other children, and one especially—Ann Putnam, a child of twelve years—showed great precocity and played a striking part in the performances. Two or three married women also, seeing the great attention paid to the afflicted, and influenced by that epidemic of morbid imitation which science now recognizes in all such cases, soon became similarly afflicted, and in their turn made charges against various persons. The Indian woman was flogged by her master, Mr. Parris, until she confessed relations with Satan; and others were forced or deluded into confession. These hysterical confessions—the results of unbearable torture, or the reminiscences of dreams, which had been prompted by the witch legends and sermons of the period—embraced such facts as flying through the air to witch gatherings, partaking of witch sacraments, signing a book presented by the devil, and submitting to satanic baptism.

The possessed had begun with charging their possession upon poor and vagrant old women, but ere long, emboldened by their success, they attacked higher game, struck at some of the foremost people of the region, and did not cease until several of these

were condemned to death, and every man, woman, and child brought under a reign of terror. Many fled outright, and one of the foremost citizens of Salem went constantly armed, and kept one of his horses saddled in the stable to flee if brought under accusation.

The hysterical ingenuity of the possessed women grew with their success. They insisted that they saw devils prompting the accused to defend themselves in court. Did one of the accused clasp her hands in despair, the possessed clasped theirs; did the accused, in appealing to Heaven, make any gesture, the possessed simultaneously imitated it; did the accused in weariness drop her head, the possessed dropped theirs, and declared that the witch was trying to break their necks. The court-room resounded with groans, shrieks, prayers, and curses; judges, jury, and people were aghast, and even the accused were sometimes thus led to believe in their own guilt.

Very striking in all these cases was the mixture of trickery with frenzy. In most of the madness there was method. Sundry witches charged by the possessed had been engaged in controversy with the Salem church people. Others of the accused had quarreled with Mr. Parris. Still others had been engaged in old lawsuits against persons more or less connected with the girls. One of the most fearful charges—which cost the life of a noble and lovely lady—arose undoubtedly from her better style of dress and living. Old slumbering neighborhood or personal quarrels bore in this way a strange fruitage of revenge; for the cardinal doctrine of a fanatic's creed is that his enemies are the enemies of God.

Any person daring to hint the slightest distrust of the proceedings was in danger of being immediately brought under accusation of a league with Satan. Husbands and children were thus brought to the gallows for daring to disbelieve these charges against their wives and their mothers. Some of the clergy were accused for endeavoring to save members of their churches.*

One poor woman was charged with "giving a look toward the great meeting-house of Salem, and immediately a demon entered the house and tore down a part of it." This cause for the falling of a bit of poorly nailed wainscoting seemed perfectly satisfactory to Dr. Cotton Mather, as well as to the judge and jury, and she was hanged, protesting her innocence. Still another lady, belonging to one of the most respected families of the region, was charged with the crime of witchcraft. The children were fearfully afflicted whenever she appeared near them. It seemed never

* This is admirably brought out by Upham, and the lawyer-like thoroughness with which he has examined all these hidden springs of the charges is one of the main things which render his book one of the most valuable contributions to the history and philosophy of demoniacal possession ever written.

to occur to any one that a bitter old feud between the Rev. Mr. Parris and the family of the accused might have prejudiced the children, and directed their attention toward the woman. No account was made of the fact that her life had been entirely blameless; and yet, in view of the wretched insufficiency of proof, the jury brought in a verdict of not guilty. As they brought in this verdict, all the children began to shriek and scream, until the court committed the monstrous wrong of causing her to be indicted anew. In order to warrant this, the judge referred to one perfectly natural and harmless expression made by the woman when under examination. The jury at last brought her in guilty. She was condemned; and, having been brought into the church heavily ironed, was solemnly excommunicated and delivered over to Satan by the minister. Some good sense still prevailed, and the Governor reprieved her; but ecclesiastical pressure and popular clamor were too powerful. The Governor was induced to recall his reprieve, and she was executed, protesting her innocence and praying for her enemies.*

Another typical case was presented. The Rev. Mr. Burroughs, against whom considerable ill will had been expressed, and whose petty parish quarrel with the powerful Putnam family had led to his dismissal from his ministry, was named by the possessed as one of those who plagued them, one of the most influential among the afflicted being Ann Putnam. Mr. Burroughs had led a blameless life, the only thing ever charged against him by the Putnams being that he insisted strenuously that his wife should not go about the parish talking of her own family matters. He was charged with afflicting the children, convicted, and executed. At the last moment he repeated the Lord's Prayer solemnly and fully, which it was supposed that no sorcerer could do, and this, together with his straightforward Christian utterances at the execution, shook the faith of many in the reality of diabolical possession.

Ere long it was known that one of the girls had acknowledged that she had belied some persons who had been executed, and especially Mr. Burroughs, and that she had begged forgiveness; but this for a time availed nothing. Persons who would not confess were tied up and put to a sort of torture which was effective in securing new revelations.

In the case of Giles Cory the horrors of the persecution culminated. Seeing that his doom was certain, and wishing to preserve his family from attainder and their property from confiscation, he refused to plead. He was therefore pressed to death, and, when in his last agonies his tongue was pressed out of his mouth, the sheriff with his walking-stick thrust it back again.

* See Drake, "The Witchcraft Delusion in New England," vol. iii, p. 34 *et seq.*

Everything was made to contribute to the orthodox view of possession. On one occasion, when a cart conveying eight condemned persons to the place of execution stuck fast in the mire, some of the possessed declared that they saw the devil trying to prevent the punishment of his associates. Confessions of witchcraft abounded; but the way in which these confessions were obtained is touchingly exhibited in a statement afterward made by several women. In explaining the reasons why, when charged with afflicting sick persons, they made a false confession, they said:

. . . "By reason of that suddain surprizal, we knowing ourselves altogether Innocent of that Crime, we were all exceedingly astonished and amazed, and consternated and affrighted even out of our Reason; and our nearest and dearest Relations, seeing us in that dreadful condition, and knowing our great danger, apprehending that there was no other way to save our lives, . . . out of tender . . . pitty perswaded us to confess what we did confess. And indeed that Confession, that it is said we made, was no other than what was suggested to us by some Gentlemen; they telling us, that we were Witches, and they knew it, and we knew it, and they knew that we knew it, which made us think that it was so; and our understanding, our reason, and our faculties almost gone, we were not capable of judging our condition; as also the hard measures they used with us, rendred us uncapable of making our Defence, but said anything and everything which they desired, and most of what we said, was in effect a consenting to what they said." * . . .

Case after case, in which hysteria, fanaticism, cruelty, injustice, and trickery played their part, was followed up to the scaffold. In a short time twenty persons had been put to a cruel death, and the number of the accused grew larger and larger. The highest position and the noblest character formed no barrier. Daily the possessed became more bold, more tricky, and more wild. No plea availed anything. In behalf of several women, whose lives had been of the purest and gentlest, petitions were presented, but to no effect. A Scriptural text was always ready to aid in the repression of mercy: it was remembered that "Satan himself is transformed into an angel of light," and above all resounded the Old Testament injunction, which had sent such multitudes in Europe to the torture-chamber and the stake, "Ye shall not suffer a witch to live."

Such clergymen as Noyes, Parris, and Mather, aided by such judges as Stoughton and Hathorn, left nothing undone to stimulate these proceedings. The great Cotton Mather based upon this outbreak of disease thus treated his famous book, "Wonders of

* See Calef, in Drake, vol. iii, pp. 56, 57; also vol. iii, pp. 38–46; also Upham.

the Invisible World," thanking God for the triumphs over Satan thus gained at Salem; and his book received the approbation of the Governor of the Province, the President of Harvard College, and various eminent theologians in Europe as well as in America.

But, despite such efforts as these, observation, and thought upon observation, which form the beginning of all true science, began a new order of things. The people began to fall away. Justice Bradstreet, having committed thirty or forty persons, became aroused to the absurdity of the whole matter; the minister of Andover had the good sense to resist the theological view; even so high a personage as Lady Phips, the wife of the Governor, began to show lenity.

Each of these was, in consequence of this disbelief, charged with collusion with Satan; but such charges seemed now to lose their force.

In the midst of all this delusion and terrorism stood Cotton Mather firm as ever. His efforts to uphold the declining superstition were heroic. But he at last went one step too far. Being himself possessed of a mania for myth-making and wonder-mongering, and having described a case of witchcraft with possibly greater exaggeration than usual, he was confronted by Robert Calef. Calef was a Boston merchant, and appears to have united the good sense of a man of business to considerable shrewdness in observation, power in thought, and love for truth. He began writing to Mather and others to show the weak points in the system. Mather, indignant that a person so much his inferior dared dissent from his opinion, at first affected to despise Calef; but, as Calef pressed him more and more closely, Mather denounced him, calling him among other things "A Coal from Hell." All to no purpose. Calef fastened still more firmly upon the flanks of the great theologian; thought and reason now began to resume their sway.

The possessed having accused certain men held in very high respect, doubts began to dawn upon the community at large. Here was the repetition of that which set men thinking under similar circumstances in the German bishoprics when those under trial for witchcraft there had at last, in their desperation or madness, charged the very bishops and the judges upon the bench with sorcery. The party of reason grew stronger. The Rev. Mr. Parris was soon put upon the defensive, for some of the possessed began to confess that they had accused people wrongfully. Herculean efforts were made by certain of the clergy and devout laity to support the declining belief, but the more thoughtful turned more and more against it; jurymen prominent in convictions solemnly retracted their verdicts and publicly craved pardon of God and man. Most striking of all was the case of Justice Sew-

all. A man of the highest character, in view of what he supposed the teachings of Scripture and the principles laid down by the great English judges, he had unhesitatingly condemned the accused; but reason now dawned upon him. He looked back and saw the baselessness of the whole proceedings, and made a public statement of his errors. His diary contains many passages showing deep contrition, and ever afterward, to the end of his life, he was wont, on one day in the year, to enter into solitude, and there remain all the day long in fasting, prayer, and penitence.

Chief-Justice Stoughton never yielded. To the last he lamented the "evil spirit of unbelief" which was thwarting the glorious work of freeing New England from demons.

The church of Salem solemnly revoked the excommunications of the condemned and drove Mr. Parris from their pastorate. Cotton Mather passed his last years in groaning over the decline of the faith and the ingratitude of a people for whom he had done so much. Very significant is one of his complaints, since it shows the evolution of a more scientific mode of thought abroad as well as at home: he laments in his diary that English publishers gladly printed Calef's book against witchcraft and possession, but would no longer publish his own, and he declares this "an attack upon the glory of the Lord."

GLASS-MAKING.

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II.—THE HISTORY OF A PICTURE-WINDOW.

IN the reproduction of the beautiful, Art has occupied itself chiefly with form and color, and has seldom made more serious demands upon light than to ask enough of it to reflect its achievements in these two directions to the eye of the beholder. So keen is the pleasure derived from well-adjusted proportions that our statuary and architecture please by their appeal to this one sentiment alone. When color joins with represented form, our delight in these harmonies is sufficiently complete to exclude for the time any sense of deficiency. We believe ourselves to be quite satisfied.

And yet, when we turn from these clever reproductions to the veritable nature of the outward world, or of our own unmaterialized fancies, our copies seem poor things after all. At best, they are so inadequate that one almost feels that the attempt is a mistake. The marble figure lacks the divine life that suffused and made adorable the human original. The painted atmosphere has

MEMORIAL WINDOW FINISHED. (Shown in process of manufacture in the following illustrations.)

not the spiritual light and transparency of the real heavens. The aureole encircling the sainted head does not palpitate with the living fire that glows in every sunbeam. Some element there is in nature's beauty that art has failed to catch. It may be, that in attempting to give permanence to impressions which are essentially transitory, a certain violence is done to the constitution of things, which we resent even while we admire. The beauty is too permanent. It is not one with the passing, ever-changeful moods of Nature.

We must not, however, be too exacting and demand the impossible. It is not to be expected that the pupil will equal the master. But the question is not unreasonable as to whether Art can not import into her work some of the life and the eternal ebb and flow which characterize that world of beauty which it is her province to attempt to reproduce. Form and color are large elements, but they do not make up nature. There must be light and motion, else the scene is deficient in its chief charms. True, it is impossible to realize motion in very fact: the strained muscle and unstable poise can only suggest it. Nor is it possible, working with marble and canvas, to realize the life and light of the real ether. This is something too subtile to be simulated. But it may be borrowed. By giving expression to his conceptions in translucent materials, the artist may so strain and filter the sunlight that it shapes itself at his bidding into such pictures as he will. And the beholder, seated on his bench before it, or perhaps kneeling in a reverential mood, loses himself in this fine vision, and under its influence sends out his thoughts over broader ranges and higher planes.

I remember distinctly, as a child, the keen pleasure I used to get from a picture-window that faced me during afternoon church. It was a poor thing, artistically—Zaccheus on the bough of a very inadequate-looking sycamore-tree, with a passing multitude of such dimensions as to make tree-climbing seem absolutely superfluous—but in the early winter twilight I found the picture very beautiful. When the increasing darkness had softened the group in the foreground into a pleasant harmony, there was a strip of sky along the horizon that sprang into glowing life. And in that bit of light I used to wander over the Judean hills in happy abstraction until the music and the benediction called me back again to the more prosaic life of an American city.

It is this added element in glass that makes it so fitting a material for the expression of artistic conceptions. It is a sensitive vehicle for the carriage of a beautiful thought. The material possesses a wealth of the purest color; it permits in its shading the accurate representation of form, and it furnishes something that marble and canvas do not—large possibilities in the way of light

and of effective changeableness. These considerations are attracting the attention of artistic people, and probably in no other field is there better work being done to-day. It is true that the material is fragile—very fragile—but then few works of art are fashioned with the idea of rough usage. If protected from mere mechanical injury, glass will outlast many forms of matter apparently much more robust. Particularly is it proof against that ever-present enemy, the atmosphere. Stone crumbles and decays, metals corrode, and pigments fade, but glass defies nearly everything but fracture. The few glass ornaments that have come down to us from the ancient world are in a state of superior preservation. Glass and terra-cotta, fragile as they are, seem better adapted than even tablets of stone for preserving the records of the past. Clay cylinders from Assyria, depicting the story of the garden of Eden, are a part of historical record still extant: the graven decalogue is no more.

The subject of picture-windows is a very large one, since their fabrication demands the exercise of such diverse faculties. Viewed from either the artist's or the technologist's standpoint, it presents many features of interest. In our nomenclature we have permitted ourselves to fall into rather careless habits. The terms "painted," "stained," and "mosaic" glass are used indiscriminately to designate any form of window-glass work which involves color, but a moment's consideration will show them to be far from synonymous. Some of our best effects are produced without the use of either paint or stain, and such windows have the advantage of a much greater durability. In painted glass the colors are produced by enamels fused to the surface of the glass by means of heat. In stained glass, a permanent transparent color effect is secured by the action of heat on certain metallic oxides applied to the surface as pigments; while in mosaic glass, pure and simple, the design is brought out by the use of shaped fragments of colored glass bound together by strips of doubly grooved lead.

The three products, it will be seen, are quite distinct. It frequently happens, and in the older examples of ecclesiastical design it is nearly always the case, that all are combined in one window. But at the present time there is a strong reaction against the employment of either paint or stain, since they are not only less durable but also less brilliant than homogeneous colored glass. There is a decided tendency to rely entirely upon the mosaic treatment, and to limit the use of paint to the representation of the human figure.

The manufacture of mosaic glass has attracted the attention of men of such ingenuity and taste that it deserves its rank among the fine arts. It has attained a degree of artistic perfection of

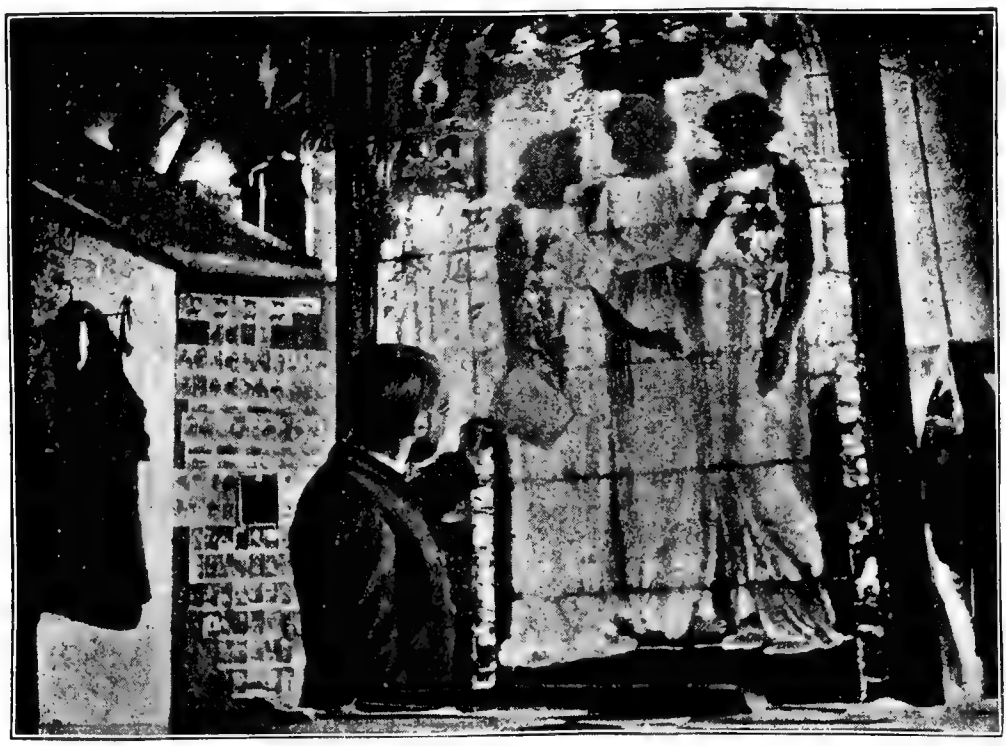
which the earlier examples gave only sparing promise. In spite of the abandonment of paint and stain, the mosaic glass has been given greater variety and greater depth of color than at any time since the Renaissance. In its present form, the mosaic picture-window is a distinctively American product. It has been evolved here, and, though now somewhat copied in Europe, it is here that the process has reached its greatest extension and perfection. The history of its mode of becoming is both unique and interesting. It is one that could not have been written much earlier to advantage, for the material of which it is composed has only been gathering during recent years. Were this history to be unfolded logically, it would start with the first conception which shaped itself in the brain of the artist, and from that intangible beginning it would be traced through the colored sketch, the full-sized cartoon, the gradual replacement of colored paper by colored glass, and so on to the completed window; but that would presuppose too much. It would take for granted that the artist in glass had only to catch his fine dreams of beauty, and that the material for their expression would be found at hand ready for his use. But such is very far from being the case. In this form of art-work the real struggle has been to make the material adapt itself to the conception it is intended to express. The struggle, however, has been carried on so cleverly and so successfully that the ultimate triumph is the more enjoyable for the prelude. It is more consistent, therefore, to consider first the technical part in the history of a picture-window, the production of that adroitly wrought and daintily colored material which has made the window possible; and then, having won the material, to regard its subsequent disposition in producing the fine effects which make it so admirable.

To describe every variety of glass utilized in a mosaic picture-window would be to describe nearly every form of glass known in the flat. In such a window, be it remembered, the entire picture, except the exposed portions of the figure, is brought out by the use of shaped fragments of colored glass; and one can readily imagine that, as all possible subjects are chosen for such representation, all possible shades and combinations and effects are needed in the glass employed. Draperies, vegetation, architecture, sky, earth, air, and water, are all successfully depicted without the use of either paint or stain. Such windows, except the flesh portions, are true mosaics, and of the most brilliant kind.

To acccomplish these wonders the glass has been made in all the colors of the spectrum, and has undergone a thousand different transformations. The shapes have been no less varied than the colors. The so-called "jewels," or pieces of richly colored glass, cut with facets after the manner of precious stones, have

added immensely to the brilliancy of modern designs, and have been particularly effective when introduced as a setting or framework to a picture-window. They are imported for the most part from Germany. The greater part of the flat glass used, however, is made in the immediate neighborhood of New York, under the direct supervision of the art-workers who are to utilize it. I had recently the pleasure of going through such a factory in Brooklyn, probably the largest of the kind in this country, and it was a veritable chromatic treat to visit the store-rooms, for some five hundred different color combinations were recognized in stock. The mosaic ateliers of the Vatican contain, it is true, not less than twenty-six thousand different tints; but these, it must be remembered, are simply opaque enamels, while the glass mentioned is all easily translucent, and much of it is clearly transparent.

In the manufacture of this glass the materials employed are much the same as in ordinary sheet and plate glass. It is a double silicate of lime and soda, the coloring being due to the addition of metallic oxides which are soluble in the fused glass. The mate-



In the Glass-Shop. Selecting the Glass from the Sheets.

rials needed for the basis are, as before, sand, limestone, and alkali. They are mixed in the proper proportions—that is to say, about thirty parts of lime and forty of soda to every hundred parts of sand—and are fused in fire-clay crucibles in the customary glass-furnace. The coloring matter is added at different stages of the process, according to the nature of the material.

The mineral world has been pretty thoroughly ransacked to

obtain the needed colors, and additions to the list are constantly being made as the result of further experimentation. Taking the colors up in the order of the spectrum, the violet shades are generally produced from manganese or from very small quantities of cobalt; the deep blues, indigos, purple blues, and normal blues, from varying proportions of cobalt; peacock-blue from copper; the finest greens from copper and chromium; and the dull sea-water tint from ferrous oxide. The oxide of copper gives an emerald green. The yellows come from a variety of sources: the sesquioxide of uranium gives a fine fluorescent yellow; the oxide of lead a pale yellow, and the oxide of silver, applied as a pigment to the surface of the glass, a permanent yellow stain. The higher oxide of iron gives an orange color, but, as it has a strong tendency to become reduced, it is necessary during the manipulation of the glass to keep some oxidizing agent present, such as manganic oxide. In the reds a number of excellent shades are readily obtainable. Manganese furnishes a variety of pinkish reds and pinks; copper, in its lower oxide, the fine blood-red of Bohemian glass; and gold, the deepest and most brilliant of all reds, the well-known ruby glass. This list, however, is but a fragment. It bears to the complete array of color at the command of the glass-worker much the same relation that an inventory of crude pigments would bear to the fine distinctions housed in an artist's color-box. It is only intended to give some little idea of the mineral bases utilized for their color effect. The fine gradations of color, and the rich and delicate tones, are the result of no such elementary chromatics. Many substances have joined their forces to produce these fine results. In many cases they have been obtained only after long experimentation, and have a corresponding value in the eyes of their discoverers. The magnificent window designed by Mr. John La Farge, which now faces the chancel in Trinity Church, Boston, owes the brilliancy of its peacock hues to the combined forces of some seventeen ingredients. This is an extreme instance of complexity, but it fairly represents the present tendency to secure a multitude of effects even at the expenditure of a multitude of agents.

In addition to these metallic compounds a number of other substances are used to produce either colors or unique effect. A little carbonaceous matter yields an amber tint of very agreeable hue, while the opalescence now so much in vogue and so justly admired results from the presence of oxide of tin, arsenic, or lime, or from native minerals, such as fluorite or the cryolite now imported in such large quantities from Greenland. The superiority of American art-work in glass is largely due to the introduction of this effective opalescent glass. It was first used in this country about ten years ago, by Mr. John La Farge and Mr. Louis C.

Tiffany. The idea is due to Mr. Tiffany, and suggested itself in the most accidental manner. His own collection of glass included several Venetian wine-glasses made of thin opalescent glass, as well as several of thin transparent ruby of the quality used in ordinary colored window glass. As a painter he was naturally keenly alive to all color effects, and could not fail to be impressed with the contrast presented by the two glasses. The opalescent afforded such varying and beautiful effects, and seemed to possess so many advantages over the ordinary transparent glass, that the idea flashed upon him that if the ruby glass could be made use of in windows, why could not the opalescent as well? He decided at any rate to attempt its introduction. After long and careful experimenting he succeeded in obtaining a sufficient quantity of glass for the construction of a window. There were so many difficulties to be overcome, however, that for a time it seemed doubtful whether the glass could ever be largely introduced. That question has now been so far set at rest that the glass may be said to enjoy too great a popularity for its own good. Its reputation has been somewhat injured at the hands of enthusiastic glass-workers—"glass sinners," Mr. Tiffany calls them—whose taste in this direction appears to have suffered chromatic aberration. It is the apparent ambition of these people to combine the greatest number of colors in the smallest possible space, and the results have been unhappy to such a degree as to frighten more sober-minded lovers of beauty from paths so seemingly dangerous. This unfortunate craze, however, may soon be expected to spend itself, and the really artistic work in opalescent glass will suffer no permanent damage from the nightmares in color which now disfigure many even of our better-class tenements and hotels.

But the glass-worker has only begun his work when he has the molten "metal" simmering in his crucibles. It must undergo many subsequent manipulations before it is available for the purpose of art. Some of these, from a technical point of view, seem retrogressional. It has been found that the rich color effects in glass of the middle ages are largely due to the imperfections in the material. Its lack of homogeneousness, its unequal thickness, and uneven surfaces contribute largely to its beauty. The modern product is too uniform to be brilliant; it transmits the light with too great regularity. Intentional imperfections are, therefore, introduced into the process; and the products, in consequence, are much more satisfactory to the artist. This work of individualizing the product has now been so far systematized that several special brands of art glass are recognized in the markets. The so-called antique glass, in both white and colors, is made precisely like the ordinary sheet window glass, except that the surface of the glass is made full of minute blow-holes, which produce almost

an aventurine effect, and add greatly to its brilliancy. In the cathedral glass the surface is rendered wavy and uneven, so that the transmission of light shall be correspondingly irregular. In the flash glass ordinary sheets are covered with a thin plating of colored glass, a process which permits a very delicate color tone, and materially decreases the expense, where a costly glass, such as ruby, is needed to give the color. But in mosaic work it is now generally preferred that the glass shall not be at all transparent, since the effect is much richer. The most of the glass is therefore cast, the process being a repetition in miniature of the

IN THE PAINTING-ROOM. THE ARTIST LAYING IN THE HEADS.

casting of rough plate. The pots containing the molten colored glass always remain, however, in the furnace, and the "metal" is dipped out in small iron ladles. It is poured at once on a little casting table, and is smoothed out by means of an iron roller. The small sheets thus obtained are readily handled, and permit the use of the convenient rod leer. In this, the annealing process requires from three to six hours, and at the end of that time the sheets are ready for use.

In case more than one color is to appear in the same sheet, the effect is obtained by mixing together several masses of differently colored and still plastic glass on the casting table, by means of a copper instrument not unlike a plasterer's trowel. In this way three or even four colors are combined in the same piece of glass, and, though the results are always more or less experimental,

artists have learned to adapt them to their picture-windows as well as to their geometrical designs. The workmen have attained no little skill in the art of mixing. They have learned to reduce the accidental element in this apparently hit-or-miss process to a minimum, and with a fair degree of accuracy to secure predetermined combinations. The mixture of blue and white translucent glass in particular is made to represent sky effects as naturally as if the colors had been laid on by an artist's brush. It is true that this combination is prone to represent an August sky; but this is not to be regretted, since at no other season of the year are the heavens more beautiful.

By this mode of manufacture the glass has an unequal thickness and consequent varying depth of color that well adapt it for art purposes. For certain uses, however, particularly for drapery, the differences in color tone are still not sufficiently great, and other devices must be resorted to. A special product, known as drapery glass, has of recent years been added to the already extended list, and produces a most excellent effect. While the sheet of glass on the casting table is still sufficiently hot to be plastic, it is seized by suitable tools, and rumpled up until it looks like a piece of crumpled cloth. It is permitted to cool in this condition, and, when introduced into a picture-window, presents a luminous substitute scarcely less natural than real drapery. One is almost tempted to run his hand over the folds to try their texture.

It is by processes so painstaking and so ingenious as these that the material for our picture-window is won. The industry is still a comparatively new one, yet so marked are the improvements witnessed by the passing years that the artist is now almost unrestricted in making the design of his window. Should it contain any effects not expressible in materials already at hand, the deficiency is only an incentive for further effort, and the needed material is pretty sure to be speedily forthcoming.

So much for the body of our window: the soul of it comes by a less visible process.

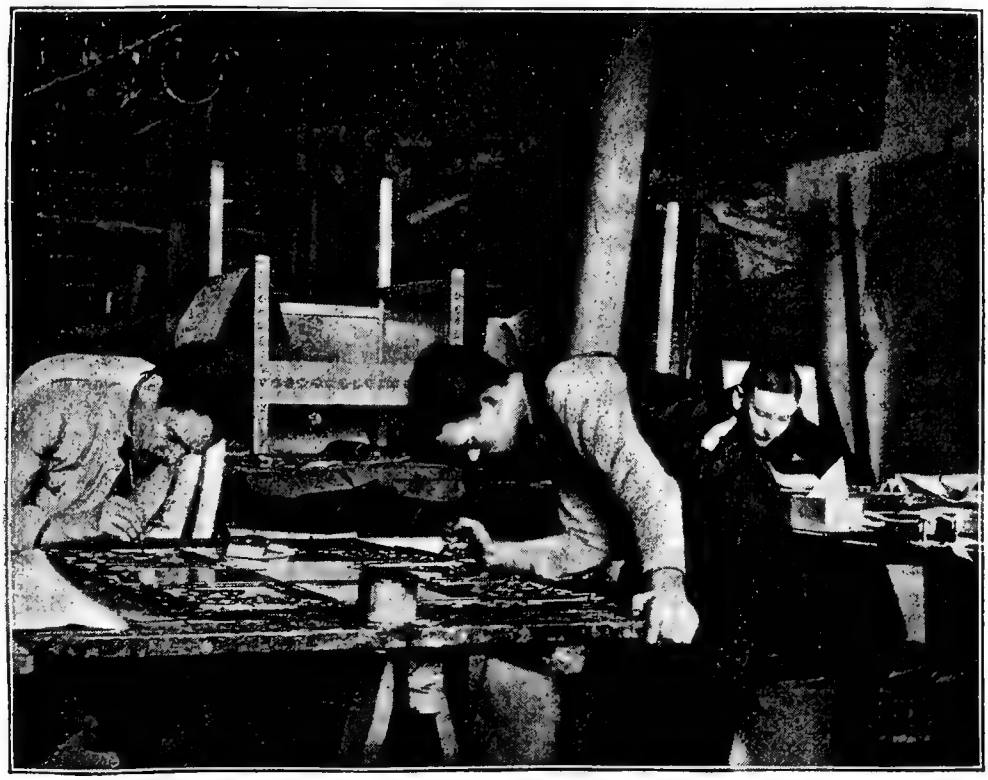
In some quiet moment, under the influence of a strong sentiment, or in the face of an inspiring vision, a suggestion of beauty is evolved in the artist mind. Why it comes in one brain rather than in another it would be difficult to say. Whether it is the result of some subtile chemical reaction in the gray and the white, or the incomprehensible force that has caused this reaction, it seems almost useless to inquire. But in some way or other the vision comes, and finds lodgment under a hospitable roof. It is entertained and communed with until it takes definite shape, and the conception is committed to paper. It is at first little more than a suggestion, a small colored sketch. If this prove satisfactory, it becomes the nucleus of a window, and undergoes its first

metamorphosis, enlargement. From the beginning of its career until finally, after months or years, the picture is in place and the bright sunlight illumines it, the different steps in the transformation involve never-ceasing care and thought. At any step a failure of attention might mean a total failure of the work. To follow this little sketch in its growth toward a window, will be to watch its fortunes under many different hands and under widely varying circumstances.

As the Tiffany Glass Company of New York has been particularly successful in adapting the mosaic treatment to picture-windows, their studios furnish typical illustrations of the several steps. Ordinarily the artist simply furnishes the small colored sketch, and from this germ the window is evolved. Occasionally he goes a step further, and supplies a cartoon in black and white of the natural size. It is only in rare instances that he does the full-sized sheet in colors. Not unfrequently the suggestion for a window is taken from some celebrated painting or engraving. The Tiffany Company recently reproduced Gustave Doré's famous picture, "Christ leaving the Prætorium," for a church memorial window, the entire piece being executed in pure mosaic, with the exception of the faces and hands. The dimensions of this truly magnificent work of art are twenty by thirty feet. It is the most ambitious window ever attempted in America, and, indeed, the largest opalescent piece in the world. In many cases, however, the suggestion comes from humbler sources. A very beautiful window designed by Mr. E. P. Sperry—"Faith, Hope, and Charity"—and recently completed as a memorial window for the Unity Church at Springfield, Mass., sprang from a thought suggested by a Christmas card. Where the design for a window is ordered and paid for by the purchaser of the window, it is of course impossible to secure a duplicate; but where a picture that is already common property is reproduced, the work may be several times repeated. Thus "The Good Shepherd," a very satisfactory figure of the Christ taken from the well-known painting by Frederick J. Shields, has been reproduced in glass three times, and now adorns as many churches in different parts of the country. It is too beautiful a conception to be rendered any less pleasing by this repetition. In all cases the patterns and other needed guides are preserved, so that, should the occasion arise, a picture-window once executed may be readily duplicated. A window has just been completed for the Buffalo Cathedral, to take the place of one recently destroyed by fire. It is a very close duplicate of the original work. But while the success in reproducing pictures already extant has been very marked, a keener pleasure is derived from modern pictures designed originally for execution in glass. Many of these are exceedingly beautiful, and represent

the thought of some of the best artists of the modern American school.

The enlargement of the colored sketch to natural size is accomplished by women artists, who work standing before large sheets of heavy brown paper tacked against the walls of the studio. While this mode of procedure would in any case be necessitated by the large size of the cartoons, it has the independent value of per-



In the Decorating-Room. Treating the Leads.

mitting the progress of the work to be checked at all stages by long-range scrutiny. As much of the enlargement as possible is done mechanically, but at best there remains much free-hand work requiring genuine artistic feeling. Indeed, throughout the entire process, true artists are needed in the most mechanical portions to make the success of the adventure complete. When the enlargement is finished, the cartoon is divided up by heavy black lines so disposed as to represent the doubly grooved lead needed to hold the fragments of colored glass together. Sketch and cartoon are now taken to the glass store-room, and appropriate glass for the window is selected and laid aside. If suitable material is not found in stock, it is ordered in such quantity that the discovery of right effects may reasonably be expected. As the accidental element, in spite of all the skill on the part of the glass-worker, is necessarily large, it sometimes happens that a ton of glass must be searched over to find a few pounds of just the right sort. In some cases several months pass before appropriate material can be selected.

The search for material ended, the work of construction may begin. Two duplicate copies of the cartoon are first made. One operation suffices to accomplish this. The cartoon is laid on a large table, and beneath it are two sheets of similar paper and two sheets of ordinary black transfer paper arranged alternately. By passing a small revolving wheel over the outlines of the cartoon, the tracings are quickly and accurately made. Each space is then numbered correspondingly on both tracings, and one of them is cut up to make patterns for the glass-cutter. An ingenious dissecting instrument is used for this purpose. It consists of a pair of double-edged shears, which, in cutting, removes a strip of paper just the width of the lead which will separate the fragments of glass when they are finally bound together. In this way each pattern is precisely the size required. When the glass is ready to be put together in the window, there is very little coaxing to be done to get it into place.

The picture-window has now reached the most critical stage in its development. The paper patterns are to find suitable counterparts in glass, and upon the nicety with which this substitution is accomplished depends the effect of the entire work. Nothing is left undone that will assist the glass-cutter in forming correct color-judgments. Throughout the entire process, and here particularly, the work progresses under precisely those conditions that are best calculated to make surprises and incongruities impossible when the whole shall be completed. A sheet of plain glass, the size of the cartoon, is laid over the undissected tracing. Outlines of the intended lead bands are then painted on the clear glass in black lines of corresponding width. On the model thus prepared the paper patterns are stuck by means of a little wax. It is now ready to be taken to the figure-room, where it is placed directly in front of a large window, and the slow work of substituting colored glass for paper begins. The position in which the completed window is to be placed must constantly be borne in mind, and the treatment adopted be made to conform to the requirements of light and neighborhood. A window that will be effective when seen against a clear northern sky will probably be somewhat dull if turned to some other point of the compass and seen against a dark background of brick walls and shadows, while a window that would be a delight under these more somber conditions would be insupportably glaring against the stronger light. Consideration must also be paid to whether the window is to be seen commonly at long or short range, and to the general color tone of neighboring windows and walls.

Piece by piece the paper patterns are removed, and the shaped fragments of glass take their place. Each fragment is obtained by repeated trials until just the right effect is secured. When the

fragment has been selected and shaped, it is also held to the sheet of clear glass by means of a little wax, and another paper pattern is removed, to be similarly replaced by glass. In this manner the removal and replacement go on step by step until the entire work is done. The colored sketch and the enlarged cartoon are always kept in sight, so that the spirit of the picture may be realized as completely as possible. The workmen who thus select and cut the glass have acquired a surprising skill in adapting its accidental variations to the needed expression of the thought. In many cases they entered the studio as boys, and have been slowly trained to perform this difficult work with much nicety of judgment. In mosaic glass of purely geometrical design, the requirements of

Soldering Joints of Lead Lines.

color harmony alone need attention; but in the picture-window, in addition to this, a very appreciative eye is needed to seize upon just the right combinations to bring out the draperies and the background and the sky. It is frequently impossible to secure the desired effect with one thickness of glass, and the custom of doubling the glass is becoming more prevalent each year. This practice gives both better drawing and deeper color. In the matter of draperies, particularly, the method leaves little to be desired. In the window representing "Faith, Hope, and Charity," the draperies of the three figures were executed in white opalescent glass, and the dainty shades desired—pale green, pink, and yellow—secured by placing back of this, fragments of plain glass of the

proper color. The effect could scarcely have been more delicate, yet the color tones were full and strong.

In another window, the design of Mr. Will H. Low, the draperies of a seated figure were executed in a vivid blue. The sketch called for a rich purple, and any one passing through the studio at this stage of progress would have been inclined to resent the seeming liberties taken by the workmen. The artist's intentions evidently were only half carried out. But, while one stands pondering over the excessive amount of assurance possessed by people of a certain class, one of their number has quietly slipped a piece of ruby glass back of the draperies, and at once the vivid blue vanishes to give place to a magnificent purple as much finer than the artist's paper-color as the sunshine is better than gas-light.

In this plan of doubling the glass the colorist has in his possession a device of immense effectiveness. The entire color tone of a window can readily be changed, even after it is completed and in place.

When the window is well under way, the preparation of the flesh portions of the picture begins. These are cut from white opalescent glass, and must be painted with no inconsiderable skill. In the early days of mosaic glass the painting was done almost in monochrome, a light reddish brown being a favorite tint. It had, however, the disadvantage of giving a statue-like sameness to all the figures. Had the taste continued, our windows would have become an assemblage of rather monotonous blonde types. But to-day there is great variety in this respect, and the painting of the face and other exposed portions of the figure is made to conform very strictly to the character of the whole picture. In ecclesiastical designs done in mediæval style, the painting is executed in a pinkish-brown monochrome on transparent antique glass. The effect is so very Elizabethan that it is hard to believe the work a modern product, unless one has seen it in process of evolution. For the saints and Madonnas of the early masters, the high cheek-bone and other characteristics of feature are reproduced with remarkable fidelity. But, while these products are highly interesting, they are in point of beauty far excelled by modern types. To the production of these nearly the whole range of mineral paint has contributed. One of the finest examples of the modern school of painting on glass is to be found in the face of "The Good Shepherd," in which nearly every possible color has been used. At a distance one is not conscious of any particular color, but is attracted by the intense life and love shown in the face. Rather bold expedients are often employed to secure these striking effects. In one face, whose eyes were more than usually expressive of life, the result was obtained by bands of bright green bordering both eyelids.

The manner of painting the flesh portions is not without interest. The pieces of opalescent glass are mounted in rough frames before a window, and nearly all other light is cut off. In this way the artist can see his work under precisely the same conditions that will prevail when the window is put in place, and he can paint to correspondingly good advantage. The colors are put on rather heavy to allow for firing, and for the distance at which the faces will commonly be seen. In many cases the paint is put on solidly, and is then picked off with a sharp instrument, giving much the effect of an etching. It looks a little eerie, on going into such a studio, to see a group of heads and hands, and other severed members of the anatomy staring at one in luminous characters. The painting must be done in installments, as it is necessary to fire the glass from two to four times. Each firing requires about an hour and a half, and six hours more for the kiln to cool down. Before the last firing the flesh portions are taken to the figure-room and given place in the otherwise completed picture. In this way the artist can judge of the final colors needed to bring them into perfect harmony with the general color tone of the picture.

It is by the expenditure of such care and labor that the soul and body of our picture-window are brought together; but, before the union is made permanent, the window undergoes a searching art scrutiny, and any changes are suggested that would add to its beauty and harmony. In some cases all the combinations have proved so fortunate that very few changes are needed; but the case is not always so easily disposed of. It happens at times that portions of the glass must be recut several times before the desired effect is secured; or, even after the window is completed, the discovery is sometimes made that a different background would have been more effective in bringing out the figure. Such was the case in a *Jeanne d'Arc* window designed by Mr. Frank D. Millet. The substitution of a light for a dark sky brought the figure into much finer relief.

When, finally, the effect is considered satisfactory, the fragments of colored glass are removed one by one from the sheet of clear glass, and are skillfully bound together by means of strips of doubly grooved lead. This requires some very nice soldering. When it is completed the lead is tinned in order to protect it from the atmosphere. The spaces between the glass and the lead are then filled with a composition of putty and lead, which sets very rigidly, and serves the double purpose of making the window perfectly water-tight and of preventing any looseness on the part of the fragments of glass. There remains only the provision of a strong, iron-bound frame, and the picture-window, after a development covering many months, is ready to be put in place. The materials for its manufacture have been gathered from many

THE GOOD SHEPHERD.

sources, and the skill of many hands and brains has united to bring them into suitable community. The functions of artist and artisan have been fulfilled. Now they give place to the office of the critic.

The result of this co-operative labor is much more than mere decoration. It is a work of art whose capacity for deep and beautiful expression we are only beginning to realize. Standing before such a picture-window, one feels anew the spiritual element in all beauty. The thought that has fastened itself to a sunbeam seems singularly alive and pervasive.

To one who is familiar only with the chromatic efforts of the "glass sinners" this praise may seem extravagant; but, as we love painting in spite of some pretty poor chromos, and statuary in the face of popular domestic groups turned out by the gross, so is it possible to warmly admire the window of real merit while we deplore its unhappy imitator. At its best one can imagine few objects more beautiful. The varying light and the purity of color in art work of this character are a source of lively pleasure. They appeal to a sentiment which, when present at all, is apt to be a dominant one. Those who entertain it turn away regretfully from so beautiful and so luminous a picture.

THE CONVICT-ISLAND OF BRAZIL—FERNANDO DE NORONHA.

By JOHN C. BRANNER, Ph. D.

THE island of Fernando de Noronha* is in the South Atlantic Ocean, two hundred and fifty miles south of the equator, about two hundred miles northeast of Cape St. Roque, and near the track of vessels plying between European ports and those of South America lying south of the cape. It belongs to Brazil, and has long been used by that Government for a penal colony. In 1876, when a member of the Imperial Geological Survey of Brazil, I visited this island for the purpose of studying its natural history and mapping it. It was no part of my official duty to criticise the administration of the affairs of the island as a prison, yet it was but natural that I should take a deep interest in this administration, and should inform myself, whenever occasion offered, regarding the methods employed in dealing with a class of persons so new to me. The commandant and other officers spoke freely whenever they addressed me in regard to administrative meas-

* The name is also erroneously written—Fernam de Loronha, Fernão de Noronha, Fernando Noronha, Ferdinando Noronha, Fernand de la Rogne, etc.

ures, while from the prisoners themselves I learned much of the operation and results of these measures.

It will throw some light upon the character of the inhabitants of Fernando de Noronha to know how crime is looked upon by the common people in Brazil, and I can not better show this than by relating a bit of personal experience.

I had the misfortune at one time to wound a Brazilian laborer —in his dignity. He thereupon threatened to take my life, and was by no means careful to keep his resolutions to himself. As the carrying out of such a determination upon his part would have caused me much inconvenience, I called upon him in person, with the purpose, if possible, of dissuading him. I found that he did not look upon the condition of a criminal with dread at all. He told me frankly that, if he should succeed in carrying out his designs, he knew perfectly well what his career would be. "At present," said he, "I am obliged to work for a living; if I am sent to jail, my living will be furnished me, and I shall have nothing to do. If you are dead, there will be no one to appear against me in the courts as my accuser, and in the course of a year or less I shall be set free, well rested, and with the reputation in the community of being a man of courage."

In this case I saw to it that he had the opportunity of enjoying the coveted *otium cum dignitate* in jail without having to commit a crime. But in a country where wrong-doing sets so lightly upon the conscience, and where it so frequently goes altogether unpunished, the criminal class is large, as we should expect, though through a lax administration of the laws but a small part of it ever reaches Fernando. I refer to this phase of the subject because, in order to understand the class of people inhabiting Fernando de Noronha, it is necessary to know something of the source of supply.

The convict-island is visited once a month by a small steamer from Pernambuco. On one of the vessels I took passage, furnished with the usual and indispensable official letters of introduction from the President of the Province of Pernambuco; and, after a voyage of two and a half days, anchored in front of the village in which the commandant or governor of the island lives. Arrived at the anchoring-ground—for there is no wharf or pier, and no small boats are allowed on the island—I could see upon the beach about seventy-five half-naked men tugging at a huge two-storied raft, trying to get it into the water. When this was launched, a large cable was secured on shore, and the great raft was paddled slowly in our direction, telling out the cable, the other end of which was finally made fast to the steamer.

The personal baggage, five or six newly arrived convicts with their guards, and myself and servant, were placed on the upper

story of this peculiar craft, and it was then drawn in near the shore by means of the cable. When we struck bottom I was taken on the wet, slippery, naked back of a convict, who waded ashore and deposited me on the dry beach. Everybody and everything landed from the raft, I was escorted by a man who took me in charge, and whom I afterward found to be a convict directed by the commandant to look after all persons and all things landing, and escorted up the very steep hill, through the well-paved streets of the village, to the house of the commandant, closely followed by the newly arrived convicts under guard.

The commandant I found to be a very aged man, an officer in the regular Brazilian army. His thin gray hair was cut close to his angular head, and his mustache was white with age and yellow with tobacco-smoke. He received me indifferently for a Brazilian, for, though he placed the island itself and everything and everybody on it at my orders, in true Brazilian style, I could see that there was a coolness beneath his politeness. I afterward found that this was due to a suspicion that I had been sent here by the Government upon some secret mission. This impression removed, he became heartily kind to me, and did all in his power to aid me in my work. He gave me a room in the official residence, the seat of honor at his bountifully served table, and a motley crew of convicts for servants, while the slender resources of the island were in reality placed at my disposal.

At the house of the commandant certain ones of the convicts were admitted freely and treated with more or less indulgence. The chief amusement of the officers of the garrison and their wives was to assemble during the evening around the big table in the reception-room in the official residence, and there to play kino. On such occasions (and this game was played every evening during my stay save two) there were from one to five privileged convicts standing about the room as lookers-on, and some of them were even invited to take, and did take, part in the game. At meal-time they frequently dropped into the dining-room, and gently encouraged the old governor to scold them while at his meal. Some of them, being ready conversationalists, were permitted to talk freely, and were even asked, before the meal was over, to take places at the great dining-table; and, though they always sat below the wine, were generally given some sweetmeats or a cup of coffee at the end of the meal.

Among the convicts thus specially privileged about the house was a tall, handsome Italian, apparently a man of education. He spoke, besides his native language, Spanish, German, some English, and Portuguese almost perfectly. I asked his story of the son of the commandant, who also told me the personal history of many of these men, and learned that he had killed five persons in less

than five minutes, including the young lady to whom he was betrothed, because she had followed the advice of her father and mother, and had broken off the match upon the morning of the day on which they were to be married. As the narrator ended the story, which was told in all its dreadful details, he remarked, "And so you see he was almost justified."

This instance, which is simply an example out of a great many of a more or less similar nature, is mentioned for the purpose of illustrating one of the most deplorable facts connected with the administration of the affairs of the island—that is, the inevitable influence upon its inhabitants of familiarity with crime. This young man, neither a criminal nor an executive officer, had come, by constant contact with criminals, to look upon crime with pity in some cases, and with actual approval in others.

It is not my purpose to repeat here in detail the stories of the lives of these people, for those stories are sensational to the last degree, and should be looked upon simply as so many facts in a social study. But, while some of the convicts were indulged, others were treated with unnecessary severity, which merged into cruelty. This unequal justice, or rather the disproportionate punishment meted out to offenders, and over which the officers in charge had full jurisdiction, was, in itself, demoralizing to the great body of convicts, and held out no hope or encouragement to any one to be anything short of the most abandoned criminal. No effort was made to fit the punishment to the crime. Flogging was the one remedy for everything, and, as it always took place in the presence of the assembled prisoners, this became a new element of degradation to the entire community. A convict having stolen a pig, was sent for and flogged. The very next morning the commandant was called to the front door, and there on the veranda stood a man horribly mangled by an assassin. "What does all this mean?" said the commandant. "Fulano has killed me," said the convict. "Away with you to the hospital"; and, turning to an officer, he continued, "and bring Fulano here to me." And Fulano was brought and flogged.* The influence of such a system of treatment upon the less depraved classes of criminals may readily be imagined.

* I undertook to witness a flogging once, but, as I did not get through it with credit to myself, the less said of that occasion the better. I was informed by one of the officers that, not long before, one convict had been so severely flogged that he had died of his injuries. In the light of these facts it is interesting to read article 179, section 19, of the Brazilian Constitution of 1824. It is as follows: "From this time forth flogging, torturing, branding, and all other cruel punishments are abolished." It should be added, however, that in 1879, since my visit to Fernando de Noronha, the Minister of Justice of the Brazilian Empire has directed that corporal punishment of the convicts should cease.

Postscript.—The "Proceedings of the Royal Geographical Society" for July, 1888, contains an article upon Fernando by a gentleman who visited that place in 1887. The convict

The amusements of the inhabitants were cock-fighting and kino. I suggested to the commandant that cock-fighting was a degrading pastime for his *protégés* (I did not mention kino, because that was the favorite amusement in his own house). His reply was: "I know it isn't good; but then—"

Often in private conversation these men would discourse to me upon the moral and social condition of their companions. On such occasions I frequently heard such expressions as these: "You must look out for Fulano." "Some people have no consciences." "The Lord deliver us from a convict!" "These convicts are a bad set, I tell you!"

Society was as varied among these men as in other parts of the world. There were all classes and grades, though they all met on the common level of crime. Social distinctions among them were based upon money first, and second, other things being equal, upon the nature of the crime committed, certain crimes being regarded as indicative of courageous manhood.

While about my work one day, my attention was attracted by a young man who was posing near by and disdainfully watching me. He was not more than twenty years of age, good-looking, and well dressed. A fine felt hat sat jauntily upon the side of his head, and he wore a blue cloak, the bright red lining of which he displayed to good advantage by tossing it back over his shoulder. I saw that he was a type, drew him into conversation, and finally asked him for what he was sent to Fernando. Bridling up and throwing back his shoulders, he struck his left breast with his right hand closed, as if upon a dagger, and exclaimed proudly, "Mor-r-rte!" (murder).

Many of the prisoners were known among themselves by what seemed to be very odd names, and I learned that they were nicknames taken from some circumstance connected with the crimes they were expiating. Sometimes there was a ghastly sort of humor about these names. One, who had murdered a priest, was called "*O Padre*," the priest; another, who had murdered a man for his money and had found but half a *pataca* upon him, was called "*Meia Pataca*," half a pataca, about sixteen cents; another, for a similar reason, was called "*Quatro Vintens*," four cents.

These are simply instances of how the minds of these people dwelt constantly upon crime, how they admired crime, and conse-

system is there spoken of as "almost unique in its excellence," and a convict of seventeen years' standing is called "our dear old guide." The great number of verbal errors in the article lead one to conclude that its author knows little or nothing of the Portuguese language, without the easy command of which he could get no clear insight into the working of the convict system. He states also that one of the prisoners was flogged during his short visit. Flogging continues, therefore, in spite of the order of the Minister of Justice made in 1879 and referred to above.

quently gravitated toward it. About their work in shop or field, the daily bread of their minds was to think and talk of crime in every shape that diseased minds and perverted natures can conjure it up. One would entertain his companions by detailing to them the story of some crime committed by himself, or of which he had knowledge, while every one listened attentively, like so many experts. The story ended, criticism began, and each one would indicate what he considered the weak points in the plan and its execution, and would suggest improvements here and there. One story always led to another, and, as might be expected, minds accustomed to this highly seasoned food soon rejected all other.

The total population of the island at the time of my visit was 2,562, about seven hundred of whom were not criminals, but the wives and children of convicts who were, by necessity or choice, accompanying husbands or parents in their exile and imprisonment. As already stated, the great majority of the convicts had been sent here for murder, and belonged to a low, brutal type of men. The general tendency of this intermingling of the innocent with the criminal, and of the less depraved of the convicts with the worst, is to reduce all to a common level, and that level the lowest.

In the ordinary experience of life a man seldom or never sinks so low that there is no hope for him, hope both subjective and objective, but of the worst of these convicts this is not true. The only priest of the island, after years of labor, went through his sacred duties in a perfunctory manner, for, as he gave me to understand, he had long since come to realize that the seed he sowed fell into the fire. Speaking to him one day regarding the peculiar charm of the place, he replied: "Ah me! I can't see these things now, for though it is, externally, all that you see and say of it, this quiet, this seclusion, this beautiful and bountiful nature are turned by man into a stifling, suffocating hole—a stench in the nostrils of God."

But fortunately the attractiveness, the beauty and grandeur of nature as seen in the delightful landscapes, the tropical vegetation, the peculiar fauna and flora, the majesty of the ocean, the violence of the tempests, the charming caprice of clouds and sunshine, prevent one from brooding too long over these dark pictures of human depravity, while the convicts themselves not infrequently come like quaint figures in the foregrounds of beautiful pictures. But to see this beauty one must look through the eyes of a lover of nature.

For the true-hearted naturalist there is no such thing as solitude, but to those who see but little or nothing companionable or intelligible in landscapes, in forests and fields and oceans, and above all to the ignorant, Fernando de Noronha doubtless seems

a lonely, desolate, and forbidding place. A phrase in common use among the inhabitants of that island expresses better than anything else could the general feeling of the prisoners in regard to their isolation and separation from all that is interesting and attractive to them on earth. For them, and in their minds, the earth is divided into two parts, one of which—that inhabited by themselves—is known as Fernando, the other part is known and usually spoken of as "the world." This term was in constant use, and I frequently heard among them such expressions as these: "When I was in the world," "This came from the world."

It is often asked whether there was not great danger in trusting one's self with men so many of whom were known to be desperate characters. This question can not be answered for every one at the same time, because whether there would be danger would depend almost entirely upon how one conducted himself. The commandant was so solicitous regarding my personal safety, when I first began my work on the island, that he wished to send an escort of soldiers with me in order to secure me against possible danger, and it was with difficulty that I persuaded him to allow me to dispense with such cumbersome attendance.

When working in parts of the island remote from the village I sometimes found it necessary to pass the night in the huts of the convicts. At such times I was never treated otherwise than with respect by them, and I never had the least reason to feel disturbed about my personal security. One day, when alone in my room in the house of the commandant, a tall mulatto came to the door and handed me a begging letter, written in very poor Portuguese. In this letter he called himself my "afflicted fellow-countryman." Addressing him in English, I found that he had been an American sailor, and was here for murder. As he seemed eager to be in my service, I employed him; but, when I informed the commandant of the arrangement, he endeavored to dissuade me from having him about me, assuring me that he was the most unconscionable, incorrigible criminal in the entire settlement. In spite of these protests, I took my "fellow-countryman" with me, and for three days his services gave entire satisfaction. At the end of that time he was discharged for the only impoliteness shown me during my stay upon the island.

Abandoned and unscrupulous as so many of the convicts were, I found them susceptible to the ameliorating influences of fair wages and reasonable treatment—a susceptibility due to some extent, perhaps, to the general absence of considerate treatment in their present lives—and when I left Fernando some of those whom I had employed manifested their good-will toward me in a way of their own. On the morning upon which the steamer was to sail for Pernambuco, my collections and baggage had all, as I thought,

been placed on board, when, previous to my taking leave of the officers and their families, I was called to the door by a visitor—one of my convicts. He stood barefooted and uncovered, his warped, reddish-brown hat held in his left hand behind him, his coarse shirt of dirty cotton cloth hung, in the customary fashion, outside his coarse trousers, and these were rolled half-way up his bare, brown legs. He laid his right forearm across his forehead like a timid child, and when asked, "And what is it, Feliciano?" he said: "My patron, pardon me, eh? but it is all I have. Here are some squashes I have brought for your lordship to take back to the world with you," and he pointed with his leather hat toward six enormous squashes that lay upon the floor of the veranda, and which he had brought during the night from a distant part of the island. My embarrassment may be realized in some degree when I say that I knew that, excepting only the clothes he wore, these six squashes were the sum total of that poor fellow's earthly possessions. I knew, too, how serious an offense it would be to decline his present, so there was nothing to be done but to accept it and take his squashes "back to the world" with me. If the matter had ended here, it would have caused me no serious inconvenience; but, before the steamer sailed, a whole wagon-load of squashes had accumulated on the floor of the veranda, and all of them had to be accepted and taken away.

When the time for my embarkation had arrived, the officers of the station accompanied me to the beach, where they bade me farewell in that affectionate and touching manner so characteristic of Brazilian gentlemen. After these had withdrawn, there came about me seven men with rough clothing—what there was of it—rough, hard hands, and hard faces. They stood uncovered, and, without speaking a word, one after another held out to me a thick, horny right hand. One of them then stooped and took me on his back, and, wading out to the great raft, left me to be transferred to the steamer. That afternoon I saw this lofty, beautiful, but sin-cursed Fernando sink slowly into the ocean; and the last sight I had of it was when, as the sun went down, it touched with crimson and gold a cloud-banner that streamed away like a pennant from the summit of its majestic peak.*

* In view of what I have said of the moral condition of the convicts confined on this island, it is but just that I should add that in the year following my visit, that is, in 1877 the Imperial Government of Brazil appointed a commission for the purpose of elaborating a prison system for the country. The President of the Province of Pernambuco held out to the Legislative Assembly of that province the hope that Fernando de Noronha would not be overlooked by this commission. Said he, "The grave social, economic, and moral questions here involved will be settled." It is to be hoped, too, that the transfer of this penal colony from the Department of War to that of Justice will also be conducive to a better prison system.

THE STRANGE MARKINGS ON MARS.

By GARRETT P. SERVISS.

IN the whole planetary empire of the sun there is but one body, if we except the moon, whose actual surface can be satisfactorily examined even with the most powerful telescope. The broad disk of Jupiter presents a most inviting and splendid sight; but it is apparent that we are not looking at the solid shell of a planet, but at a vast expanse of thick clouds, surrounding and concealing the planetary core, and reflecting the sunlight from their shifting surfaces. Saturn presents a somewhat similar appearance, modified by greater distance. Uranus and Neptune are so nearly beyond the present reach of telescopes, so far as the phenomena of their disks are concerned, that we know almost nothing of their surface appearances. Some observations of Uranus, however, indicate that it presents the same equatorial parallelism of exterior markings that characterizes Jupiter and Saturn; and so we may infer that what we faintly discern on its disk are the outlines of cloud-masses, enveloping the planet, and drawn out by the effects of its rotation into belts and streaks. Coming to the nearer planets, we find that Venus, superbly brilliant to the naked eye, and consequently, it might naturally be thought, a promising object for telescopic scrutiny, is nevertheless the most disappointing of all the planets when viewed with a telescope. The splendor of its luminosity in itself forms an obstacle to the study of its surface, where flitting glimpses of shadowy forms and brilliant spots only serve to excite the keenest curiosity. With respect to Mercury, our knowledge is equally unsatisfactory. The surface of the moon, of course, has been well studied, as such maps as those of Beer and Mädler, Neison and Schmidt sufficiently attest. But, after all, the absence of the faintest indication of life robs the wonderful lunar landscapes of a large share of the interest that would otherwise attach to them.

Finally, we look at Mars, and here at last we find a globe whose true surface we can inspect, and which at the same time possesses an atmosphere and other concomitants of vital organization. Since Mars has been selected by more than one astronomer as the probable abode of life (and perhaps the only one besides the Earth in the solar system), and especially since a discussion of the markings seen upon the planet necessarily involves the physical features upon which the theory of Mars's fitness for inhabitation rests, it will be well to recall here the principal facts that have been ascertained respecting that interesting orb.

The diameter of Mars is 4,200 miles, or only some 240 miles

more than half of the mean diameter of the Earth. The density of the planet is rather less than three quarters of the density of the Earth, or about four times the density of water. The force of gravity upon its surface is less than two fifths of that upon the Earth; more accurately, 0·38. That is to say, if a man from the Earth could visit Mars, he would find that his weight had diminished almost two thirds. Members of terrestrial fat men's clubs could become agile dancers by simply going to Mars. This feebleness of the force of gravity must, it is clear, have an important effect upon the organization of any forms of life that may exist upon Mars, whether animal or vegetable. The mean distance of Mars from the sun is 141,500,000 miles, that of the Earth being 92,900,000. The length of Mars's year is six hundred and eighty-seven days. Its day is only forty-one minutes longer than our day upon the Earth. The inclination of its equator to the plane of its orbit differs but slightly from that of the Earth. But when we come to consider the eccentricity of its orbit, we find a decided difference between the Earth and Mars. The Earth's orbit is so nearly a circle that its greatest and least distances from the sun differ by only 3,000,000 miles, while the orbit of Mars is so eccentric that that planet is 26,000,000 miles nearer to the sun at one extremity of its orbit than at the other. It follows that, while Mars receives, upon the whole, less than half as much light and heat from the sun as the Earth gets, yet that quantity is variable to the extent of about one third of its greatest value—in other words, the sun gives Mars half as much again heat at its perihelion as it does at its aphelion. It is hardly necessary to point out the important climatic effect of such a variation. Another remarkable resemblance between the Earth and Mars comes in here. Just as on the Earth, the summer of the northern hemisphere of Mars occurs when the planet is farthest from the sun and its winter when nearest. The effect, as Mr. Proctor has pointed out, tends to equalize the temperature of the seasons in Mars's northern hemisphere, but to exaggerate their difference in the southern hemisphere.

We may dwell for a moment upon this last-stated peculiarity, for it is exceedingly interesting in its suggestiveness. Having summer occurring in the southern hemisphere of Mars at the planet's perihelion, and winter at its aphelion, we should find there a most remarkable disparity both in temperature and in the brilliancy of daylight between the two seasons. The difference would be the sum of the effects produced by the greater or less distance of the sun and the variation in the inclination of its rays to the surface of the planet. Since the first cause alone would produce an inequality amounting, in the extreme, nearly to the ratio of 3 to 2, it is evident that the addition of the second would

increase the difference to such an extent that the seasonal changes might be fatal to all higher forms of life. We have only to recollect how powerful the effect of the comparatively moderate variations between the seasons of our own planet is upon the human organism in order to understand what must be the condition of things in the southern hemisphere of Mars, where the passage from one season to the other presents the succession of violent winter cold, accompanied by days of gloom and faint sunshine, followed by a blazing summer, with the sun hanging overhead, visibly increased in apparent size by its approach. Telescopic observations show clearly by the great variation in the extent of the polar snows how extensive is the effect of these changes upon the surface of the planet. In the hot summer the snows rapidly retreat toward the pole, and even leave the actual pole itself bare of snow, showing that upon Mars, as upon the Earth, the center, or pole, of greatest cold (at least in the southern hemisphere) does not coincide with the geographical pole of the planet. Then, with the on-coming of winter, the march of the snows begins and they rapidly advance further and further toward the equator, spreading over the antarctic regions until another change of season brings back a flaming sun to melt them away. It should be added that, as Prof. Young has remarked, the climate of Mars, upon the whole, appears to be much milder than we should naturally have expected in view of its distance from the sun.

Bearing in mind these general facts about the size of Mars and its position in the solar system, we shall now proceed to the discussion of its surface phenomena as revealed by the telescope, merely pausing to remark that the atmosphere of Mars is apparently less dense than that of the Earth, and that the spectroscope has demonstrated the presence of watery vapor in it.

The little telescope of Galileo, which had enabled him to discover the phases of Venus, the satellites of Jupiter, the mountains of the moon, the existence of Saturn's ring, and "vast crowds of stars" in the Milky Way, was not powerful enough to show him the markings that diversified the disk of Mars. The earliest drawings of Mars that have come down to us were made by Fontana, in Italy, in 1636 and 1638. They contain very little detail, the best representing the planet simply with a darkish spot in the center of the disk. Twenty odd years later Huygens made much better drawings, and then the work was taken up by Cassini, Maraldi, and others, with the cumbersome telescopes of the time, the most powerful of which consisted of an object-glass suspended high in the air by means of a long pole or other support, while the eye-piece in the hand of the observer on the ground was, with infinite difficulty, brought and kept in line with the optical axis of the instrument. One of these telescopes was no less than three

hundred feet in length, the great length being necessary in order to avoid, as far as possible, the chromatic aberration of the single lenses of which object-glasses were then made! Considering the enormous difficulties under which they labored, the results attained by these early observers are astonishing. The delineations of the planet's surface made by Huygens and Hooke were sufficiently exact to be used by modern astronomers in ascertaining the rotation period of the planet within a fraction of a second, while Cassini's observations enabled him to calculate that period with an error of less than three minutes. In fact, Huygens saw enough to suggest to his penetrating mind the existence of an analogy between the surface of Mars and that of the Earth.

In 1666 Cassini made a drawing of Mars, which is reproduced in our cut, showing in rough outline a feature of the planet's surface which has since become well known under the names of Kaiser Sea and the Hour-glass Sea, the last being suggested by its shape. Directly underneath Cassini's drawing I have placed, for the purpose of comparison, a picture of Mars made by Herschel in 1780, and showing the same sea, but with much more detail. Allowing for the difference in the position of the disk (for the two drawings were plainly not made at precisely the same period of the planet's rotation, nor at the same inclination), and also considering the great superiority of Herschel's telescope, the resemblance is sufficiently striking to show that the two observers were looking at the same feature of the planet, and that it was a permanent marking on the disk. The south polar ice-cap is conspicuous in Cassini's drawing.

A word, by the way, in regard to the "seas" and "ice-caps" of Mars. The general color of the planet is ruddy, some observers say rose-color, and this hue is plain in naked-eye observations. But the telescope shows that the disk, instead of being uniformly red, although that tint predominates, is divided into streaks and patches of varying hue. The reddish regions are regarded as being the land-surfaces of the planet, while the dusky or greenish parts are looked upon as probably oceans or seas. At the poles there are seen white caps which, inasmuch as they increase in size when it is winter and decrease when it is summer in their respective hemispheres, are regarded as the arctic and antarctic snow regions of Mars.

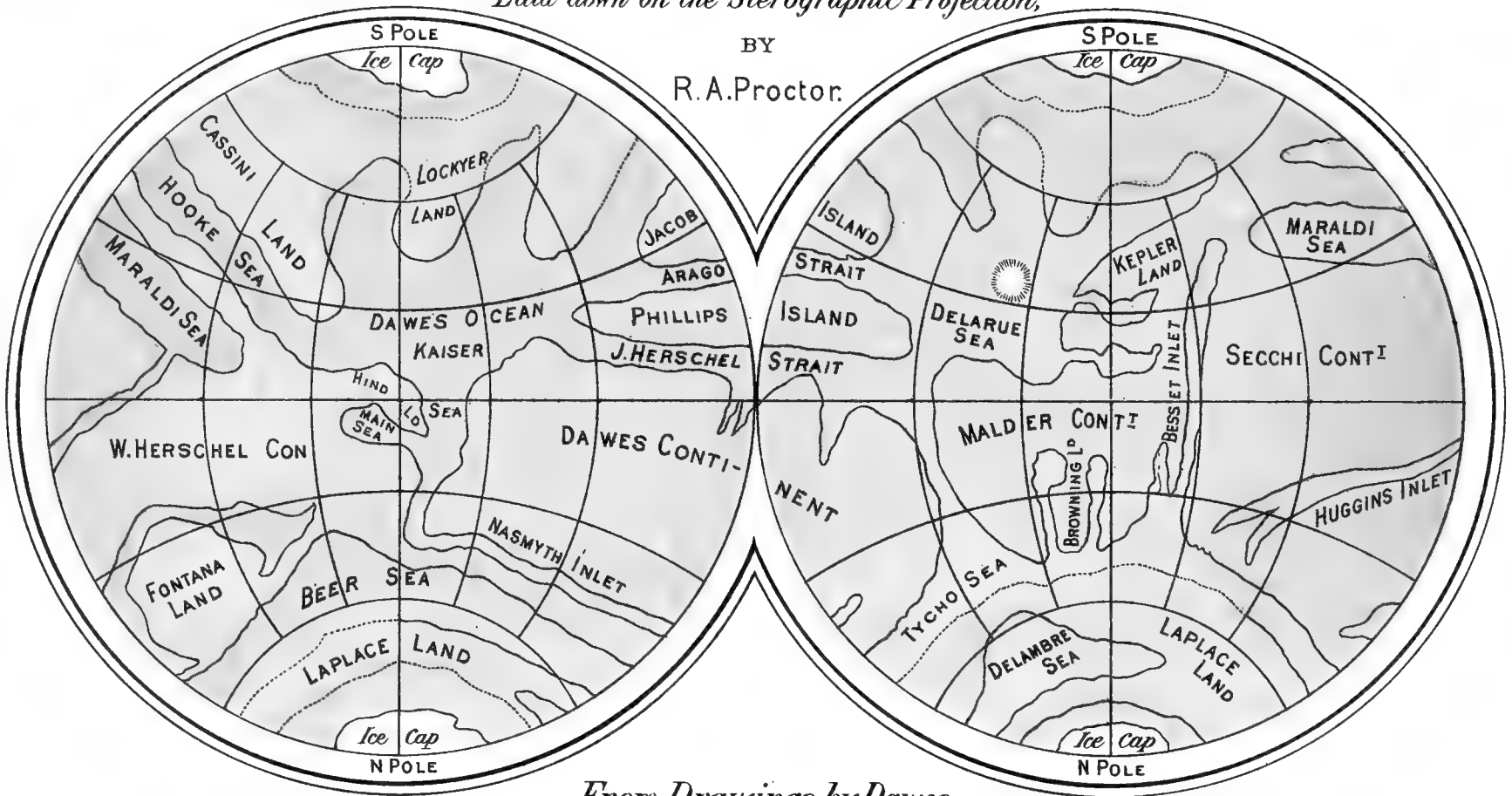
From the time of Herschel the study of the surface markings of Mars was prosecuted by many observers with more or less success, and Beer and Mädler, those indefatigable portrayers of celestial scenery, made a chart of Mars; but it was not until some twenty years ago that a reasonably full and satisfactory map of the red planet was produced. Then Mr. Proctor, using the drawings of the "eagle-eyed" Dawes as the basis of his work, con-

A CHART OF MARS,

Laid down on the Sterographic Projection,

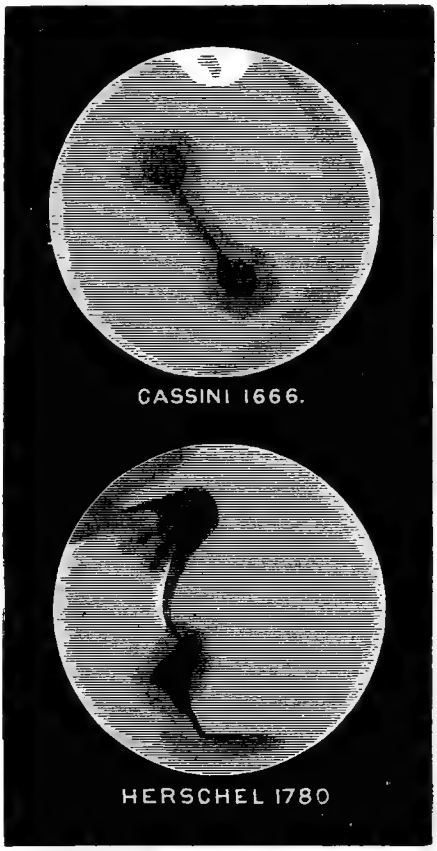
BY

R. A. Proctor.



From Drawings by Dawes.

structed a chart of Mars, which was published in his most famous book, "Other Worlds than Ours," and which is reproduced with this article. The most hasty comparison of this chart with the drawings of Cassini and Herschel shows that an enormous advance had been made since the time of the latter, incomparably greater, in fact, than had been accomplished in the hundred and more years that elapsed between Cassini and Herschel. Yet if we should place any single one of Dawes's drawings side by side with those of the old observers, the difference would not appear by any means so striking, for, the reader must recollect, Mr. Proctor's chart was constructed by inspecting and comparing twenty-seven of Dawes's sketches, representing the planet at different periods of its rotation, so that all sides of it were successively viewed in the best position for observation. If we had an equally numerous series of Cassini's, or preferably of Herschel's sketches, made in a similar manner, we should probably be able to construct from them a chart which, while it certainly would be greatly inferior to Proctor's in its details, would nevertheless make it clear that the earlier observers saw many of the principal markings that are shown in the more modern map.



OLD DRAWINGS OF MARS.

Still more detailed charts of Mars followed that of Mr. Proctor, notably those of M. Flammarion, and Mr. Green, the latter being a very beautiful work based upon a series of splendid drawings made by Mr. Green in the island of Madeira. But no very considerable advance was made in areography, as the geography of Mars has been called, until Signor Schiaparelli published the results of his surprising observations made during the very favorable opposition of Mars in 1877. Although Schiaparelli has repeated these observations again and again, and they have been confirmed, in part at least, by several able observers, there is a disposition in some quarters to cast doubt upon them, and to ascribe them to the effects of optical illusion or some other hallucination. Considering the wonderful character of these observations, and the immense advance that they constitute in the study of the surface of Mars, there is, perhaps, the shadow of an excuse for some incredulity about them. Yet I think the reader will be

convinced, after inspecting Schiaparelli's map, and hearing the story of what he has seen, that to throw discredit upon the substantial accuracy of his observations, marvelous though they may appear, is to do serious injustice to the great Italian astronomer.

And, now, what is it that Schiaparelli has seen on Mars? Many readers will probably at once answer "canals," for the fame of "Schiaparelli's canals" has become wide-spread, and that very word has, perhaps, done as much as anything to foster incredulity in regard to these discoveries. It is true that Schiaparelli himself suggested the name canals to describe the strange lines that he found traversing the continents of Mars, and forming, as it were, a network of intercommunication between its seas; but, at the same time, he indicated that that name was simply to be taken, for lack of a better, as descriptive of their general appearance, and not as implying that they were canals in our sense of the word. Of course, the term was at once restricted, in popular acceptation, to its terrestrial sense, and there have not been wanting speculations about the engineers who constructed those wonderful canals on Mars! Mr. Proctor rather helped on this fanciful interpretation of Schiaparelli's discovery by throwing out the suggestion that, owing to the slight force of gravity on Mars, we should not be too hasty in setting limits to the engineering achievements of the giants who might dwell upon that planet!

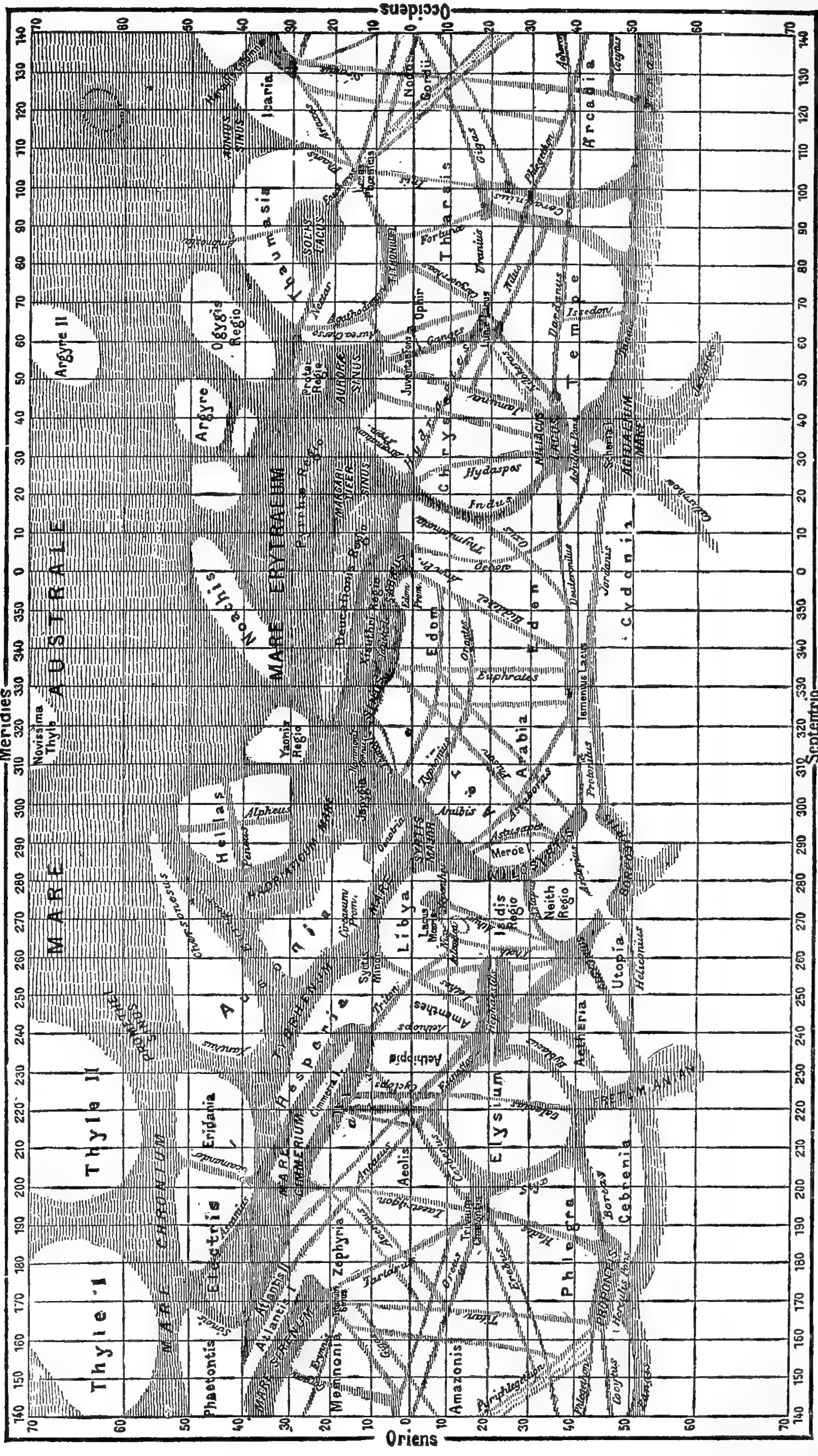
But, setting aside the manifestly false analogy which would make of Schiaparelli's "canals" actual artificial water-courses, we shall find that the real facts are not the less wonderful and suggestive of interesting reflections. Schiaparelli's first observations of these singular objects were made, as I have already said, during the opposition of Mars in 1877. It will be remembered that it was at that very same opposition that Prof. Hall, using the great Washington telescope, at that time the most powerful refractor in the world, discovered the moons of Mars. Yet Prof. Hall saw nothing wonderful or very unusual on the disk of the planet; and Schiaparelli, on the other hand, failed to discover the little moons. Hall's discovery was made in August; Schiaparelli's began in September. All this is very singular; but it seems still more strange that, while the moons of Mars, having once been discovered, were afterward seen with comparatively small telescopes, the canals have never been seen with the great glass at Washington, and that only three or four observers besides Schiaparelli have ever seen them. In the last annual report of the Naval Observatory for the year ending June, 1888, it is stated that the great telescope had been in constant use, under the charge of Prof. Hall, and that the surfaces of both Saturn and Mars were constantly and carefully examined, and drawings made from time to time. In the case of the latter planet the

canals of Prof. Schiaparelli, though specially looked for, both during and after the opposition, could not be made out. At the very same time the canals were visible not only to Schiaparelli, but to Perrotin and Terby, and, as we shall see further on, some very remarkable phenomena connected with them were observed. At the Lick Observatory, too, they saw the canals, though they did not perceive all the details and peculiarities noted by Schiaparelli and Perrotin. How shall we account for these remarkable discrepancies? I do not for a moment think that they shake the substantial accuracy of the Italian observations. No doubt a clew to the explanation is furnished by what Schiaparelli has recently said of the difficulty of seeing the objects he has described: "On the rare days when these extremely difficult observations are possible, the period of good telescopic images does not last, ordinarily, more than two or three hours during the twilight, or the commencement of night. . . . I have found by experience, at Milan, that one can hardly hope to have an atmosphere sufficiently good during more than eight or ten evenings (during an opposition); sometimes even entire months pass without one's being able to make a satisfactory observation. Much rarer still are evenings of perfect images, those in which one can employ the whole power of an instrument like our Merz equatorial of eighteen inches."

And this is said of the Italian sky, which has long been famous for the steady views that it gives of the heavenly bodies. What could be expected, then, of the mist-haunted atmosphere of the Potomac flats through which the watchers at our Naval Observatory must strain their vision? At Mount Hamilton they have atmospheric conditions that rival those of Italy, and therefore it was to be foreseen that they could hardly fail to confirm the existence of Schiaparelli's strange markings.

It should be said, before proceeding, that while the great majority of the canals have been seen only by Schiaparelli himself and a few other observers, there are two or three which had been recognized, though not under their present designation, and perhaps not in their complete extent, before the Italian astronomer made his discovery. Notable among these is the narrow arm running out of the Kaiser Sea, or Syrtis Magna, as Schiaparelli names it, and which he calls the Nilosyrtis. Herschel, and even earlier observers, seem to have noticed this.

But the detection of the dark lines called canals was only the beginning of Schiaparelli's singular discoveries. The next development in this remarkable series of observations was the *doubling* of the canals. Those that he saw in 1877 were simple lines, or narrow bands, and, strange as their appearance was, the liveliest imagination could hardly have prefigured their aspect at subse-



SCHIAPARELLI'S MAP OF MARS.

quent oppositions. In 1879 Schiaparelli noticed that the canal which he calls *Nilus* (see his map) was double, or consisted of two streaks running side by side, and perfectly parallel. This observation was made shortly after the time of the vernal equinox on Mars.

"These two regular, equal, and parallel lines," he says, "I confess profoundly surprised me, all the more because a few days before, the 23d and 24th of December, I had carefully examined that same region without discovering anything of the kind. I awaited with curiosity the return of the planet in 1881 in order to see if an analogous phenomenon would present itself in the same place, and I saw the same thing reappear on the 11th of January, 1882, one month after the vernal equinox of the planet, which had occurred on the 8th of December, 1881. The duplication was still plainer at the end of February. At this same date, the 11th of January, another duplication had already been produced, that of the middle section of the canal of the *Cyclops* at the edge of *Elysium* (see map). Greater still was my astonishment when, on the 19th of January, I saw the canal *Jamuna*, which was then in the center of the disk, composed very plainly of two parallel straight lines traversing the space which separates the *Niliacus Lacus* from the *Aurorœ Sinus*. At first I thought it was an illusion caused by fatigue of the eye and by some new kind of strabismus; but there was no resisting the evidence. From the 19th of January I simply went from surprise to surprise; the *Orontes*, the *Euphrates*, the *Phison*, the *Ganges*, and most of the other canals showed themselves very clearly, and indubitably divided in two."

It is not a matter for surprise that this announcement of Schiaparelli's, coming upon the heels of his original discovery of the canals as single lines, which in itself was sufficiently remarkable, caused still greater doubt to be entertained of the correctness of his observations. It seemed to many easier to believe that a distinguished astronomer and practiced telescopist had been misled by some deception of the eyes, some optical trick of his instrument or of the atmosphere, than that the globe of Mars was covered, over the larger part of its surface, with a network of lines, apparently connected with the water-system of the planet, and that, at certain times, these lines, canals, or water-courses, or whatever they might be, were doubled up throughout their whole extent. Even the positive assurance of the celebrated astronomer, "I am absolutely certain of what I have observed," could not banish all doubt. The manner in which the doubling of the canals was brought about seemed most mysterious, and added to the apparently dubious character of the whole occurrence. Schiaparelli declared that sometimes he was able to perceive precur-

sory symptoms of the change. A light, hardly visible shade would make its appearance, extended alongside one of the canals. In a few days only a series of whitish spots would appear there. A day or two later the perfect double of the canal would be seen with absolute distinctness lying beside the original, exactly parallel with it, and of equal length, breadth, and depth of color.

"One can," says Schiaparelli, "compare this process of formation to the appearance that would be presented by a multitude of soldiers dispersed without order who, little by little, should arrange themselves in ranks or in columns; so that we are here dealing with formations unknown on the earth, determined by the geographical configuration of the ground, and capable of reproducing themselves periodically in the same places and under the same aspects."

These canals (we must continue to call them by that name for lack of a better) vary in length from a few hundred miles to two or three thousand, while their width is seventy-five or eighty miles. When they become double, the distance between the twin canals is from two hundred and fifty to five hundred miles.

The Italian astronomer's later observations have again and again confirmed the results of his earlier ones. During the oppositions of 1883–'84, 1886, and 1888, under somewhat varying conditions, and with different degrees of visibility, yet always unmistakably, he has seen not only the canals, but the strange phenomenon of their doubling or gemination. The character of the appearances has been always the same, but in details they have differed.

Let the reader compare Schiaparelli's map with the chart of Mr. Proctor, and he can not fail to be impressed by the enormous advance in the matter of minute detail exhibited by the former. Apparently more has been learned about the surface of Mars during the past twelve years than was learned in the previous two hundred years, and the greater part of this gain is the work of a single observer.

While it is more or less idle to speculate on the nature of these singular objects appearing on a globe that never approaches the earth nearer than about forty millions of miles, and that ordinarily is very much farther away, yet it is impossible to avoid indulging a natural curiosity to know what they are. It is known that all the features of Mars's globe are more or less changeable, though upon the whole they preserve the same general aspect, and Schiaparelli declares that in the case of the canals the changes are not only extensive but periodical. It has generally been believed that the variations of appearance in the larger features of the disk were owing principally to atmospheric causes. Large regions of the planet have, at times, been seen

apparently hidden under a veil, the gradual withdrawal of which has again revealed their well-known contours, and in such cases the conclusion has seemed irresistible that what had been observed was the formation and subsequent dissipation of vast cloud areas concealing or obscuring the outlines of continents and seas beneath them. So the indistinctness near the edges of the disk and the altered appearance of the planetary features there have been partially ascribed to atmospheric influences as well as to the effects of perspective. Whether the observed changes in the appearance of the canals can be ascribed to similar causes is a question which can not yet be solved. Schiaparelli appears to think that they are principally due to something which occurs on the surface of the planet itself, and which something, in its turn, depends upon the changes of the seasons.

In order to form any opinion whatever upon this question it is necessary to examine a little more closely the varying aspects of the canals. Their discoverer has noted these four points:

1. A canal may remain *invisible* for a longer or shorter time. This invisibility, he insists, is an actual disappearance of the canal, and is not due simply to unfavorable circumstances of observation. Moreover, he finds here a striking appearance of connection with the seasons. The epoch most favorable for the disappearance of the canals is near the time of the southern solstice of Mars, which, as we have seen, occurs when the planet is nearest to the sun.

2. In many cases, according to Schiaparelli, the presence of a canal begins to manifest itself to the eye in a very vague and uncertain manner, by a slight shading which irregularly extends itself in the direction of its length. This phenomenon is so delicate that, he says, it marks, as it were, the limit between visibility and invisibility.

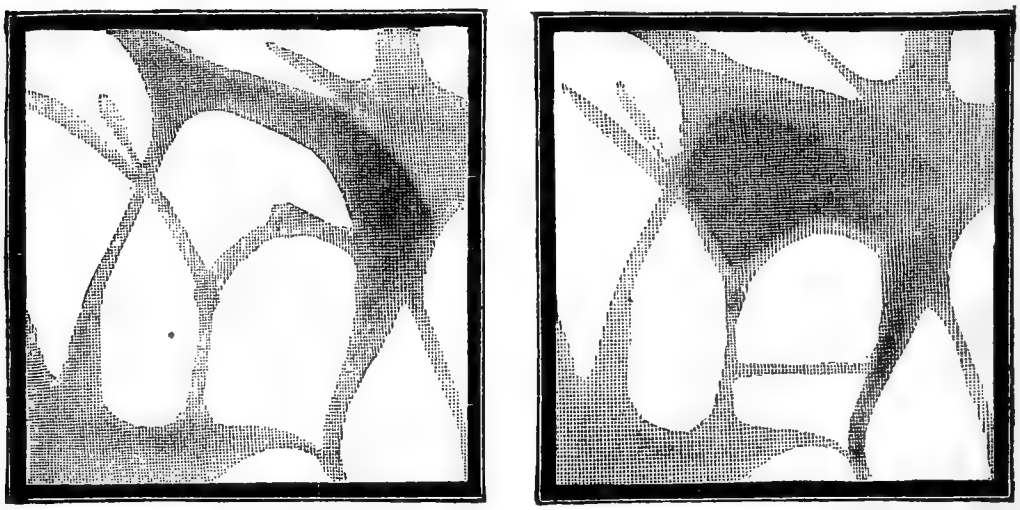
3. Very often the canals present the appearance of a gray band fading out on each side and having the deepest shade in the middle, which may be dark enough to suggest the appearance of a more or less clearly marked line. Sometimes, but rarely, one side of the band alone is nebulous or indistinct, the other being clearly defined. Various other anomalous appearances have been observed.

4. The most perfect type of the canals, and that which their discoverer says he regards as the expression of their normal condition, "is a dark line, sometimes quite black and well defined, looking as if it had been traced with a pen on the yellow surface of the planet." When the canals appear in this form they are very uniform throughout their length, and Schiaparelli says, on the rare occasions when he has been able to clearly distinguish the two edges, one from the other, he has discerned slight sinuosities or scallopings on the borders. He adds that the width of a canal may change with time from a thread, barely perceptible in the

best atmospheric conditions, to a broad black band visible at the first glance.

To all these characteristics must be added, of course, the extraordinary occurrence of the gemination or doubling of the canals. It is natural to suppose that, in such cases, what would be seen would be the apparition of a new canal along side of an old one. That, in fact, is what Schiaparelli described as occurring during his earlier observations; but, during the opposition just passed (1888), he discovered that this was not a general rule, and that it may happen that neither of the new canals, when a doubling takes place, may coincide with the old one. "The identity," he adds, "in the general direction and situation is then merely approximative; every trace of the former canal disappears, giving place to two new lines." Both the width and the distance apart of the twin canals vary in successive seasons.

It would carry us far beyond the limits of space available for this article to enter into a more minute account of Schiaparelli's observation of the many anomalies and changes of appearance which the canals present at different seasons and under varying circumstances. Enough has been said to indicate that it would be impossible to make a map which should show the precise appearance of the surface of Mars at any fixed period, and at the same time contain a representation of all the phenomena which are, from time to time, to be seen there. And it should be said, because this is a matter that has been misunderstood, that Schia-



Ordinary Appearance. Appearance in April, 1888.

CHANGES IN THE ASPECT OF LIBYA.

parelli does not intend his maps to be taken as portraitures of the planet, but simply as sketches showing details of whose existence there is no doubt whatever, but all of which can not be, or have not been, seen simultaneously.

And now there remain yet other remarkable circumstances to be mentioned in order to complete the picture of the surface of Mars,

and some of these may have an important bearing upon the question of the nature of the canals. A glance at Schiaparelli's map shows us the disk of the planet divided into areas of land and water, which are about equal in their total extent. Then crossing the land areas in every direction are the canals, which it will be observed always begin and end either at the edge of a sea, or at a point of junction with other canals. Without varying their direction they cross one another, and in some cases several canals radiate from a single center, which then generally appears expanded into a "lake." In addition there are certain regions which Schiaparelli describes as variable in appearance, or intermediate between the seas and the lands, presenting sometimes the character of maritime surfaces and at other times that of continental areas. Among these are the places marked on the map *Deucalionis Regio*, *Hellas*, and the island called *Cimmeria*. The region named *Libya*, which ordinarily appears as a continental expanse, seems to belong to this class of variable areas, and within the past year it has obtained great celebrity because it was said to have been submerged by an inundation from the adjoining sea. This region is more than 200,000 square miles in area, and lies just under the equator. In May last M. Perrotin, of the Nice Observatory, made the somewhat startling announcement that the continent of *Libya* had disappeared. "Clearly visible two years ago," said M. Perrotin, in his report to the Paris Academy of Sciences, "to-day it no longer exists. The neighboring sea, if sea it is, has completely invaded it. In place of the light reddish tint of the continents of Mars the black, or rather dark-blue, color of the seas has appeared there. . . . In sweeping over the continent the sea has abandoned on the south the region that it formerly occupied, and which now appears with a tint intermediate between that of the continents and that of the seas, a light-blue color, analogous to that of a slightly misty sky in winter."

A look at the accompanying cut will show the change which Perrotin detected. This extraordinary aspect of Libya was first seen in April and lasted into May. In June the "continent" seems to have resumed, or nearly so, its ordinary appearance. Perrotin's suggestion that the change observed was probably periodic appears to be borne out by an examination of former observations of this region of the planet. There was a partial "inundation" of Libya in 1882, and a still more extensive one in 1884, both of which were noted by Schiaparelli, who confirms Perrotin's observation of 1888 in a general way, but does not describe the continent as having at any time completely disappeared. Speaking of its appearance in 1884, Schiaparelli says Libya had a flaky look, as if it had been "covered with innumerable little spots all jumbled together." The suggestion of clouds contained in this

description is very striking, yet Schiaparelli does not pursue the analogy.

All of the regions which possess this semi-maritime character frequently present a lighter color when viewed obliquely, or near the edge of the planet's disk, than when seen near the meridian. This fact seems strongly to suggest the presence of atmospheric phenomena, which may change or modify the appearance of any district covered by them according to the visual angle under which it is observed. The reader has only to take an ordinary terrestrial globe, and, supposing it to represent Mars, turn it slowly around its axis, in order to perceive how the situation of any region with respect to the center or the edges of the disk may influence its appearance. Near the edge the surface of the planet must necessarily be seen through a far greater depth or thickness of its atmosphere than in the center of the disk, and, if that atmosphere contained clouds or mist, of course its opacity would be greater in proportion to its greater depth, and the reflection of light from the mist would give a whiter tone to the features of the planet seen through it. Nevertheless, the cloud theory fails to account satisfactorily for all the appearances that have been so carefully described by Perrotin and Schiaparelli. Yet if it were possible for us to imagine that masses of clouds of some sort could retain, for considerable periods, a fixed or nearly fixed general form and position in the planet's atmosphere, disappearing and reappearing in the same localities according to the seasons, and occasionally extending their outlines or slightly shifting their positions, then we might be able to account for such phenomena as those presented by Libya, without recourse to such violent, extensive, and rapid geological changes as would seem to be necessary to produce alternate inundations and emergences of large areas of land.

As to the nature of the canals, it is still more difficult to suggest any satisfactory explanation. Several hypotheses have been presented, none of which appears entirely to meet the case. I have already remarked that there has not been lacking the suggestion that these curious streaks represent the lines of actual artificial water-courses on Mars. The straight and undeviating course which they pursue might be regarded as lending some degree of probability to such a view, but the enormous scale on which they exist seems to compel the rejection of the hypothesis. It is true that, if we consider only the influence of the force of gravity on Mars, giants could dwell upon that planet whose mechanical achievements might vastly surpass the greatest performances of our engineers; for a body weighing a ton on the earth would weigh only seven hundred and sixty pounds on Mars, and on the other hand a man on Mars possessing relatively the same activity as one of us might be fifteen feet tall and strong in propor-

tion. But even granting the existence of such a race of Goliaths on our neighbor world, it is not conceivable that they could have constructed a system of tremendous canals over half the surface of their planet, or that they would have done it if they could. The canals of Mars are enormously disproportioned in magnitude to the most gigantic inhabitants that a due regard for the law of gravitation would suffer us to imagine there.

An ingenious Frenchman has considerately and considerably diminished the difficulty for the inhabitants of Mars by the suggestion that the continents of that planet are so slightly elevated above the level of its seas that frequent and periodical inundations occur over large areas, thus forming temporary channels of communication between the seas which leave only the more elevated points above water to serve as places of refuge for the non-aquatic inhabitants. According to the theory, these inhabitants, possessing a horse sense comparable to that of the descendants of Noah, have, in the course of ages, improved and strengthened their natural places of refuge in times of flood, by excavating the ground from the low lands periodically invaded by the sea, and piling it up on the higher places, thus producing lines of partly artificial hills geometrically placed, and with talus-like flanks.

It will be observed that these attempts at explanation make no reference to the duplication of the canals. Mr. Proctor, always fertile in ingenious theories, undertook to include this strange transformation in an explanation of the canals which he suggested; namely, that they are great rivers, over and along which, in certain seasons, vast fog-banks are formed, or which, perhaps, being frozen in winter, remain covered with snow and ice in spring until the snow is melted along their banks, so that by a phenomenon of diffraction the image of the rivers appears to us as a light line between two dark ones.

M. Fizeau has put forth a theory according to which the canals of Mars are simply glacial productions, enormous crevasses and clefts in the ice covering the planet, like those seen on a smaller scale in our glaciers. But this theory, of course, would imply that Mars is now undergoing the effects of a glacial epoch, involving even the equatorial regions of the planet, while, as a matter of fact, the surface of Mars appears not to suffer from any extreme degree of cold. Attention has also been called to a fancied resemblance between the rectilineal canal system of Mars and the systems of rays seen on the moon, especially that which has its center at the crater Tycho, and which, under certain illuminations, is one of the most conspicuous features of the lunar surface.

In fact, it may be said, in a double sense, that there is no end of speculations on this curious subject. But nothing has yet been proposed that covers all the appearances presented, and even a

combination of atmospheric and geological activities seems insufficient to explain everything. It is possible that some deception of the eye may enter to a minor degree into the observations that have been so carefully described by Schiaparelli and others, but I can not believe that that excellent observer has been mistaken as to the main facts.

Mars is a world having an atmosphere as the Earth has, and possessing a diversified surface, upon which great operations of Nature are taking place under our eyes; and, while it may be idle for us to speculate as to whether those operations involve the weal or woe of a race of intelligent beings dwelling in the midst of them, yet the mind of man will never be satisfied to let such questions as these alone. If he can plant his foot upon one globe only, at least his thoughts can and will range among a million.

BEGINNINGS IN SCIENCE AT MUGBY SCHOOL.*

By Dr. J. E. TAYLOR, F. R. S.

JACK HAMPSON was a capital sample of the best traditions of Mugby School. A lad of fourteen, with well-knit limbs, brave, honest-looking, bluish-gray eyes, a good cricketer and swimmer, and not bad at a high jump. He could no more do a mean thing than he could tell a lie; and he could give or take a thrashing if absolutely necessary, although he would be in no hurry for either.

Mugby School has kept the lead in modern educational progress which a former distinguished master introduced many years ago. That master was not content that boys should learn Latin and Greek. He was more anxious they should learn to be Christian gentlemen; to fear and eschew an untruth as they would poison; to be brave and yet gentle; tender toward the weak, not defiant even to the strong. The boys at Mugby School were well acquainted with the lives of the best men of all ages and of all nations, as well as with the most stirring deeds of valor, self-denial, and manly bravery. The noblest thoughts of the wisest men were drawn freely upon for their benefit.

Much of this "new education" was thought an innovation at first; but never before were English lads turned out of school in such high-toned, manly form, or so well able to hold their own at the universities, or in the bigger world outside.

As may be imagined, the wonders of science had not been ignored in such a school. One can hardly believe that modern science is almost included within the present century. All before

* From advance-sheets of "The Playtime Naturalist," in press of D. Appleton & Co.

then, except astronomy, was more or less speculation. Nobody would call Linnæus's system of botany a science, although it was very useful and introductory; nor was geology, zoölogy, nor chemistry. Scientists had only been playing, like children, in the vestibule of the great temple. It may be that we ourselves have not advanced far within the precincts—at least those who study these subjects a hundred years hence may think so. But, at any rate, the amount of knowledge extant concerning the world in which we live, and its ancient and modern inhabitants, is vast compared with what it was when the present century commenced.

At Mugby School, science was an important and also a welcome subject. How welcome it was is best indicated by the fact that the boys got up a Natural History Society among themselves. This was really a self-imposed task, done out of school-hours. Some of the principal teachers encouraged the lads by becoming members; not that they knew much of natural history or scientific subjects (some of them, indeed, knew nothing at all, and actually learned a good deal from the boys themselves).

Of course, the society was founded on the best models. It was not a bit behind the famous "Royal Society of London" in its equipment. It had its president and vice-president, and its committee were called "the council." It also published, for the world's benefit, abstracts of the short papers the boys read—the abstracts being nearly as long as the papers. Although its members were not numerous, they felt they bore the weight of the dignity of the society on their shoulders; and, as they were too boyishmanly to be priggish, the training did them no harm.

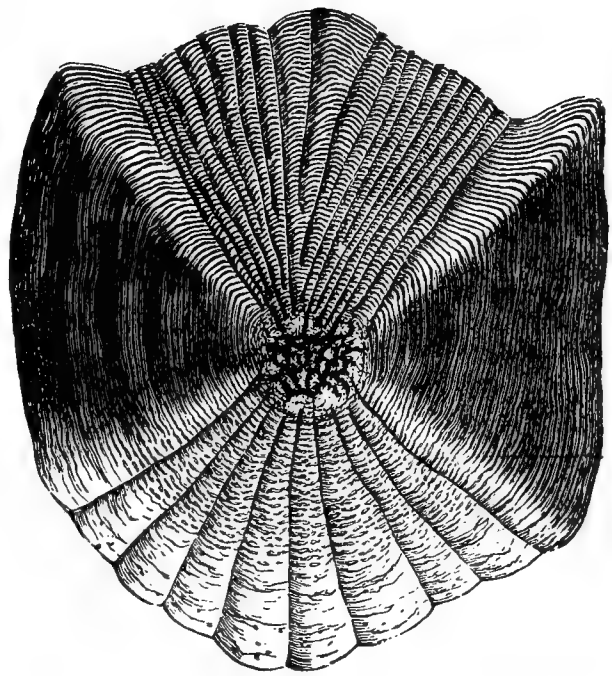


Fig. 1.—Scale of Chub.

Well, the society was divided into sections. One section was appointed to collect the plants of the neighborhood—that is, those obtainable during the school half-holidays; another to collect butterflies and moths; a third, beetles; a fourth, birds; a fifth, fossils, etc. They were to publish lists of the plants, birds, insects, and fossils of the district in the "Society's Proceedings"; for, of course, the latter was the name given to the abstracted papers.

The society had only been founded the year before Jack Hampson was sent to Mugby School; so it was in the first zeal and freshness of its youth. Jack didn't like science—it was nothing but a lot of hard, jaw-breaking names, he said, and what was the good of them? He and others had enough of hard words in their daily Latin and Greek tasks. Jack rather snubbed the fellows who volunteered to learn more hard words than were required—he couldn't understand it. What was the good of calling a buttercup *Ranunculus*, and a white stone *quartz?* It was all sham and show!

Now, Jack was a born hunter. He was ardently fond of fishing, and not a bad shot, considering he had been mistrusted, instead of trusted, with a gun. I dare say his skill with the latter would have astonished his father; and I have no doubt a good many ounces of 'bacca found their way into the keeper's pocket before he became so creditable a shot.

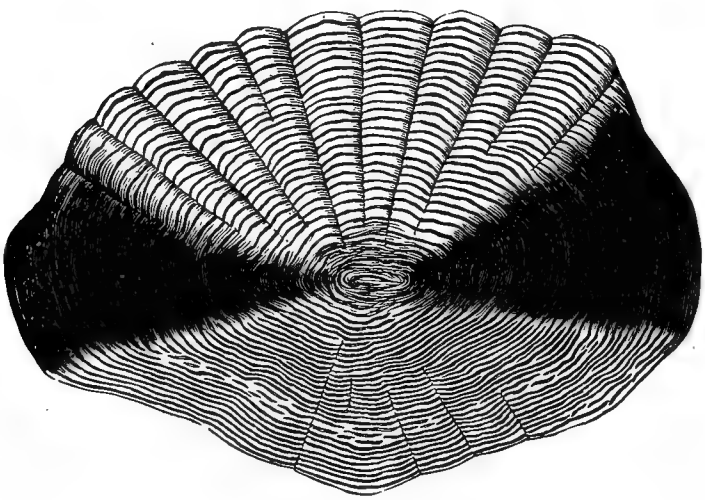


FIG. 2.—SCALE OF BLEAK.

But there was not much fishing about Mugby; or, rather, they were such little things that Jack felt ashamed of pulling them out, and so he slipped them in again, although they never seemed to grow any bigger. This was a wise act on their part, if they had only known the unconscious chivalry of Jack's nature, which hated

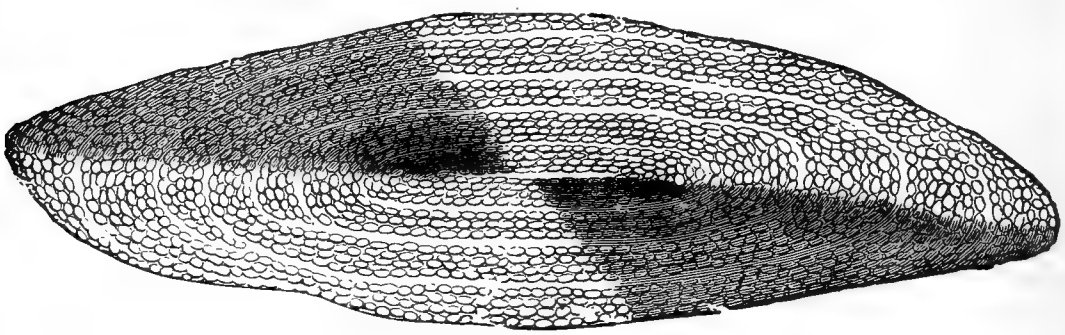


FIG. 3.—SCALE OF EEL.

taking advantage of a weak thing. Then as to shooting—first, he hadn't a gun, and, if he had possessed one, the rules of the school would have precluded his using it. Next, what was there to shoot? The small birds in the hedges? Any cad could do that! Sneak

after the poor beggars behind hedges, and then bang at a robin, a wren, a yellow-hammer, or a tit, and perhaps blow it to pieces! That was not good enough. Partridge and pheasant shooting, Jack thought, are hardly much better sport, only you can eat them.

Of course, there was the excitement of cricket and foot-ball, hare-and-hounds, paper-chases, hurdle-racing, jumping—not only not bad, but altogether good and brave and manly sports. But, somehow, a lad of superior mental abilities wants something else.

Now, the scientist is also a hunter. He traces his descent from Nimrod—he is a hunter before the Lord. He roams through the stellar universe for his prey—hunts for stars, comets, planets. He is not daunted because he did not live on the world when it was young, millions of years ago; for he makes up for it by hunting the remains of the animals and plants that lived during countless

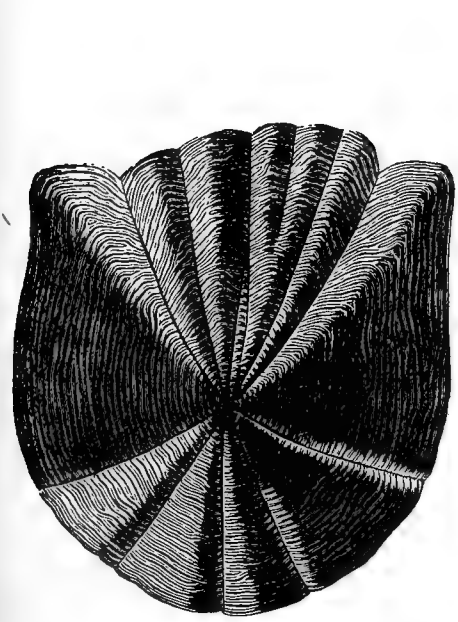


FIG. 4.—SCALE OF ROACH.

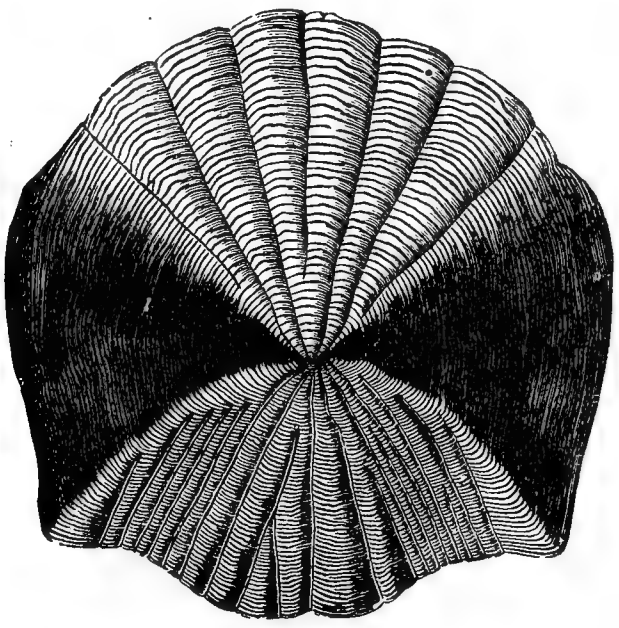


FIG. 5.—SCALE OF DACE.

ages, and which have long been buried in the rocks of the earth's crust as *fossils*. He hunts for flowering plants and animals in all parts of the earth; braves heat and cold, hunger and thirst, wounds and death, in his ardent search for them. The structures of rocks do not escape his mineralogical hunting, nor the composition of any sort of substance, organic or inorganic, his chemical analysis. He hunts down stars thousands of millions of miles away with his telescope, and creatures less than the fifteen-thousandth part of an inch long with his microscope. Was there ever such a great hunter? This hunting instinct began scores of thousands of years ago, when the hairy, naked Palæolithic men hunted extinct hairy elephants and rhinoceroses. It has been de-

veloped until it has assumed the high intellectual pleasure of roaming through God's great creation, and of confirming the ancient writer's conclusion—"Lo, there is no end to it!"

Of all these things Jack Hampson had never heard a word. Perhaps he had occasionally listened to a few joking remarks about Darwin and our "being descended from monkeys" at his father's dinner-table. But his father (who was anything but a wealthy man these hard agricultural times, although he farmed his own estate) had not much time for considering the discoveries of modern science. Their echoes faintly reached him occasionally, but never touched him seriously. Not only were the times bad, but his family was large, and it was not without a stretch that Jack was sent to Mugby School, rather more than twenty miles off. His brother (Jack's uncle) was better off, because he had no family; and the uncle also had more leisure, and, what is more, was really a man of a literary and scientific turn of mind.

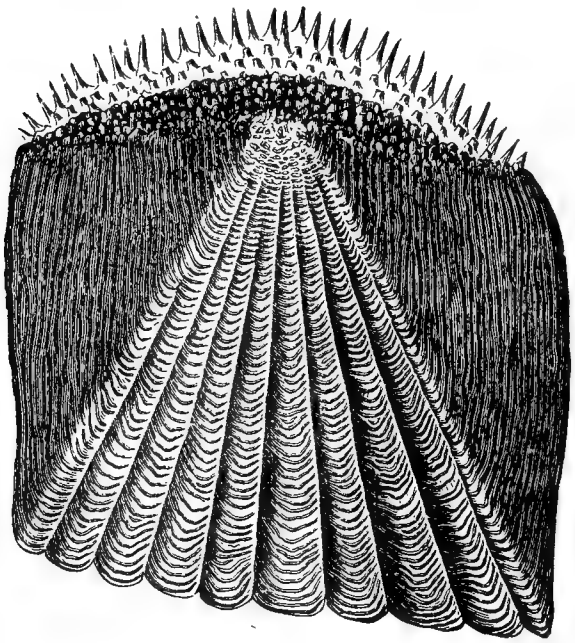


FIG. 6.—SCALE OF GUDGEON.

All school-boys make friends at school. Nobody has ever analyzed the process of friend-making among boys. It is as mysterious as genuine love-making. Friendships—at least, boys' friendships—are also made "at first sight." Live in a public school a few years, and you will find it out. You might just as well tell a boy to make friends with a certain other boy, as order him to make love a few years later with your female selection! And yet what issues of life depend on those boyish friendships made at school! They are often more durable than marriages. They survive success, disaster, and disease. Not unfrequently, they are prolonged to the second and third generation. If there

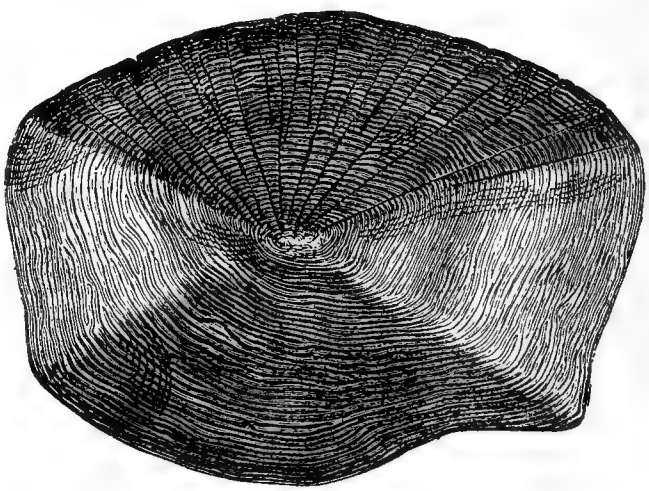


FIG. 7.—SCALE OF BREAM.

is one thing more difficult to explain concerning instincts than another, it is the instinct of boys' friendships.

How Jack Hampson—big-limbed, broad-backed Jack—came to take up, the very day he arrived at Mugby, with little Willie Ransome, I can not tell. There is something in the doctrine of contrasts; doubtless Willie was as great a contrast to Jack as you would have found in the whole school—rather undersized, weakly, but nevertheless a brave and truthful boy. He was fond of books—a trifle too fond, for it would have done him good to have got away from them a little. The chief feature about Willie was his large, bright, inquiring eyes, and his altogether affectionate disposition. He took to Jack at once, and Jack to him. Never before was there a better illustration of "friendship at first sight."

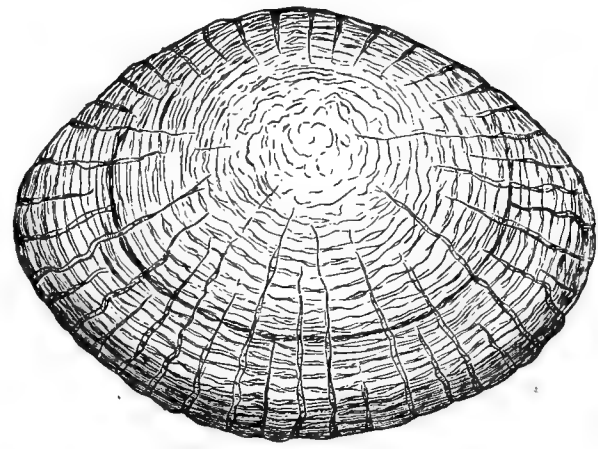


FIG. 8.—SCALE OF LOACH.

It was at the commencement of the spring term that the friends came to Mugby School. Without knowing it, but fortunately for them and for the whole school, a fine, enthusiastic young fellow had been appointed "science teacher." The term sounds vague, but so do all terms if too strictly analyzed. The boys dubbed him "professor," and thereby unconsciously gave him higher rank than his *confrères*, who were only "teachers." It would have been impossible for a young man to have been selected better fitted for such a post. Nothing gets hold of boys sooner than enthusiasm. Boys are naturally enthusiastic. There is no better proof of vitality, even in an old man, than that he continues to be enthusiastic about anything intellectual.

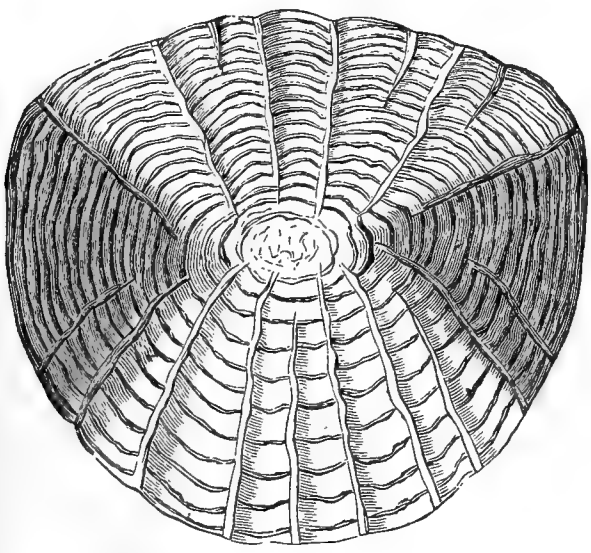


FIG. 9.—SCALE OF MINNOW.

Willie Ransome's father was a village doctor, and it was hoped Willie would some day help his father in his increasingly larger, but not increasingly profitable, rounds. Willie entered the science class the first term. His father was a man of scientific tastes, with

little leisure to indulge them. But he had already inoculated his only son with a love for such subjects. Willie, however, had never before been drawn within the magic circle of enthusiasm for them, and his highly sensitive temperament was fixed by the professor's descriptions and demonstrations immediately. Before the term was half over, he was a member of the society, and doing his best to "collect" for the society's museum.

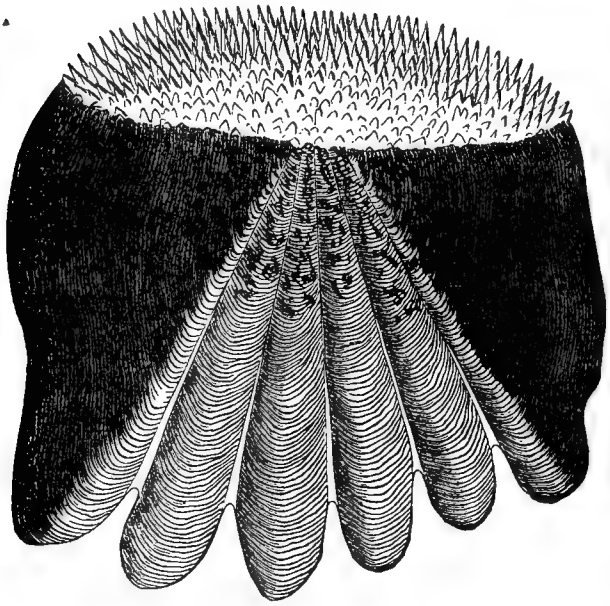


FIG. 10.—SCALE OF PERCH.

Jack had many a hearty laugh over this disposition to hoard up a lot of old stones and things, and give them hard names. More than once he was asked to attend a society's meeting —for each member had the privilege of introducing a friend—but he always shirked it. "No," he said; "they are not my sort."

One wet evening, however, Willie Ransome got Jack to go, just because there was nothing else to do. There was a short paper being read on "Fish-Scales," and a number of them were mounted for microscopical examination, of course with a low power, say inch and half-inch. Anything relating to fish or fishing was certain to gain Jack's attention, therefore a better subject could not have been selected to engage his notice. Besides, Jack had never yet even looked through a microscope! He felt a bit ashamed of this now; but there were a couple of microscopes present, and Jack determined to have a good look through them. The scales of different sorts of British fishes were on view. Of course, fish-scales are common enough; but who would think that each kind

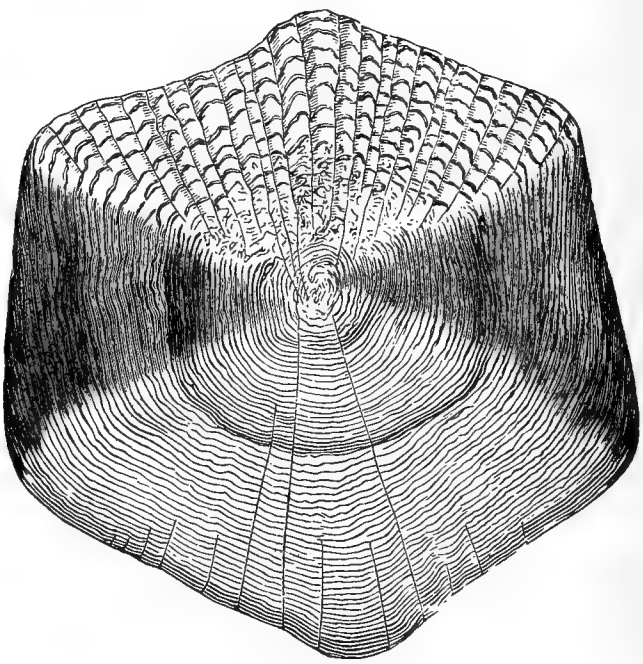


FIG. 11.—SCALE OF COMMON CARP.

has its own pattern of scale, and that you could tell a species of fish by its scales?

The paper showed that the scales of fishes were composed of the same material, *chitine*, as the feathers of birds, or the hair and nails of animals—a kind of substance only found in the animal kingdom, and never in the vegetable; that these scales are developed in little pockets in the fish's skin, which you can plainly see for yourself when a herring is scaled. They are arranged all over the fish's body like the tiles covering a roof, partly overlapping each other, as is seen by one part of the scale being often different from the other.

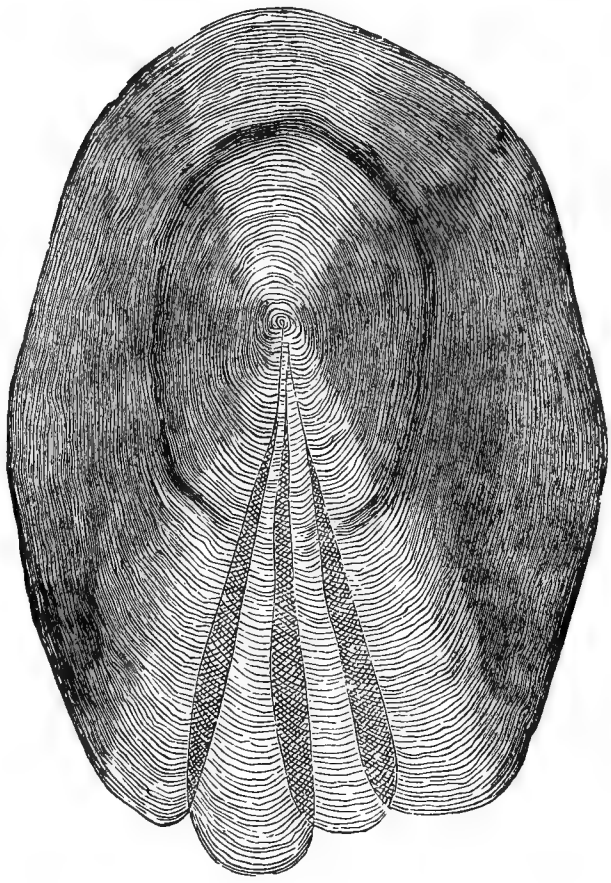


FIG. 12.—SCALE OF PIKE.

Jack looked through the microscope and was delighted. He was always a reverent-minded boy, and the sight broke on his mind like a new revelation. How exquisitely chaste and beautiful were the markings, lines, dots, and other peculiarities! Then the scales which run along the middle line of the fish were shown him, and the ducts perforating them, out of which the mucus flows to anoint the fish's body, and thus reduce the friction of its rapid movement through the water. The lad was half bewildered at the possibility of the new knowledge. "Could anybody get to know about these things?" he asked Willie, who told him of course he could, if he would only take a little trouble.

"But," said his young friend, "I would advise you to get a pocket-magnifier first, and begin to examine with that. Some fellows begin right off with a powerful microscope they get their governors to buy them, and they work it like mad for a month or two, and then get tired of it. Fact is, they never learned the art of observing."

"What do you mean by that?" said Jack.

"Why, getting into the habit of looking about you, keeping your eyes open, and quickly spotting anything unusual. Fancy a fellow beginning to use magnifying glasses of thousands of times

before he has begun to use his own eyes! Use your own eyes first, then get a little extra help in the shape of a shilling pocket-lens, and by and by you will be able to use a real microscope, and enjoy using it too."

This was rather a long lecture for Willie to give, or for Jack to listen to. He wouldn't have listened if it had not been for what he had just seen. He said nothing, but he made up his mind he would get one of these useful shilling magnifiers. Willie usually had a country walk during the school half-holiday, and Jack had often been invited to accompany him; but he didn't care to go "humbugging after grubs and weeds," he said. Now, however, he invited himself, and somewhat surprised his friend by stating he wanted to go with him.

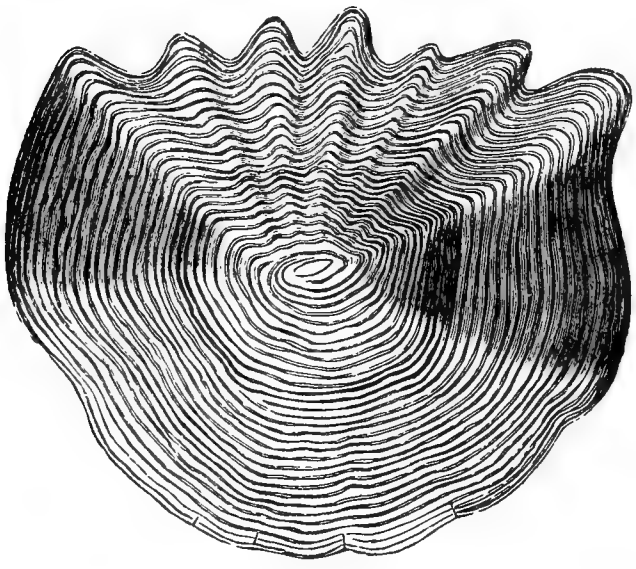


FIG. 13.—SCALE OF GRAYLING.

AGNOSTICISM.

A REPLY TO PROFESSOR HUXLEY.

I.

BY REV. DR. HENRY WACE, PRINCIPAL OF KING'S COLLEGE.

IT would hardly be reasonable to complain of Prof. Huxley's delay in replying to the paper on "Agnosticism" which I read five months ago, when, at the urgent request of an old friend, I reluctantly consented to address the Church Congress at Manchester. I am obliged to him for doing it the honor to bring it to the notice of a wider circle than that to which it was directly addressed; and I fear that, for reasons which have been the occasion of universal regret, he may not have been equal to literary effort. But, at the same time, it is impossible not to notice that a writer is at a great advantage in attacking a fugitive essay a quarter of a year after it was made public. Such a lapse of time ought, indeed, to enable him to apprehend distinctly the argument with which he is dealing; and it might, at least, secure him from any such inaccuracy in quotation as greater haste might excuse. But if either his idiosyncrasy, or his sense of assured superiority, should

lead him to pay no real attention to the argument he is attacking, or should betray him into material misquotation, he may at least be sure that scarcely any of his readers will care to refer to the original paper, or will have the opportunity of doing so. I can scarcely hope that Prof. Huxley's obliging reference to the "Official Report of the Church Congress" will induce many of those who are influenced by his answer to my paper to purchase that interesting volume, though they would be well repaid by some of its other contents; and I can hardly rely on their spending even twopence upon the reprint of the paper, published by the Society for Promoting Christian Knowledge. I have therefore felt obliged to ask the editor of this review to be kind enough to admit to his pages a brief restatement of the position which Prof. Huxley has assailed, with such notice of his arguments as is practicable within the comparatively brief space which can be afforded me. I could not, indeed, amid the pressing claims of a college like this in term time, besides the chairmanship of a hospital, a preachership, and other duties, attempt any reply which would deal as thoroughly as could be wished with an article of so much skill and finish. But it is a matter of justice to my cause and to myself to remove at once the unscientific and prejudiced representation of the case which Prof. Huxley has put forward; and fortunately there will be need of no elaborate argument for this purpose. There is no occasion to go beyond Prof. Huxley's own article and the language of my paper to exhibit his entire misapprehension of the point in dispute; while I am much more than content to rely for the invalidation of his own contentions upon the authorities he himself quotes.

What, then, is the position with which Prof. Huxley finds fault? He is good enough to say that what he calls my "description" of an agnostic may for the present pass, so that we are so far, at starting, on common ground. The actual description of an agnostic, which is given in my paper, is indeed distinct from the words he quotes, and is taken from an authoritative source. But what I have said is that, as an escape from such an article of Christian belief as that we have a Father in heaven, or that Jesus Christ is the Judge of quick and dead, and will hereafter return to judge the world, an agnostic urges that "he has no means of a scientific knowledge of the unseen world or of the future"; and I maintain that this plea is irrelevant. Christians do not presume to say that they have a scientific knowledge of such articles of their creed. They say that they believe them, and they believe them mainly on the assurances of Jesus Christ. Consequently their characteristic difference from an agnostic consists in the fact that they believe those assurances, and that he does not. Prof. Huxley's observation, "Are there then any Christians who say that they

know nothing about the unseen world and the future? I was ignorant of the fact, but I am ready to accept it on the authority of a professed theologian," is either a quibble, or one of many indications that he does not recognize the point at issue. I am speaking, as the sentence shows, of scientific knowledge—knowledge which can be obtained by our own reason and observation alone—and no one with Prof. Huxley's learning is justified in being ignorant that it is not upon such knowledge, but upon supernatural revelation, that Christian belief rests. However, as he goes on to say, my view of "the real state of the case is that the agnostic 'does not believe the authority' on which 'these things' are stated, which authority is Jesus Christ. He is simply an old-fashioned 'infidel' who is afraid to own to his right name." The argument has nothing to do with his motive, whether it is being afraid or not. It only concerns the fact that that by which he is distinctively separated from the Christian is that he does not believe the assurances of Jesus Christ.

Prof. Huxley thinks there is "an attractive simplicity about this solution of the problem"—he means, of course, this statement of the case—"and it has that advantage of being somewhat offensive to the persons attacked, which is so dear to the less refined sort of controversialist." I think Prof. Huxley must have forgotten himself and his own feelings in this observation. There can be no question, of course, of his belonging himself to the more refined sort of controversialists; but he has a characteristic fancy for solutions of problems, or statements of cases, which have the "advantage of being somewhat offensive to the persons attacked." Without taking this particular phrase into account, it certainly has "the advantage of being offensive to the persons attacked" that Prof. Huxley should speak in this article of "the pestilent doctrine on which all the churches have insisted, that honest disbelief"—the word "honest" is not a misquotation—"honest disbelief in their more or less astonishing creeds is a moral offense, indeed a sin of the deepest dye, deserving and involving the same future retribution as murder or robbery," or that he should say, "Trip in morals or in doctrine (especially in doctrine), without due repentance or retractation, or fail to get properly baptized before you die, and a *plébiscite* of the Christians of Europe, if they were true to their creeds, would affirm your everlasting damnation by an immense majority." We have fortunately nothing to do in this argument with *plébiscites;* and as statements of authoritative Christian teaching, the least that can be said of these allegations is that they are offensive exaggerations. It had "the advantage" again, of being "offensive to the persons attacked," when Prof. Huxley, in an article in this review on "Science and the Bishops," in November, 1887, said that "scientific ethics can and does declare

that the profession of belief" in such narratives as that of the devils entering a herd of swine, or of the fig-tree that was blasted for bearing no figs, upon the evidence on which multitudes of Christians believe it, "is immoral"; and the observation which followed, that "theological apologists would do well to consider the fact that, in the matter of intellectual veracity, Science is already a long way ahead of the churches," has the same "advantage." I repeat that I can not but treat Prof. Huxley as an example of the more refined sort of controversialist; it must be supposed, therefore, that when he speaks of observations or insinuations which are somewhat offensive to the "persons attacked" being dear to the other sort of controversialists, he is unconscious of his own methods of controversy—or, shall I say, his own temptations?

But I desire as far as possible to avoid any rivalry with Prof. Huxley in these refinements—more or less—of controversy; and am, in fact, forced by pressure both of space and of time to keep as rigidly as possible to the points directly at issue. He proceeds to restate the case as follows: "The agnostic says, 'I can not find good evidence that so and so is true.' 'Ah,' says his adversary, seizing his opportunity, 'then you declare that Jesus Christ was untruthful, for he said so and so'—a very telling method of rousing prejudice." Now that superior scientific veracity to which, as we have seen, Prof. Huxley lays claim, should have prevented him putting such vulgar words into my mouth. There is not a word in my paper to charge agnostics with declaring that Jesus Christ was "untruthful." I believe it impossible in these days for any man who claims attention—I might say, for any man—to declare our Lord untruthful. What I said, and what I repeat, is that the position of an agnostic involves the conclusion that Jesus Christ was under an "illusion" in respect to the deepest beliefs of his life and teaching. The words of my paper are, "An agnosticism which knows nothing of the relation of man to God must not only refuse belief to our Lord's most undoubted teaching, but must deny the reality of the spiritual convictions in which he lived and died." The point is this—that there can, at least, be no reasonable doubt that Jesus Christ lived, and taught, and died, in the belief of certain great principles respecting the existence of God, our relation to God, and his own relation to us, which an agnostic says are beyond the possibilities of human knowledge; and of course an agnostic regards Jesus Christ as a man. If so, he must necessarily regard Jesus Christ as mistaken, since the notion of his being untruthful is a supposition which I could not conceive being suggested. The question I have put is not, as Prof. Huxley represents, what is the most unpleasant alternative to belief in the primary truths of the Christian religion, but what is the least un-

pleasant; and all I have maintained is that the least unpleasant alternative necessarily involved is, that Jesus Christ was under an illusion in his most vital convictions.

I content myself with thus rectifying the state of the case, without making the comments which I think would be justified on such a crude misrepresentation of my argument. But Prof. Huxley goes on to observe that "the value of the evidence as to what Jesus may have said and done, and as to the exact nature and scope of his authority, is just that which the agnostic finds it most difficult to determine." Undoubtedly, that is a primary question; but who would suppose from Prof. Huxley's statement of the case that the argument of the paper he is attacking proceeded to deal with this very point, and that he has totally ignored the chief consideration it alleged? Almost immediately after the words Prof. Huxley has quoted, the following passage occurs, which I must needs transfer to these pages, as containing the central point of the argument: "It may be asked how far we can rely on the accounts we possess of our Lord's teaching on these subjects. Now it is unnecessary for the general argument before us to enter on those questions respecting the authenticity of the gospel narratives, which ought to be regarded as settled by M. Renan's practical surrender of the adverse case. *Apart from all disputed points of criticism, no one practically doubts that our Lord lived, and that he died on the cross, in the most intense sense of filial relation to his Father in heaven, and that he bore testimony to that Father's providence, love, and grace toward mankind. The Lord's Prayer affords sufficient evidence upon these points. If the Sermon on the Mount alone be added, the whole unseen world, of which the agnostic refuses to know anything, stands unveiled before us. There you see revealed the divine Father and Creator of all things, in personal relation to his creatures, hearing their prayers, witnessing their actions, caring for them and rewarding them. There you hear of a future judgment administered by Christ himself, and of a heaven to be hereafter revealed, in which those who live as the children of that Father, and who suffer in the cause and for the sake of Christ himself, will be abundantly rewarded. If Jesus Christ preached that sermon, made those promises, and taught that prayer, then any one who says that we know nothing of God, or of a future life, or of an unseen world, says that he does not believe Jesus Christ.*"

Prof. Huxley has not one word to say upon this argument, though the whole case is involved in it. Let us take as an example the illustration he proceeds to give. "If," he says, "I venture to doubt that the Duke of Wellington gave the command, 'Up, Guards, and at 'em!' at Waterloo, I do not think that even Dr. Wace would accuse me of disbelieving the duke." Certainly

not. But if Prof. Huxley were to maintain that the pursuit of glory was the true motive of the soldier, and that it was an illusion to suppose that simple devotion to duty could be the supreme guide of military life, I should certainly charge him with contradicting the duke's teaching and disregarding his authority and example. A hundred stories like that of "Up, Guards, and at 'em!" might be doubted, or positively disproved, and it would still remain a fact beyond all reasonable doubt that the Duke of Wellington was essentially characterized by the sternest and most devoted sense of duty, and that he had inculcated duty as the very watchword of a soldier; and even Prof. Huxley would not suggest that Lord Tennyson's ode, which has embodied this characteristic in immortal verse, was an unfounded poetical romance.

The main question at issue, in a word, is one which Prof. Huxley has chosen to leave entirely on one side—whether, namely, allowing for the utmost uncertainty on other points of the criticism to which he appeals, there is any reasonable doubt that the Lord's Prayer and the Sermon on the Mount afford a true account of our Lord's essential belief and cardinal teaching. If they do—then I am not now contending that they involve the whole of the Christian creed; I am not arguing, as Prof. Huxley would represent, that he ought for that reason alone to be a Christian—I simply represent that, as an agnostic, he must regard those beliefs and that teaching as mistaken—the result of an illusion, to say the least. I am not going, therefore, to follow Prof. Huxley's example, and go down a steep place with the Gadarene swine into a sea of uncertainties and possibilities, and stake the whole case of Christian belief as against agnosticism upon one of the most difficult and mysterious narratives in the New Testament. I will state my position on that question presently. But I am first and chiefly concerned to point out that Prof. Huxley has skillfully evaded the very point and edge of the argument he had to meet. Let him raise what difficulties he pleases, with the help of his favorite critics, about the Gadarene swine, or even about all the stories of demoniacs. He will find that his critics—and even critics more rationalistic than they—fail him when it comes to the Lord's Prayer and the Sermon on the Mount, and, I will add, the story of the Passion. He will find, or rather he must have found, that the very critics he relies upon recognize that in the Sermon on the Mount and the Lord's Prayer, allowing for variations in form and order, the substance of our Lord's essential teaching is preserved. On a point which, until Prof. Huxley shows cause to the contrary, can hardly want argument, the judgment of the most recent of his witnesses may suffice—Prof. Reuss, of Strasburg. In Prof. Huxley's article on the "Evolution of Theology" in the number of this review for March, 1886,

he says, "As Reuss appears to me to be one of the most learned, acute, and fair-minded of those whose works I have studied, I have made most use of the commentary and dissertations in his splendid French edition of the Bible." What, then, is the opinion of the critic for whom Prof. Huxley has this regard? In the volume of his work which treats of the first three Gospels, Reuss says at page 191–192, "If anywhere the tradition which has preserved to us the reminiscences of the life of Jesus upon earth carries with it certainty and the evidence of its fidelity, it is here"; and again: "In short, it must be acknowledged that the redactor, in thus concentrating the substance of the moral teaching of the Lord, has rendered a real service to the religious study of this portion of the tradition, and the reserves which historical criticism has a right to make with respect to the form will in no way diminish this advantage." It will be observed that Prof. Reuss thinks, as many good critics have thought, that the Sermon on the Mount combines various distinct utterances of our Lord, but he none the less recognizes that it embodies an unquestionable account of the substance of our Lord's teaching.

But it is surely superfluous to argue either this particular point, or the main conclusion which I have founded on it. Can there be any doubt whatever, in the mind of any reasonable man, that Jesus Christ had beliefs respecting God which an agnostic alleges there is no sufficient ground for? We know something at all events of what his disciples taught; we have authentic original documents, unquestioned by any of Prof. Huxley's authorities, as to what St. Paul taught and believed, and of what he taught and believed respecting his Master's teaching; and the central point of this teaching is a direct assertion of knowledge and revelation as against the very agnosticism from which Prof. Huxley manufactured that designation. "As I passed by," said St. Paul at Athens, "I found an altar with this inscription: 'To the unknown God.' Whom therefore ye ignorantly—or in agnosticism—worship, Him I declare unto you." An agnostic withholds his assent from this primary article of the Christian creed; and though Prof. Huxley, in spite of the lack of information he alleges respecting early Christian teaching, knows enough on the subject to have a firm belief "that the Nazarenes, say of the year 40," headed by James, would have stoned any one who propounded the Nicene Creed to them, he will hardly contend that they denied that article, or doubted that Jesus Christ believed it. Let us again listen to the authority to whom Prof. Huxley himself refers. Reuss says at page 4 of the work already quoted:

> Historical literature in the primitive church attaches itself in the most immediate manner to the reminiscences collected by the apostles and their friends,

directly after their separation from their Master. The need of such a return to the past arose naturally from the profound impression which had been made upon them by the teaching, and still more by the individuality itself of Jesus, and on which both their hopes for the future and their convictions were founded. . . . It is in these facts, in this continuity of a tradition which could not but go back to the very morrow of the tragic scene of Golgotha that we have a strong guarantee for its authenticity. . . . We have direct historical proof that the thread of tradition was not interrupted. Not only does one of our evangelists furnish this proof in formal terms (Luke i, 2); but in many other places besides we perceive the idea, or the point of view, that all which the apostles know, think, and teach, is at bottom and essentially a reminiscence—a reflection of what they have seen and learned at another time, a reproduction of lessons and impressions received.

Now let it be allowed for argument's sake that the belief and teaching of the apostles are distinct from those of subsequent Christianity, yet it is surely a mere paradox to maintain that they did not assert, as taught by their Master, truths which an agnostic denies. They certainly spoke, as Paul did, of the love of God; they certainly spoke, as Paul did, of Jesus having been raised from the dead by God the Father (Gal. i, 1); they certainly spoke, as Paul did, of Jesus Christ returning to judge the world; they certainly spoke, as Paul did, of "the God and Father of our Lord Jesus Christ" (2 Cor. xi, 31). That they could have done this without Jesus Christ having taught God's love, or having said that God was his Father, or having declared that he would judge the world, is a supposition which will certainly be regarded by an overwhelming majority of reasonable men as a mere paradox; and I can not conceive, until he says so, that Prof. Huxley would maintain it. But if so, then all Prof. Huxley's argumentation about the Gadarene swine is mere irrelevance to the argument he undertakes to answer. The Gospels might be obliterated as evidence to-morrow, and it would remain indisputable that Jesus Christ taught certain truths respecting God, and man's relation to God, from which an agnostic withholds his assent. If so, he does not believe Jesus Christ's teaching; he is so far an unbeliever, and "unbeliever," Dr. Johnson says, is an equivalent of "infidel."

This consideration will indicate another irrelevance in Prof. Huxley's argument. He asks for a definition of what a Christian is, before he will allow that he can be justly called an infidel. But without being able to give an accurate definition of a crayfish, which perhaps only Prof. Huxley could do, I may be very well able to say that some creatures are not crayfish; and it is not necessary to frame a definition of a Christian in order to say confidently that a person who does not believe the broad and unquestionable elements of Christ's teachings and convictions is not a Christian. "Infidel" or "unbeliever" is of course, as Prof. Huxley

says, a relative and not a positive term. He makes a great deal of play out of what he seems to suppose will be a very painful and surprising consideration to myself, that to a Mohammedan I am an infidel. Of course I am; and I should never expect a Mohammedan, if he were called upon, as I was, to argue before an assembly of his own fellow-believers, to call me anything else. Prof. Huxley is good enough to imagine me in his company on a visit to the Hazar Mosque at Cairo. When he entered that mosque without due credentials, he suspects that, had he understood Arabic, "dog of an infidel" would have been by no means the most "unpleasant" of the epithets showered upon him, before he could explain and apologize for the mistake. If, he says, "I had had the pleasure of Dr. Wace's company on that occasion, the undiscriminative followers of the Prophet would, I am afraid, have made no difference between us; not even if they had known that he was the head of an orthodox Christian seminary." Probably not; and I will add that I should have felt very little confidence in any attempts which Prof. Huxley might have made, in the style of his present article, to protect me, by repudiating for himself the unpleasant epithets which he deprecates. It would, I suspect, have been of very little avail to attempt a subtle explanation, to one of the learned mollahs of whom he speaks, that he really did not mean to deny that there was one God, but only that he did not know anything on the subject, and that he desired to avoid expressing any opinion respecting the claims of Mohammed. It would be plain to the learned mollah that Prof. Huxley did not believe either of the articles of the Mohammedan creed—in other words that, for all his fine distinctions, he was at bottom a downright infidel, such as I confessed myself, and that there was an end of the matter. There is no fair way of avoiding the plain matter of fact in either case. A Mohammedan believes and asserts that there is no God but God, and that Mohammed is the prophet of God. I don't believe Mohammed. In the plain, blunt, sensible phrase people used to use on such subjects I believe he was a false prophet, and I am a downright infidel about him. The Christian creed might almost be summed up in the assertion that there is one, and but one God, and that Jesus Christ is his prophet; and whoever denies that creed says that he does not believe Jesus Christ, by whom it was undoubtedly asserted. It is better to look facts in the face, especially from a scientific point of view. Whether Prof. Huxley is justified in his denial of that creed is a further question, which demands separate consideration, but which was not, and is not now, at issue. All I say is that his position involves that disbelief or infidelity, and that this is a responsibility which must be faced by agnosticism.

But I am forced to conclude that Prof. Huxley can not have taken the pains to understand the point I raised, not only by the irrelevance of his argument on these considerations, but by a misquotation which the superior accuracy of a man of science ought to have rendered impossible. Twice over in the article he quotes me as saying that "it is, and it ought to be, an unpleasant thing for a man to have to say plainly that he does not believe in Jesus Christ." As he winds up his attack upon my paper by bringing against this statement his rather favorite charge of "immorality" —and even "most profound immorality"—he was the more bound to accuracy in his quotation of my words. But neither in the official report of the congress to which he refers, nor in any report that I have seen, is this the statement attributed to me. What I said, and what I meant to say, was that it ought to be an unpleasant thing for a man to have to say plainly "that he does not believe Jesus Christ." By inserting the little word "in," Prof. Huxley has, by an unconscious ingenuity, shifted the import of the statement. He goes on to denounce "the pestilent doctrine on which all the churches have insisted, that honest disbelief in their more or less astonishing creeds is a moral offense, indeed a sin of the deepest dye."* His interpretation exhibits, in fact, the idea in his own mind, which he has doubtless conveyed to his readers, that I said it ought to be unpleasant to a man to have to say that he does not believe in the Christian creed. I certainly think it ought, for reasons I will mention; but that is not what I said. I spoke, deliberately, not of the Christian creed as a whole, but of Jesus Christ as a person, and regarded as a witness to certain primary truths which an agnostic will not acknowledge. It was a personal consideration to which I appealed, and not a dogmatic one; and I am sorry, for that reason, that Prof. Huxley will not allow me to leave it in the reserve with which I hoped it had been sufficiently indicated. I said that "no criticism worth mentioning doubts the story of the Passion; and that story involves the most solemn attestation, again and again, of truths of which an agnostic coolly says he knows nothing. An agnosticism which knows nothing of the relation of man to God must not only refuse belief to our Lord's most undoubted teaching, but must deny the reality of the spiritual convictions in which he lived and died. It must declare that his most intimate, most intense beliefs, and his dying aspirations were an illusion. Is that supposition tolerable?" I do not think this deserves to be called "a proposition of the most profoundly immoral character." I think it ought to be unpleasant, and I am sure it always will be unpleasant, for a man to listen to the Saviour on the cross uttering such words as "Father, into thy hands I commend my spirit," and to

* "Popular Science Monthly" for April, 1889, p. 766.

say that they are not to be trusted as revealing a real relation between the Saviour and God. In spite of all doubts as to the accuracy of the Gospels, Jesus Christ—I trust I may be forgiven, under the stress of controversy, for mentioning his sacred name in this too familiar manner—is a tender and sacred figure to all thoughtful minds, and it is, it ought to be, and it always will be, a very painful thing, to say that he lived and died under a mistake in respect to the words which were first and last on his lips. I think, as I have admitted, that it should be unpleasant for a man who has as much appreciation of Christianity, and of its work in the world, as Prof. Huxley sometimes shows, to have to say that its belief was founded on no objective reality. The unpleasantness, however, of denying one system of thought may be balanced by the pleasantness, as Prof. Huxley suggests, of asserting another and a better one. But nothing, to all time, can do away with the unpleasantness, not only of repudiating sympathy with the most sacred figure of humanity in his deepest beliefs and feelings, but of pronouncing him under an illusion in his last agony. If it be the truth, let it by all means be said; but if we are to talk of "immorality" in such matters, I think there must be a lack of moral sensibility in any man who could say it without pain.

The plain fact is that this misquotation would have been as impossible as a good deal else of Prof. Huxley's argument, had he, in any degree, appreciated the real strength of the hold which Christianity has over men's hearts and minds. The strength of the Christian Church, in spite of its faults, errors, and omissions, is not in its creed, but in its Lord and Master. In spite of all the critics, the Gospels have conveyed to the minds of millions of men a living image of Christ. They see him there; they hear his voice; they listen, and they believe him. It is not so much that they accept certain doctrines as taught by him, as that they accept him, himself, as their Lord and their God. The sacred fire of trust in him descended upon the apostles, and has from them been handed on from generation to generation. It is with that living personal figure that agnosticism has to deal; and as long as the Gospels practically produce the effect of making that figure a reality to human hearts, so long will the Christian faith, and the Christian Church, in their main characteristics, be vital and permanent forces in the world. Prof. Huxley tells us, in a melancholy passage, that he can not define "the grand figure of Jesus." Who shall dare to "define" it? But saints have both written and lived an *imitatio Christi*, and men and women can feel and know what they can not define. Prof. Huxley, it would seem, would have us all wait coolly until we have solved all critical difficulties, before acting on such a belief. "Because," he says, "we are often obliged, by the pressure of events, to act on very

bad evidence, it does not follow that it is proper to act on such evidence when the pressure is absent." Certainly not; but it is strange ignorance of human nature for Prof. Huxley to imagine that there is no "pressure" in this matter. It was a voice which understood the human heart better which said, "Come unto me, all ye that labor and are heavy laden, and I will give you rest"; and the attraction of that voice outweighs many a critical difficulty under the pressure of the burdens and the sins of life.

Prof. Huxley, indeed, admits, in one sentence of his article, the force of this influence on individuals.

> If (he says) a man can find a friend, the hypostasis of all his hopes, the mirror of his ethical ideal, in the pages of any, or of all, of the Gospels, let him live by faith in that ideal. Who shall, or can, forbid him? But let him not delude himself with the notion that his faith is evidence of the objective reality of that in which he trusts. Such evidence is to be obtained only by the use of the methods of science, as applied to history and to literature, and it amounts at present to very little.

Well, a single man's belief in an ideal may be very little evidence of its objective reality. But the conviction of millions of men, generation after generation, of the veracity of the four evangelical witnesses, and of the human and divine reality of the figure they describe, has at least something of the weight of the verdict of a jury. *Securus judicat orbis terrarum.* Practically the figure of Christ lives. The Gospels have created it; and it subsists as a personal fact in life, alike among believers and unbelievers. Prof. Huxley himself, in spite of all his skepticism, appears to have his own type of this character. The apologue of the woman taken in adultery might, he says, "if internal evidence were an infallible guide, well be affirmed to be a typical example of the teachings of Jesus." Internal evidence may not be an infallible guide; but it certainly carries great weight, and no one has relied more upon it in these questions than the critics whom Prof. Huxley quotes.

But as I should be sorry to imitate Prof. Huxley, on so momentous a subject, by evading the arguments and facts he alleges, I will consider the question of external evidence on which he dwells. I must repeat that the argument of my paper is independent of this controversy. The fact that our Lord taught and believed what agnostics ignore is not dependent on the criticism of the four Gospels. In addition to the general evidence to which I have alluded, there is a further consideration which Prof. Huxley feels it necessary to mention, but which he evades by an extraordinary inconsequence. He alleges that the story of the Gadarene swine involves fabulous matter, and that this discredits the trustworthiness of the whole Gospel record. But he says:

At this point a very obvious objection arises and deserves full and candid consideration. It may be said that critical skepticism carried to the length suggested is historical pyrrhonism; that if we are to altogether discredit an ancient or a modern historian because he has assumed fabulous matter to be true, it will be as well to give up paying any attention to history. . . . Of course (he acknowledges) this is perfectly true. I am afraid there is no man alive whose witness could be accepted, if the condition precedent were proof that he had never invented and promulgated a myth.

The question, then, which Prof. Huxley himself raises, and which he had to answer, was this: Why is the general evidence of the Gospels, on the main facts of our Lord's life and teaching, to be discredited, even if it be true that they have invented or promulgated a myth about the Gadarene swine? What is his answer to that simple and broad question? Strange to say, absolutely none at all! He leaves this vital question without any answer, and goes back to the Gadarene swine. The question he raises is whether the supposed incredibility of the story of the Gadarene swine involves the general untrustworthiness of the story of the Gospels; and his conclusion is that it involves the incredibility of the story of the Gadarene swine. A more complete evasion of his own question it would be difficult to imagine. As Prof. Huxley almost challenges me to state what I think of that story, I have only to say that I fully believe it, and moreover that Prof. Huxley, in this very article, has removed the only consideration which would have been a serious obstacle to my belief. If he were prepared to say, on his high scientific authority, that the narrative involves a contradiction of established scientific truth, I could not but defer to such a decision, and I might be driven to consider those possibilities of interpolation in the narrative, which Prof. Huxley is good enough to suggest to all who feel the improbability of the story too much for them. But Prof. Huxley expressly says:

I admit I have no *a priori* objection to offer. . . . For anything I can absolutely prove to the contrary, there may be spiritual things capable of the same transmigration, with like effects. . . . So I declare, as plainly as I can, that I am unable to show cause why these transferable devils should not exist.

Very well, then, as the highest science of the day is unable to show cause against the possibility of the narrative, and as I regard the Gospels as containing the evidence of trustworthy persons who were contemporary with the events narrated, and as their general veracity carries to my mind the greatest possible weight, I accept their statement in this, as in other instances. Prof. Huxley ventures "to doubt whether at this present moment any Protestant theologian, who has a reputation to lose, will say that he believes the Gadarene story." He will judge whether I fall under his description; but I repeat that I believe it, and that he has removed the only objection to my believing it.

However, to turn finally to the important fact of external evidence. Prof. Huxley reiterates, again and again, that the verdict of scientific criticism is decisive against the supposition that we possess in the four Gospels the authentic and contemporary evidence of known writers. He repeats, "without the slightest fear of refutation, that the four Gospels, as they have come to us, are the work of unknown writers." In particular, he challenges my allegation of "M. Renan's practical surrender of the adverse case"; and he adds the following observations, to which I beg the reader's particular attention:

I thought (he says) I knew M. Renan's works pretty well, but I have contrived to miss this "practical"—(I wish Dr. Wace had defined the scope of that useful adjective)—surrender. However, as Dr. Wace can find no difficulty in pointing out the passage of M. Renan's writings, by which he feels justified in making his statement, I shall wait for further enlightenment, contenting myself, for the present, with remarking that if M. Renan were to retract and do penance in Notre Dame to-morrow for any contributions to biblical criticism that may be specially his property, the main results of that criticism, as they are set forth in the works of Strauss, Baur, Reuss, and Volkmar, for example, would not be sensibly affected.

Let me begin, then, by enlightening Prof. Huxley about M. Renan's surrender. I have the less difficulty in doing so as the passages he has contrived to miss have been collected by me already in a little tract on the "Authenticity of the Gospels," * and in some lectures on the "Gospel and its Witnesses"; † and I shall take the liberty, for convenience' sake, of repeating some of the observations there made.

I beg first to refer to the preface to M. Renan's "Vie de Jésus." ‡ There M. Renan says:

As to Luke, doubt is scarcely possible. The Gospel of St. Luke is a regular composition, founded upon earlier documents. It is the work of an author who chooses, curtails, combines. The author of this Gospel is certainly the same as the author of the Acts of the Apostles. Now, the author of the Acts seems to be a companion of St. Paul—a character which accords completely with St. Luke. I know that more than one objection may be opposed to this reasoning; but one thing at all events is beyond doubt, namely, that the author of the third Gospel and of the Acts is a man who belonged to the second apostolic generation; and this suffices for our purpose. The date of this Gospel, moreover, may be determined with sufficient precision by considerations drawn from the book itself. The twenty-first chapter of St. Luke, which is inseparable from the rest of the work, was certainly written after the siege of Jerusalem, but not long after. We are, therefore, here on solid ground, for we are dealing with a work proceeding entirely from the same hand, and possessing the most complete unity.

It may be important to observe that this admission has been supported by M. Renan's further investigations, as expressed in his subsequent volume on "The Apostles." In the preface to that

* Religious Tract Society. † John Murray, 1883. ‡ Fifteenth edition, p. xlix.

volume he discusses fully the nature and value of the narrative contained in the Acts of the Apostles, and he pronounces the following decided opinions as to the authorship of that book, and its connection with the Gospel of St. Luke (page x *sq.*):

One point which is beyond question is that the Acts are by the same author as the third Gospel, and are a continuation of that Gospel. One need not stop to prove this proposition, which has never been seriously contested. The prefaces at the commencement of each work, the dedication of each to Theophilus, the perfect resemblance of style and of ideas, furnish on this point abundant demonstrations.

A second proposition, which has not the same certainty, but which may, however, be regarded as extremely probable, is that the author of the Acts is a disciple of Paul, who accompanied him for a considerable part of his travels.

At a first glance, M. Renan observes, this proposition appears indubitable, from the fact that the author, on so many occasions, uses the pronoun "we," indicating that on those occasions he was one of the apostolic band by whom St. Paul was accompanied. "One may even be astonished that a proposition apparently so evident should have found persons to contest it." He notices, however, the difficulties which have been raised on the point, and then proceeds as follows (page 14):

Must we be checked by these objections? I think not; and I persist in believing that the person who finally prepared the Acts is really the disciple of Paul, who says "we" in the last chapters. All difficulties, however insoluble they may appear, ought to be, if not dismissed, at least held in suspense, by an argument so decisive as that which results from the use of this word "we."

He then observes that MSS. and tradition combine in assigning the third Gospel to a certain Luke, and that it is scarcely conceivable that a name in other respects obscure should have been attributed to so important a work for any other reason than that it was the name of the real author. Luke, he says, had no place in tradition, in legend, or in history, when these two treatises were ascribed to him. M. Renan concludes in the following words: "We think, therefore, that the author of the third Gospel and of the Acts is in all reality Luke, the disciple of Paul."

Now let the import of these expressions of opinion be duly weighed. Of course, M. Renan's judgments are not to be regarded as affording in themselves any adequate basis for our acceptance of the authenticity of the chief books of the New Testament. The Acts of the Apostles and the four Gospels bear on their face certain positive claims, on the faith of which they have been accepted in all ages of the Church; and they do not rest, in the first instance, on the authority of any modern critic. But though M. Renan would be a very unsatisfactory witness to rely upon for the purpose of positive testimony to the Gospels, his estimates of the value of modern critical objections to those sacred books have

all the weight of the admissions of a hostile witness. No one doubts his familiarity with the whole range of the criticism represented by such names as Strauss and Baur, and no one questions his disposition to give full weight to every objection which that criticism can urge. Even without assuming that he is prejudiced on either one side or the other, it will be admitted on all hands that he is more favorably disposed than otherwise to such criticism as Prof. Huxley relies on. When, therefore, with this full knowledge of the literature of the subject, such a writer comes to the conclusion that the criticism in question has entirely failed to make good its case on a point like that of the authorship of St. Luke's Gospel, we are at least justified in concluding that critical objections do not possess the weight which unbelievers or skeptics are wont to assign to them. M. Renan, in a word, is no adequate witness to the Gospels; but he is a very significant witness as to the value of modern critical objections to them.

Let us pass to the two other so-called "synoptical" Gospels. With respect to St. Matthew, M. Renan says in the same preface ("Vie de Jésus," p. lxxxi):

> To sum up, I admit the four canonical Gospels as serious documents. All go back to the age which followed the death of Jesus; but their historical value is very diverse. St. Matthew evidently deserves peculiar confidence for the discourses. Here are "the oracles," the very notes taken while the memory of the instruction of Jesus was living and definite. A kind of flashing brightness at once sweet and terrible, a divine force, if I may so say, underlies these words, detaches them from the context, and renders them easily recognizable by the critic.

In respect again to St. Mark, he says (p. lxxxii):

> The Gospel of St. Mark is the one of the three synoptics which has remained the most ancient, the most original, and to which the least of later additions have been made. The details of fact possess in St. Mark a definiteness which we seek in vain in the other evangelists. He is fond of reporting certain sayings of our Lord in Syro-Chaldaic. He is full of minute observations, proceeding, beyond doubt, from an eye-witness. There is nothing to conflict with the supposition that this eye-witness, who had evidently followed Jesus, who had loved him and watched him in close intimacy, and who had preserved a vivid image of him, was the apostle Peter himself, as Papias has it.

I call these admissions a "practical surrender" of the adverse case, as stated by critics like Strauss and Baur, who denied that we had in the Gospels contemporary evidence, and I do not think it necessary to define the adjective, in order to please Prof. Huxley's appetite for definitions. At the very least it is a direct contradiction of Prof. Huxley's statement * that we know "absolutely nothing" of "the originator or originators" of the narratives in the first three Gospels; and it is an equally direct contradiction of the case, on which his main reply to my paper is based, that we

* "Popular Science Monthly" for April, 1889, p. 756.

have no trustworthy evidence of what our Lord taught and believed.

But Prof. Huxley seems to have been apprehensive that M. Renan would fail him, for he proceeds, in the passage I have quoted, to throw him over and to take refuge behind "the main results of biblical criticism, as they are set forth in the works of Strauss, Baur, Reuss, and Volkmar, for example." It is scarcely comprehensible how a writer, who has acquaintance enough with this subject to venture on Prof. Huxley's sweeping assertions, can have ventured to couple together those four names for such a purpose. "Strauss, Baur, Reuss, and Volkmar"! Why, they are absolutely destructive of one another! Baur rejected Strauss's theory and set up one of his own; while Reuss and Volkmar in their turn have each dealt fatal blows at Baur's. As to Strauss, I need not spend more time on him than to quote the sentence in which Baur himself puts him out of court on this particular controversy. He says,* "The chief peculiarity of Strauss's work is, that it is a criticism of the Gospel history without a criticism of the Gospels." Strauss, in fact, explained the miraculous stories in the Gospels by resolving them into myths, and it was of no importance to his theory how the documents originated. But Baur endeavored, by a minute criticism of the Gospels themselves, to investigate the historical circumstances of their origin; and he maintained that they were *Tendenz-Schriften*, compiled in the second century, with polemical purposes. Volkmar, however, is in direct conflict with Baur on this point, and in the very work to which Prof. Huxley refers,† he enumerates (p. 18) among "the written testimonies of the first century"—besides St. Paul's epistles to the Galatians, Corinthians, and Romans, and the apocalypse of St. John—"the Gospel of Jesus Christ, the Son of God, according to John Mark of Jerusalem, written a few years after the destruction of Jerusalem, between the years 70 and 80 of our reckoning—about 75, probably; to be precise, about 73," and he proceeds to give a detailed account of it, "according to the oldest text, and particularly the Vatican text," as indispensable to his account of Jesus of Nazareth. He treats it as written (p. 172) either by John Mark of Jerusalem himself, or by a younger friend of his. Baur, therefore, having upset Strauss, Volkmar proceeds to upset Baur; and what does Reuss do? I quote again from that splendid French edition of the Bible, on which Prof. Huxley so much relies. On page 88 of Reuss's introduction to the synoptic Gospels, he sums up "the results he believes to have been obtained by critical analysis," under thirteen heads; and the following are some of them:

* "Kritische Untersuchungen über die kanonischen Evangelien," 1847, p. 41.

† "Jesus Nazarenus und die erste christliche Zeit," 1882.

2. Of the three synoptic Gospels one only, that which ecclesiastical tradition agrees in attributing to Luke, has reached us in its primitive form.

3. Luke could draw his knowledge of the Gospel history partly from oral information; he was able, in Palestine itself, to receive direct communications from immediate witnesses. . . . We may think especially here of the history of the passion and the resurrection, and perhaps also of some other passages of which he is the sole narrator.

4. A book, which an ancient and respectable testimony attributes to Mark, the disciple of Peter, was certainly used by St. Luke as the principal source of the portion of his Gospel between chapter iv, 31, and ix, 50; and between xviii, 15, and xxi, 38.

5. According to all probability, the book of Mark, consulted by Luke, comprised in its primitive form what we read in the present day from Mark i, 21, to xiii, 37.

It seems unnecessary, for the purpose of estimating the value of Prof. Huxley's appeal to these critics, to quote any more. It appears from these statements of Reuss that if "the results of biblical criticism," as represented by him, are to be trusted, we have the whole third Gospel in its primitive form, as it was written by St. Luke; and in this, as we have seen, Reuss is in entire agreement with Renan. But besides this, a previous book written by Mark, St. Peter's disciple, was certainly in existence before Luke's Gospel, and was used by Luke; and in all probability this book was, in its primitive form, the greater part of our present Gospel of St. Mark.

Such are those "results of biblical criticism" to which Prof. Huxley has appealed; and we may fairly judge by these not only of the value of his special contention in reply to my paper, but of the worth of the sweeping assertions he, and writers like him, are given to making about modern critical science. Prof. Huxley says that we know "absolutely nothing" about the originators of the Gospel narratives, and he appeals to criticism in the persons of Volkmar and Reuss. Volkmar says that the second Gospel is really either by St. Mark or by one of his friends, and was written about the year 75. Reuss says that the third Gospel, as we now have it, was really by St. Luke. Now Prof. Huxley is, of course, entitled to his own opinion; but he is not entitled to quote authorities in support of his opinion when they are in direct opposition to it. He asserts, without the slightest fear of refutation, that "the four Gospels, as they have come to us, are the work of unknown writers." His arguments in defense of such a position will be listened to with respect: but let it be borne in mind that the opposite arguments he has got to meet are not only those of orthodox critics like myself, but those of Renan, of Volkmar, and of Reuss—I may add of Pfleiderer, well known in this country by his Hibbert Lectures, who, in his recent work on original Christianity, attributes most positively the second Gospel in its present

form to St. Mark, and declares that there is no ground whatever for that supposition of an *Ur-Marcus*—that is an original groundwork—from which Prof. Huxley alleges that "at the present time there is no visible escape." If I were such an authority on morality as Prof. Huxley, I might perhaps use some unpleasant language respecting this vague assumption of criticism being all on his side, when it, in fact, directly contradicts him; and his case is not the only one to which such strictures might be applied. In "Robert Elsmere," for example, there is some vaporing about the "great critical operation of the present century" having destroyed the historical basis of the Gospel narrative. As a matter of fact, as we have seen, the great critical operation has resulted, according to the testimony of the critics whom Prof. Huxley himself selects, in establishing the fact that we possess contemporary records of our Lord's life from persons who were either eye-witnesses, or who were in direct communication with eye-witnesses, on the very scene in which it was passed. Either Prof. Huxley's own witnesses are not to be trusted, or Prof. Huxley's allegations are rash and unfounded. Conclusions which are denied by Volkmar, denied by Renan, denied by Reuss, are not to be thrown at our heads with a superior air, as if they could not be reasonably doubted. The great result of the critical operation of this century has, in fact, been to prove that the contention with which it started in the persons of Strauss and Baur, that we have no contemporary records of Christ's life, is wholly untenable. It has not convinced any of the living critics to whom Prof. Huxley appeals; and if he, or any similar writer, still maintains such an assertion, let it be understood that he stands alone against the leading critics of Europe in the present day.

Perhaps I need say no more for the present in reply to Prof. Huxley. I have, I think, shown that he has evaded my point; he has evaded his own points; he has misquoted my words; he has misrepresented the results of the very criticism to which he appeals; and he rests his case on assumptions which his own authorities repudiate. The questions he touches are very grave ones, not to be adequately treated in a review article. But I should have supposed it a point of scientific morality to treat them, if they are to be treated, with accuracy of reference and strictness of argument.

II.

By W. C. MAGEE,

BISHOP OF PETERBOROUGH.

I SHOULD be wanting in the respect which I sincerely entertain for Prof. Huxley if I were not to answer his "appeal" to me in the last number of this review for my opinion on a point in controversy between him and Dr. Wace. Prof. Huxley asks me,

"in the name of all that is Hibernian, why a man should be expected to call himself a miscreant or an infidel"? I might reply to this after the alleged fashion of my countrymen by asking him another question, namely—When or where did I ever say that I expected him to call himself by either of these names? I can not remember having said anything that even remotely implied this, and I do not therefore exactly see why he should appeal to my confused "Hibernian" judgment to decide such a question.

As he has done so, however, I reply that I think it unreasonable to expect a man to call himself anything unless and until good and sufficient reason has been given him why he should do so. We are all of us bad judges as to what we are and as to what we should therefore be called. Other persons classify us according to what they know, or think they know, of our characters or opinions, sometimes correctly, sometimes incorrectly. And were I to find myself apparently incorrectly classified, as I very often do, I should be quite content with asking the person who had so classified me, first to define his terms, and next to show that these, as defined, were correctly applied to me. If he succeeded in doing this, I should accept his designation of me without hesitation, inasmuch as I should be sorry to call myself by a false name.

In this case, accordingly, if I might venture a suggestion to Prof. Huxley, it would be that the term "infidel" is capable of definition, and that when Dr. Wace has defined it, if the professor accept his definition, it would remain for them to decide between them whether Prof. Huxley's utterances do or do not bring him under the category of infidels, as so defined. Then, if it could be clearly proved that they do, from what I know of Prof. Huxley's love of scientific accuracy and his courage and candor, I certainly should expect that he would call himself an infidel—and a miscreant too, in the original and etymological sense of that unfortunate term, and that he would even glory in those titles. If they should not be so proved to be applicable, then I should hold it to be as unreasonable to expect him to call himself by such names as he, I suppose, would hold it to be to expect us Christians to admit, without better reason than he has yet given us, that Christianity is "the sorry stuff" which, with his "profoundly" moral readiness to say "unpleasant" things, he is pleased to say that it is.

There is another reference to myself, however, in the professor's article as to which I feel that he has a better right to appeal to me—or, rather, against me, to the readers of this review—and that is, as to my use, in my speech at the Manchester Congress, of the expression "cowardly agnosticism." I have not the report of my speech before me, and am writing, therefore, from memory; but my memory or the report must have played

me sadly false if I am made to describe all agnostics as cowardly. A much slighter knowledge than I possess of Prof. Huxley's writings would have certainly prevented my applying to all agnosticism or agnostics such an epithet.

What I intended to express, and what I think I did express by this phrase was, that there is an agnosticism which is cowardly. And this I am convinced that there is, and that there is a great deal of it too, just now. There is an agnosticism which is simply the cowardly escaping from the pain and difficulty of contemplating and trying to solve the terrible problems of life by the help of the convenient phrase, "I don't know," which very often means "I don't care." "We don't know anything, don't you know, about these things. Prof. Huxley, don't you know, says that we do not, and I agree with him. Let us split a B. and S."

There is, I fear, a very large amount of this kind of agnosticism among the more youthful professors of that philosophy, and indeed among a large number of easy-going, comfortable men of the world, as they call themselves, who find agnosticism a pleasant shelter from the trouble of thought and the pain of effort and self-denial. And if I remember rightly it was of such agnostics I was speaking when I described them as "chatterers in our clubs and drawing-rooms," and as "freethinkers who had yet to learn to think."

There is therefore in my opinion *a* cowardly agnosticism just as there is also *a* cowardly Christianity. A Christian who spends his whole life in the selfish aim of saving his own soul, and never troubles himself with trying to help to save other men, either from destruction in the next world or from pain and suffering here, is a cowardly Christian. The eremites of the early days of Christianity, who fled away from their place in the world where God had put them, to spend solitary and, as they thought, safer lives in the wilderness, were typical examples of such cowardice. But in saying that there is such a thing as *a* cowardly Christianity, I do not thereby allege that there is no Christianity which is not cowardly. Similarly, when I speak of *a* cowardly agnosticism, I do not thereby allege that there is no agnosticism which is not cowardly, or which may not be as fearless as Prof. Huxley has always shown himself to be.

I hope that I have now satisfied the professor on the two points on which he has appealed to me. There is much in the other parts of his article which tempts me to reply. But I have a dislike to thrusting myself into other men's disputes, more especially when a combatant like Dr. Wace, so much more competent than myself, is in the field. I leave the professor in his hands, with the anticipation that he will succeed in showing him that a scientist dealing with questions of theology or biblical criticism may

go quite as far astray as theologians often do in dealing with questions of science.

My reply to Prof. Huxley is accordingly confined to the strictly personal questions raised by his references to myself. I hope that, after making due allowance for Hibernicisms and for imperfect acquaintance with English modes of thought and expression, he will accept my explanation as sufficient.—*Nineteenth Century.*

GROWTH OF THE BEET-SUGAR INDUSTRY.

By A. H. ALMY.

THE statistics collected from the sugar-producing countries show that more than one half of the world's sugar is derived from the beet-root; and it is known that the consumers of sugar in the United States often make daily use of it in their households without suspecting that they are contributing to the support of the peasantry and wage-earners of continental Europe.

Whenever the history of the beet-sugar industry shall have been written, it will prove interesting and instructive to the student, as an achievement of science, and will present a problem to the political economist of grave import in its reflection on the future business possibilities. It is a matter of historical record that for many years, in the early part of the present century, continental Europe worked almost hopelessly to produce a sugar-yielding plant which would thrive in its northern climate and supply the sugar it consumed.

Chemistry had demonstrated that the beet-root—as well as other forms of plant-life—contained a solution of sugar identical with that found in the cane-plant of the tropics; but the amount of sugar extracted was so inconsiderable as to preclude the hope of obtaining a supply from that source, unless new discoveries should make it possible to increase the saccharine product.

Schools of instruction were established for imparting special information in the cultivation of the beet and the extraction of the saccharine principle. And costly experiments and researches were made.

Scientific men were rewarded, subsidies were granted, and factories were built, but sugar was produced only at extravagant cost; and, as a financial venture, without other considerations, it proved a stupendous failure. The industry was abandoned in France with the fall of Napoleon, but was continued in a moderate way by some of the continental states without a profitable result, until about twenty years ago, when the possible war complications of that period—which afterward culminated in the humilia-

tion of France—forced Germany to rehabilitate her agricultural industries, from which the armies of the empire were chiefly supplied. Her lands were worn under a thousand years of tillage without rotation of crops, and had more recently become unprofitable and valueless under the vain attempt to produce the staple crops of grain in competition with the rich prairies of our Northwest, and her farmers were emigrating to America. The soil was not exhausted, as many have supposed, but, like our own farms in New England, laboring at present under the same difficulties, required a diversity of culture and new fertilization. Their previous experiments had shown that the beet-root, depending largely for its growth upon the atmosphere, did not exhaust the soil, as was the case in the cultivation of grain, but, in rotation with the staple crops, like wheat, barley, and rye, it left the land richer for the following crop. Besides, the beet-root was peculiarly a product of the temperate zone—indigenous to the latitude of northern France and Germany, requiring fair skies, sunlight, and long seasons, for the full perfection of its growth for sugar-making purposes. It could not be raised profitably for saccharine extraction on the sea-coast, as it easily absorbed saline matters, or in the dark and damp places of England, or in the higher latitudes, where the season is too short to ripen the plant to perfection, any more than it would thrive in the hot climate of the South.

A new system of excise duties was established which induced the farmer to enter into the growing of beets on a larger scale, and bounties were given to attract capital into the construction of factories for the manufacture of beet-sugar. This excise tax, not unlike that of our own internal revenue collection on whisky and tobacco—where the consumer pays the tax—was equal to two and a half cents per pound on the sugar extracted from the beet. To the sugar exporter the tax was returned, and there was also paid a bonus which assumed the character of an export bounty.

Under these conditions an enormous increase of sugar production and a rapidly augmented exportation of sugar followed. The farmer commenced a new system of fertilization that produced larger crops, and began with energy to develop from the soil the nitrogen which the chemists had found to be so much needed in the cultivation of the beet-root. He made more manure on the farm by feeding his cattle with the pulp, received from the factories that had sprung up like magic a residuum derived from the chemical processes in the extraction of sugar containing all the salts and elements remaining, thus giving a new impulse to cattle-raising and dairy products from its rich fodder.

Gathering from twenty to twenty-five tons of beets from an

acre, each ton yielding from one hundred and fifty to two hundred pounds of sugar, which gave him three times the profit that he had hitherto derived from the cultivation of wheat, rye, barley, and the staple crops, leaving the land better prepared to receive the annual plant in its rotation with the beet, he found the value of his farm increasing enormously, and his prosperity phenomenal, as the swarms of peasants—men, women, and children—flocked to his growing fields or followed the harvesting, while full employment was given to the general wage-earner and the artisan.

New employments and collateral industries increased in the same ratio; railroads were projected and built to transport the beet-root from the interior farms to the great factories scattered for hundreds of miles throughout Germany, long trains of platform-cars, often numbering fifty to sixty, piled full of white sugar-beets, met the eye of the traveler during the harvesting season, and speculation ran high with the fabulous profits of the sugar manufacturers.

Subsequently the attempt to manufacture beet-sugar in the Southern United States met with signal failure. Later, beet-sugar factories were started in the Northern States, in the latitude of Germany, where the soil and meteorological conditions were equal to the best of beet-growing sections on the Continent; to which was added the long Indian summer, which can not be approached by any country in its advantages for maturing the plant. To these factories, erected in different sections of the North, subsidies were granted and bounties were given by several of the States in which they were located, fostered and assisted by the Agricultural Bureau and experimental stations of the Government; yet they were overcome by the same difficulties that had for fifty years and more confronted their foreign pioneers, and they, one and all, came to grief in their attempts to manufacture sugar from the beet-root at a profit, for the metamorphosis of the plant and the sugar-beet process had not yet been developed.

But during the last decade great discoveries have been made in the cultivation of the root, as well as in the methods for the extraction of the solution of sugar by ingenious mechanical devices, and the sugar-beet of to-day bears no resemblance to that of the past century, either in its form or the minerals it contains; and the saccharine principle has been increased a thousand per cent above the extraction of one per cent secured by the early experiments of Archaud in the days of the first Napoleon. Forty years afterward the chemists found their experimentation had increased the product to six per cent only, and a quarter of a century later the highest attainable result proved that it required twelve and a half parts of beet-root to produce one part of grain sugar, about one eighth per cent of the whole, which was the

basis on which the German excise duty was established; yet last year the statistical organ of the German Empire reports an average extraction of thirteen per cent. The employment of an ingenious contrivance known as the "diffusion battery"—though simple in its conception, nevertheless illustrates well-known laws of chemical science in the transfusion of liquids, and successfully opens the membranous walls of the sugar-cells of the plant, giving a higher grade of juice, with less gummy, nitrogenous, and fibrous impurities, at less cost than by the old methods of mechanical pressure—has in no small degree contributed to this result. It had taken three quarters of a century to develop the chemistry and the mechanical adjustment of the sugar-beet processes, and even now we notice that the progress in this direction is great.

Meantime France, Belgium, Austria-Hungary, Poland, Russia, and other countries in continental Europe, after a series of unsuccessful attempts, resumed the manufacture of beet-sugar, and by a system of subsidies, bounties, and drawbacks, notwithstanding the many climatic and meteorological difficulties, produced a large quantity of sugar, but little as compared with Germany, as is shown by the following table, estimating the production of beet-sugar in the year 1885:

German Empire	1,155,000 tons.
France	308,000 "
Belgium	88,000 "
Austria-Hungary	558,000 "
Russia and Poland	387,000 "
Holland and other countries	50,000 "
	2,546,000 "

The entire production of cane-sugar in Cuba, Java, Brazil, Peru, British India, Egypt, Manila, Louisiana, and other cane-sugar producing countries, during the same period, did not exceed 2,260,100 tons, or less than one half of the world's sugar production.

The simple and inexpensive methods adopted in the German factories have made the beet-sugar manufacture one of the most profitable of industries, and the work goes on day and night, at a prime cost for conversion of two dollars per ton of beets, or one cent per pound of sugar, not estimating the cost of the beet-root, but including labor and all materials used, like coal, coke, lime, charcoal, wear and tear, and interest on the invested capital. The monthly disbursements of such an establishment exceed sixty thousand dollars, and give employment to thousands of wage-earners in direct and collateral industries. One sugar corporation in France reported a net profit derived from the manufacture of beet-sugar a few years ago of two millions of dollars, and the season did not extend beyond one hundred and twenty days. Under

these new conditions the production of beet-sugar in continental Europe has doubled in the last decade; and, after the home populations are supplied, the surplus is exported to Great Britain and the United States, reducing the price of sugar in the markets of the world more than fifty per cent.

The sugar-refineries of this country use the beet- and cane-sugar indiscriminately in the manufacture of the block sugar of commerce, and the family grocer sells the imported refined beet-sugar at a price from twenty-five to fifty per cent above the price of cane-sugar.

Before our late war, Louisiana produced more sugar than Germany; and although the beet-sugar industry in the latter country was greatly stimulated by the high prices of sugar prevailing, incident to the entire destruction of the cane-sugar industry of the United States, yet as late as 1875 the empire produced only twenty-five hundred tons, while for the year 1888 a production of one million three hundred thousand tons of sugar and saccharine resultants is recorded.

If the increasing production of continental sugar continues in the same ratio as in the past, it needs no prophet to foretell the future of the cane-sugar colonies. Even now the English market can not afford to take colonial cane-sugar, although it is admitted free of duty. The English refining factories, which represent an investment of fifteen or twenty millions of dollars, and have hitherto supported a large population of wage-earners, are being closed, from the competition with continental sugar.

These questions are attracting the attention of all the governments of Europe; and while a number of members of the British Parliament tried to find compensation for the losses of the cane-sugar colonies, and the destruction of the British sugar-refineries, in the circumstance that the consumers of sugar in Great Britain saved fifty-five millions of dollars annually, in the reduced cost of an article of prime necessity of which the consumption had increased thirty-three per cent within a few years; yet an international congress was determined upon, for the purpose of doing away, if possible, with all bounties on sugar manufacture.

This grave question was presented, in all its bearings, to the Parliaments, Finance Ministers, Boards of Trade, and Chambers of Commerce of many of the Continental Governments, but at the gathering in London the proposition met with little or no favor.

After the adjournment of the congress the German Empire announced a new excise duty, which took effect last August, involving all the principles of the old duties, and increased the "material and consumption" tax on beets to three cents per pound on sugar as against two and a half cents per pound previously,

and fixed the export bounty at two cents and two and a half cents per pound on raw and refined sugar respectively.

During the past year large capital has been attracted toward the development of the sugar-beet industry in the United States on the Pacific coast. Although that section of the country, with its peculiar surroundings, does not generally present the meteorological and climatic conditions necessary to secure the best results in the cultivation of the beet-root for sugar-making purposes, yet a factory was started last October, with equipment and machinery capable of reducing three hundred and fifty tons of beets per diem, and has proved a great financial success. A full supply of beets, cultivated by the wheat-growers of California, kept the works fully employed, and a boom was given to the town of Watsonville. The factory consumes seven tons of lime daily in the chemical processes of extracting the sugar, which is distributed pro rata to the grower of beets free, and can be returned to the soil. Besides, the farmers averaged over eighty dollars per acre for their beet products, while the recent report of the Agricultural Bureau estimates the returns from the total production of the five principal crops—oats, corn, rye, barley, and wheat—in the United States to be less than twelve dollars per acre as an average.

The beet-root, deriving its fertilization from previous crops of annuals, can not rotate effectually with the cereals, except in the third season; and of course the comparative estimate of increased profit over wheat is not as large as it would be if the plant admitted of continuous culture, and thus may be misleading.

When we take into consideration the elements—organic and mineral—of which all plants are composed, and that each variety requires for its perfect development certain meteorological conditions, peculiar characters of soil, and combinations of the various leading constituents of plant-food, which have enlisted the energies of scientists for years in continued investigation, we are struck with admiration and wonder at the progress of agricultural chemistry—not only in revealing the chemicals as they exist, replacing them in the soil when exhausted by cultivation, but in transforming a root and making almost a new creation, by extracting the noxious minerals which had retarded its development, with simply special culture.

It is admitted that the new appliances of steam and electricity and the inventions of the past quarter of a century have changed the commerce of civilization, but, as economic factors, these can scarcely prove more far-reaching in their influence than those discoveries of science, in the same period, which have made it possible to open a new industry in a northern latitude for the

manufacture of an article of prime necessity, whose habitat has been for a century in the tropics.

The chemists have found that the four principal elements which enter into plant-life are met every day, only under other names and slightly different forms. Nitrogen in one form is the ammonia of commerce. Potash is simply lye from wood-ashes. Phosphoric acid is ground bones dissolved in acid; and lime is seen everywhere. These represent the necessary nutrition of the beet-root when the climatic conditions are favorable; but if they exist in insoluble combination, they will be useless in the economy of nutrition, or if in form suitable for similation, but excessive in quantities, they will stimulate the plant to abnormal growth, unsuited to its desired perfection.

The scientists have shown us how to cultivate the beet for sugar-making; that soils charged with mineral salts are injurious to its development for that purpose; that, in fact, the beet easily absorbs saline matters, while the alkaline salts constitute one of the greatest obstacles to sugar extraction. They say new ground, or that lately cleared of forest, should not be applied to the culture of the beet, but the land used for this purpose should have been under continued cultivation at least ten or fifteen years for the removal of the nitrates and the organic matter containing nitrogen, which are always present in new soils, and exert an injurious influence on the quality of the root.

We now have elaborate tables of analyses of soils to show the chemical composition of those most favorable to the culture, as well as to the physical character which render them best suited to the cultivation of the beet, their porosity and subsoil conditions.

Unless the supply of the elements of plant-food is continuous and regular, a purely sandy soil would be undesirable. If no means are provided for the removal of surplus water which may be found in a purely clay soil, or to so improve its condition as to admit of free circulation of air as well as water, it will be too heavy, and become absolutely useless. The same is true of purely calcareous soil, since the same unfavorable conditions would prevail, though perhaps to not quite the same extent. Such soils would also be unsuited to the plant itself, because they would not admit of the free progress of the tap-root nor of the lateral fibrous roots in their search for nutrition. These conditions have a powerful influence upon the ultimate yield of sugar from the surface cultivated.

But if the sandy soil be mixed with either or both of the others, and with humus—*pulverulent brown earth*—in suitable proportions, the conditions most favorable to the maintenance of a regular and plentiful supply of food, the healthy condition of the root and its consequent normal development will be assured.

The beet-root, as a biennial plant, enters readily into rotation with annual plants, and with those plants known to exhaust the soil. It precedes barley, wheat, rye, and oats, and prepares the soil in a marvelous manner for cereals, the subsequent fertilization of which prepares the soil for the beet. The land must not receive fertilizing treatment during the season of the growth of the beet-root, but must be well prepared—not too light, not too moist; it should be warm, rich in humus, deep and free from stones, like a garden. The form of the beet desired for greater sugar extraction would, with this physical condition, be long and tapering.

In this collection of data, derived from the best authorities in Europe, where the cultivation of the beet is best managed, it will not be possible to speak of the meteorological conditions necessary to the perfect growth of the root for sugar-producing purposes, except to say that the principal conditions to be studied in this connection are those of the temperature and moisture with which the plant may be surrounded. The amount of moisture at the disposition of the plant, at all seasons of its growth, is the most important factor in its normal development. Temperature has an influence: if it be too low or too high, it has the same power of evil as a deficiency of moisture. Various sections of the United States north of Mason and Dixon's line, where the rainfall is regular, like New England, with its long Indian summer, present all the conditions to produce the sugar-beet to perfection.

The cultivation of the root, and the latest approved processes for extracting the sugar, will be considered hereafter.

EGGS IN CHEMISTRY AND COMMERCE.

By P. L. SIMMONDS, F. L. S.

WHAT a subject scientific research has found in eggs as a study, witness the works of Moquin-Tandon and O. des Murs.* These publications serve to show how the oölogic characteristics may assist in the methodical classification of birds, what relation there is between the egg and the organic conformation of the bird, and what particular habits of birds may be gathered from a study of their eggs and nests.

Some birds only lay a single egg, others many. The largest ordinary number, on the average, is five or seven. The species laying less are more rare than the species laying a larger number. Those in a state of liberty produce, on the average, twelve to fifteen. But in domestic poultry the number is larger. Farm-

* "Traité Général d'Oologie Ornithologique," par P. O. des Murs.

yard hens average sixty or seventy eggs in the year, and certain Cochin-China fowls are said to lay from two hundred to three hundred eggs. The number of eggs laid is less at the commencement and end of life. With hens, for instance, the number laid is less in the first and fourth year than in the second and third, and after the fifth year, generally, they cease laying. Chickens and ducklings, which can generally shift for themselves soon after emerging from the egg, are more numerous in a brood than young pigeons, which have to be fed by the parent. But if pigeons only lay two eggs at a time, they lay more frequently—once or twice a month—and hence rear a large number of young.

In form and general aspect the difference among birds' eggs is endless. Some are elongated, some are spherical, some are dull on the surface, some are polished, some are dark, others gray or white, others very bright. The shape of eggs offers as much diversity as their size and weight. They may be thrown, however, into six principal or typical forms—the cylindrical, the oval, the spherical, the ovicular, oviconical, and the elliptic. The ovicular form of egg belongs to the *Passeræ* and *Gallinaceæ*, the ovoid to the rapacious birds and the *Palmipedes*, the conical to the wading birds and some *Palmipedes*, the short to some game and many stilted birds, and the spherical to nocturnal birds of prey and the kingfishers.

Mr. W. C. Hewitson observes that in their relative sizes the eggs of different birds vary in a remarkable degree from each other. The guillemot and the raven are themselves about equal in size, but their eggs differ as ten to one. The snipe and the blackbird differ but slightly in weight, their eggs remarkably. The egg of the curlew is six or eight times as large as that of the rook; the birds are about the same size. The eggs of the guillemot are as big as those of an eagle, while those of the snipe equal the eggs of the partridge and the pigeon. The reason of this great disparity in size is, however, obvious. The eggs of all those birds which quit the nest soon after they are hatched, and are consequently more fully developed at their birth, are very large, and yet so admirably formed to occupy the least possible space, that the snipe has no more difficulty in covering its eggs, though apparently so disproportionate, than the thrush or the blackbird. Hence we see that eggs are not always proportioned to the size of the birds which lay them. The standard yield and weight of eggs for the different varieties of domestic fowl are about as follow: Light Brahmas and partridge Cochins, eggs seven to the pound; they lay, according to treatment and keeping, from eighty to one hundred per annum, oftentimes more if kept well. Dark Brahmas, eight to the pound, and about seventy per annum. Black, white, and buff Cochins, eight to the pound; one hundred is a

large yield per annum. Plymouth Rocks, eight to the pound, lay one hundred per annum. Houdans, eight to the pound, lay one hundred and fifty per annum; non-sitters. La Flèche, seven to the pound, lay one hundred and thirty per annum; non-sitters. Black Spanish, seven to the pound, lay one hundred and fifty per annum. Dominiques, nine to the pound, lay one hundred and thirty per annum. Game fowl, nine to the pound, lay one hundred and thirty per annum. Crèvecœurs, seven to the pound, lay one hundred and fifty per annum. Leghorns, nine to the pound, lay from one hundred and fifty to two hundred per annum. Hamburgs, nine to the pound, lay one hundred and seventy per annum. Polish, nine to the pound, lay one hundred and fifty per annum. Bantams, sixteen to the pound, lay sixty per annum. Turkeys, eggs five to the pound, lay from thirty to sixty per annum. Ducks' eggs vary greatly with different species, but from five to six to the pound, and from fourteen to twenty-eight per annum, according to age and keeping. Geese, four to the pound, lay twenty per annum. Guinea fowls, eleven to the pound, lay sixty per annum. Large eggs have generally a thicker shell than small ones. By comparison with eggs in former times, those of improved breeds of fowls of the present day have gained one third in weight.

Exceptionally large hens' eggs are often met with. Thus, in the journal "Land and Water" for June 16, 1877, a Cochin-China fowl's egg is recorded which weighed one quarter of a pound and measured eight and five eighth inches lengthwise, six and a half inches in circumference. That of a Dorking weighing seven ounces measured seven and a half inches round the middle and nine and a half inches across the ends. Another weighed ten and a half ounces, and measured eight inches round the center and twelve and a half inches across the ends.

In the "Birmingham Mercury" of May 9, 1857:

A half-bred Cochin-China hen belonging to Mr. Campbell, carter, of Great Croft Street, Darlaston, is stated during the past few weeks to have laid eleven extraordinary eggs of an enormous size, each weighing upward of five ounces, and one when just laid weighed not less than seven ounces. On one being broken another perfect egg, of the usual size, was found inside, which led to seven being broken with the same results. Around the one weighing seven ounces (being the tenth egg) a third shell and egg had begun to form. Several of these eggs are whole, and by carefully handling them the motion of the inner eggs may be perceived. Two of the inner eggs are also preserved, and numbers of people have been to see them, and have expressed themselves highly gratified at such an extraordinary phenomenon. The hen is not above the middle size, being about four and a half pounds in weight.

Many eggs are laid naked, dry, and smooth; others are impregnated with a greasy, glutinous substance. The latter are

chiefly those of sea-birds, or those which live in moist localities. This glutinous coating is doubtless intended to preserve the eggs from the water, or to maintain the degree of heat necessary to preserve life. There are soft eggs laid entirely without shells, or with only the albuminous inner membrane. This occurs chiefly in hens that are too fat; and this failing can be remedied by supplying calcareous substances with their food.

Egg-shell is much used in medical prescriptions. When calcined at a low red heat the shells afford a very pure form of carbonate of lime. The principal use of egg-shells is, however, when blown, for the cabinets of private ornithological collections and those of public museums. The eggs of the ostrich are often mounted in silver, and form elegant drinking-cups; so are the handsome green eggs of the Australian emeu, which look as if made of dark morocco-leather. Ostrich egg-shells serve as water-vessels among the African women; necklaces made of pieces of egg-shells punched out in a circular form are worn by some African natives.

Eggs blown are sometimes used in shooting-galleries, strung as a mark or target. The smooth surface of the egg-shell can even be used for artistic purposes, and we often see ostrich-eggs and hens' eggs painted or engraved with fanciful designs.

The employment of egg-shells for ornamental purposes is extremely ancient. A MS. in the Harleian collection represents a number of egg-shells ornamented in the most elegant and costly manner; miniatures were often painted upon them with extreme care, and egg-shells thus curiously decorated became valuable and highly esteemed presents. In Venice young noblemen frequently lavished large sums of money upon portraits painted within egg-shells, intended as presents.

Those who have only seen the ordinary fowl's eggs of our shops and poultry-yards would suppose that eggs were always white. But, on examining a large collection of birds' eggs, it will be found that they are of all colors. Except, perhaps, some very clear shades, the yellow for instance, none are wanting. There are blue eggs, yellowish, green, reddish, and olive. When we consider the eggs of some nine thousand different birds known, we find that not one fifth of those of the European birds are white, and among the exotic birds the number of white is much less. The white color is not always pure; there are gray and yellow shades, more or less of a dirty hue. In colored eggs, there are uniform colors and spotted colors. Although the larger number of the races of domestic fowls lay white eggs, there are some which have a yellow or nankeen tint; these are principally Asiatic birds. Birds which build open nests seem uniformly to have

colored eggs, and those which possess concealed or covered nests, white eggs.

But few of those who break the shells of the cooked eggs of our common domestic fowls at the breakfast-table ever think of the wonderful nature of the structure they crush, or of the complex chemical nature of the contents consumed as food. The white, fragile cortex called the shell, composed of mineral matter, is not the tight, compact covering which it appears to be, for it is everywhere perforated with a multitude of holes. Under the microscope the shell appears like a sieve, or it more closely resembles the white perforated paper sold by stationers. The shell of the egg is lined upon its interior everywhere with a very thin but pretty tough membrane, which, dividing at or very near the obtuse end, forms a small bag which is filled with air. In new-laid eggs this follicle appears very small, but it becomes larger when the egg is kept. In breaking an egg this membrane is removed with the shell, to which it adheres, and therefore is regarded as a part of it, which it is not. The shell proper is made up mostly of earthy materials. The proportions vary according to the food of the bird, but ninety to ninety-seven per cent is carbonate of lime. The remainder is composed of two to five per cent of animal matter, and one to five of phosphate of lime and magnesia.

If a farmer has a flock of one hundred hens they produce in eggshells about one hundred and thirty-seven pounds of chalk annually; and yet not a pound of the substance, or perhaps not even an ounce, exists around the farm-house within the circuit of their feeding-grounds. The materials of the manufacture are found in the food consumed, and in the sand, pebble-stones, brick-dust, bits of bones, etc., which hens and other birds are continually picking from the earth. The instinct is keen for these apparently innutritious and refractory substances, and they are devoured with as eager a relish as the cereal grains or insects. If hens are confined to barns or out-buildings, it is obvious that the egg-producing machinery can not be kept long in action unless the materials for the shell are supplied in ample abundance.

Within the shell the animal portion of the egg is found, which consists of a viscous colorless liquid called albumen, or the *white*, and a yellow globular mass called the vitellus, or *yolk*. The white of the egg consists of two parts, each of which is enveloped in distinct membranes. The outer bag of albumen, next the shell, is quite a thin, watery body, while the next, which invests the yolk, is heavy and thick. But few housekeepers who break eggs ever distinguish between the two whites, or know of their existence even. Each has its appropriate office to fulfill during the process of incubation or hatching, and one acts, in the mysterious process, as important a part as the other.

The yolk contains water and albumen, but associated with these is quite a large number of mineral and other substances, which render it very complex in composition. The bright yellow color is due to a peculiar fat or oil, which is capable of reflecting the yellow rays of light, and this holds the sulphur and phosphorus which abound in the egg.

It is well known that from the egg all the constituent parts of the young animal are formed—its skeleton, as well as its various soft textures. Now, for the construction of the skeleton an amount of earthy matter is required which does not exist preformed in the soft contents of the egg, but has to be drawn from the shell. During the process of incubation, with the co-operation of the atmospheric air which permeates the shell, it appears that the phosphorus present in the yolk gradually undergoes oxidation, and becomes converted into phosphoric acid. This acts upon and dissolves the carbonate of lime belonging to the shell, which thus, as incubation proceeds, becomes thinner and thinner. The thinning of the shell also makes it easier for the young bird to peck its way out.

An enveloping membrane or bag surrounds the yolk, and keeps the fluid matter of which it is composed together. Being lighter than the white, it floats to that portion of the egg which is uppermost, but is kept in position between the two extremities by two processes of inspissated albumen, called *chalazea*, which pass to and are attached, one to either end of the egg.

	Entire contents.	White.	Yolk.
Nitrogenous matter	14·0	20·4	16·0
Fatty matter	10·5	....	30·7
Saline matter	1·5	1·6	1·3
Water	74·0	78·0	52·0
Total	100·0	100·0	100·0

The white of egg, as this shows, contains a considerably larger proportion of water than the yolk. It contains no fatty matter, but consists mainly of albumen in a dissolved state, and inclosed within very thin-walled cells. It is this arrangement which gives to the white of egg its ropy, gelatinous state. Thoroughly shaking or beating it up with water breaks the cells and removes the ropy state.

Eggs are useful for many purposes besides food and hatching. The white of an egg has proved a most efficacious remedy for burns; seven or eight successive applications of this substance soothe the pain and effectually exclude the air from the burn. This simple remedy seems preferable to collodion, or even cotton. Extraordinary stories are told of the healing properties of an oil

which is easily made of the yolks of fowls' eggs. It is in general use among the peasants of southern Russia as a means of curing cuts, bruises, and scratches. When, as sometimes by accident, sulphate of copper, or corrosive poisons generally, are swallowed, the white of one or two eggs will neutralize the poison, and change the effect to that of a dose of calomel. Raw eggs have at all times been considered an excellent remedy for debility, on account of the phosphorus contained in them, as well as a preventive of jaundice in its more malignant form. The yolk is sometimes used as a convenient medium for forming an emulsion of the thick turpentines with water. These mixtures are used as enemata.

As a flesh-producer, one pound of eggs is equal to one pound of beef. About one third of the weight of an egg is solid nutriment, which is more than can be said of meat. Eggs, at average prices, are among the cheapest and most nutritious articles of diet. Like milk, an egg is a complete food in itself. It is also easily digested, if not damaged in cooking.

The celebrated Guinod de Reynière, who consecrated his life to studying the delicacies of the table, affirms, in his "Almanach des Gourmands," that eggs can be served in more than six hundred ways, and a book is published in London by a French cook, which gives one hundred and fifty recipes for cooking eggs. The feeble man, who has regained strength by boiled eggs for several days, will continue the same comforting food when presented in the form of an omelet, which is one of the principal food preparations made with eggs.

The flavor of eggs is much influenced by the nature of the package, for they imbibe foreign odors with the greatest readiness. Eggs brought in the same ship as oranges become impregnated with the scent and flavor of the fruit. If the cases in which they are packed are made of green wood, the eggs will be ruined. The straw in which they are packed should also be perfectly dry, or it will ferment and communicate a fusty smell to the eggs.

A raw egg beaten up in a glass of wine is recommended for vocalists for clearing their voice, and in cases of debility; and a spirit of eggs is sold which is said to be useful in impaired health or the infirmities of age, when vital energy is wanting, and as a specific for soreness of the throat. The white of eggs forms an albuminous solution, useful in diarrhœa of phlegmatic origin. To make this, beat up the white of four eggs and add a quart of water slowly, remove the froth formed, add sugar, a little orange-water, and, if necessary, a dozen drops of laudanum. This albumenized water is the best antidote to a great number of mineral poisons. The phosphorus in the egg is very good for all those who have

brain-work to do. The sulphur in the yolk, as is well known, acts chemically on silver spoons, turning them black, forming a sulphide of silver that can not be removed without taking off the surface of silver, thus rapidly wearing the spoon away.

Eggs, although of animal origin, are now allowed to be eaten by Catholics during Lent. But it was not always so: formerly eggs never figured on the tables of the faithful during the fast; but, on the Saturday previous to Easter, a great quantity of eggs, held over for six weeks, was blessed and distributed among friends on Easter Sunday. They were dyed yellow, violet, and especially red, hence the origin of the red or Easter eggs. In the reigns of Louis XIV and XV, after grand mass on Easter-Sunday, pyramids of eggs gilded were taken to the cabinet of the king, who distributed them to his courtiers. The custom of Easter eggs is continued to the present time, although modified. Easter eggs are no longer blessed nor gilded to be offered to sovereigns, nor are they held over to Easter eve to receive brilliant colors. A fortnight before Easter, in the coffee-houses and beer-shops of Catholic cities, may be seen huge dishes of eggs of various colors, which are eaten by the customers with their beer. And in families a hard egg is added to the salad, after removing the colored shell.

The mutual presentation of colored eggs at Easter by friends continues in Russia and all Catholic countries. Fowls' eggs variously colored, and having flowers and other devices upon them, formed by the coloring matter being picked off, so as to expose the white shell of the egg, are a part of all the Malay entertainments in Borneo.

The eggs of the domestic fowl are the edible eggs *par excellence*, but many others can be utilized for food. The egg of the goose, which is larger, is inferior in quality; in districts where geese are bred they give, however, some benefit. The egg of the duck, with a smoother shell, smaller and less rounded, is of a greenish or dark white, the yolk is larger and of a deeper color than that of other poultry eggs, and the white by cooking attains a consistence like transparent isinglass. The egg of the pea-fowl or guinea-hen has a thick and hard shell, flesh-colored; the yolk is proportionally much larger than the white.

The common wild or gray lag goose is the origin of our domestic goose. It used to be common and bred in our fens in former years. The common goose begins to lay toward Candlemas, and lays from nine to eleven eggs. If well fed, she will lay thirty-five to forty eggs, and sometimes fifty, if the eggs are removed and she is not allowed to set. The turkey-hen lays from twelve to twenty eggs, rather smaller than those of the goose, which are white, mixed with reddish or yellow freckles. They are very

good in pastry, and mixed with fowls' eggs they improve omelets.

The question whether fowls or ducks are the better investment for the production of eggs has to some extent been settled experimentally in Germany and France in favor of ducks. They laid more eggs than the fowls, and, though they were rather smaller, they proved to be decidedly superior in nutritive material. It may be doubted whether as much attention is paid in England to the production of eggs as the utility of the food demands, and particularly by the poor, to whom their value is a consideration. Efforts should be made to induce all persons conveniently circumstanced to keep hens and ducks, and there is reason to believe that ducks are more profitable than hens, having regard to the number and size of the eggs laid by them. The solid matter and the oil in a duck's egg exceeds that of a hen's egg by as much as one fourth.

Eggs, their dietetic use apart, are of great utility in many branches of industry. In some, as in confectionery, both the whites and yolks are used, but usually the two find separate applications. The whites are employed in calico-printing, in photography, in gilding, in clarifying wines and liquors, and by the bookbinder on the leather previous to lettering or tooling.

An egg-oil is obtained in Russia in large quantities and of various qualities; the best so fine as to far excel olive-oil for cooking purposes. The less pure and very yellow qualities are chiefly used in the manufacture of the celebrated Kazan soap. Both of these products were shown at the London International Exhibition in 1862, and at subsequent exhibitions. Neither the oil for cooking purposes nor the soap are sufficiently cheap for general use; they are consumed only by the wealthy classes as luxuries; the soap, being regarded chiefly in the light of a cosmetic, is a much-valued addition to a Russian lady's toilet necessaries. The yolk is also used for medicinal purposes. It was used in the middle ages for the painter's art, before the discovery of oil-colors, as in the chapter-house at Westminster.

Eggs, whether to be used in culinary or pharmaceutical preparations, should be fresh. To determine this they should be examined by the light of a lamp. Fresh eggs are easily known by their transparency when held up to the light. By keeping they become cloudy, and when decidedly stale a distinct, dark, cloud-like appearance is discernible opposite some portion of the shell. Another simple mode is by placing the egg against the closed eyelid, and if the end of the egg is void it will feel warm, whereas if the egg is new laid it continues cold. A way to tell bad eggs is to put them in a pail of water, and, if good, they will lie on their sides; if bad, they will stand on their small ends, the large

end always uppermost, unless they have been shaken considerably, when they will stand either end up.

How to keep eggs is a problem that has attracted the attention of inquirers from the earliest times. Twenty or more processes are generally known, all of which give unsatisfactory and incomplete results—a circumstance scarcely to be wondered at when the composition of an egg and the various changes to which it is subjected by exposure to atmospheric influence are taken into consideration. The egg-shell is furnished with numerous pores, through which the water evaporates, the loss of aqueous contents thus sustained being scarcely perceptible in the first week, more marked in the second, and of considerable interest in the third. The surrounding atmospheric air takes the place of the water that has evaporated, and oxygenates the contents of the shell, which then commence to ferment and are speedily spoiled. To hinder this evaporation, and so aid the preservation of eggs, they are often steeped for twelve hours in lime-water, by which means molecules of lime are deposited on the shell, and so obstruct the pores to some extent.

To the solution of the problem of how to prevent the air from penetrating the shell of the egg, the experiments of such eminent *savants* as Musschenbroek, Réaumur, and Nollet have greatly contributed. They all agree that the most practicable method is to envelop the new-laid egg in a light coating of some impermeable substance, such as wax, tallow, oil, or a mixture of wax and olive-oil, or of olive-oil and tallow. Réaumur suggested an alcoholic solution of resin, or a thick solution of gelatin. Nollet experimented successfully with India-rubber, collodion, and various kinds of varnish. At the Dairy Products Show at the Agricultural Hall in 1884, three prizes were awarded for eggs preserved in the following manner:

1. Eggs which had been dipped twice in a solution of gum arabic and then dried, enveloped in paper, and kept in bran.

2. Eggs which had been rubbed with lard and then kept in dry salt.

3. Eggs coated with a composition of mutton and beef suet, and then wiped with a dry cloth.

With a view to utilizing in a more portable and consequently cheaper form the large supply of eggs obtainable in Austria, Messrs. Effner & Co. started a factory at Passau, in Bavaria, for condensing them. The eggs are carefully selected and dried, then reduced to a fine meal, and packed in tins ready for use. Although it is scarcely probable that the condensed egg can ever replace new-laid eggs for breakfast, it is asserted that a good omelet, as also the finest pastry, may be prepared from the product.

The eggs of wild birds are not very generally eaten in this country, but in some localities those of sea-fowl are largely consumed, and a considerable trade is carried on in gulls' eggs on many of our coasts. There is a great demand for plovers' eggs in the city markets for epicures. They are the eggs of the lapwing (*Vanellus cristatus*), a bird which lays about four eggs of an olive cast, spotted with black. These eggs come chiefly from Holland, the home produce being now very small, and they are received during the spring and summer, from March to June. Mr. Yarrell, who wrote many years ago, mentions that two hundred dozens of peewits' eggs were sent in one season from Romney Marsh to London. The eggs of many other species of birds are imposed upon the Londoners in the place of plovers' eggs.

In the sea islands of Alaska, the eggs of the thick-billed guillemot have an economic value, being the most palatable of all the varieties found in the islands, and hence are much sought after by the natives. The bird lays a single egg, large and very fancifully colored. The shell is so tough that, in gathering them, they are thrown into tubs and baskets on the cliffs, and poured out upon the rocks with a single flap of the hand, just as a sack of potatoes would be emptied, and only a trifling loss is sustained from broken or crushed eggs.

On the Faro Islands the number of eggs laid by the lesser black-backed gull, and sent annually to shore for culinary purposes, must be prodigious. The eggs of the common guillemot lie there so close together that it is difficult to move among them.

The eggs of the stork are very good eating, whether hot or cold. The natural color of the cormorant's egg seems to be a bluish green, like the usual variety of the common domestic duck, but over this is a thick, white, irregular covering of lime, which is frequently in such abundant quantity as to stand out in lumps on the surface, seldom allowing much of the original color to be visible. No doubt this superabundance of lime is produced by the bones of the fish, of which this bird is said to eat prodigious quantities, and perhaps also from shell-fish.

Turtles' eggs are held in great esteem wherever they are found, as well by Europeans as by others. They have a very soft shell, and are about the size of a pigeon's egg. The mother turtles lay three or four times a year, at intervals of two or three weeks. An experienced eye and hand are required to detect the eggs, as they are always ingeniously covered up with sand. The Orinoco and Amazon Indians obtain from these eggs a kind of clear, sweet oil, which they use instead of butter. In the month of February, when the high waters of the Orinoco have receded, millions of turtles come on shore to deposit their eggs. The certainty and abundance of the harvest is estimated by the acre. The yearly

gathering about the mouth of the river Amazon alone is some five thousand jars of oil, and it takes five thousand eggs to make a jar. The turtle comes at night, and deposits from one hundred and forty to two hundred white eggs in the sand, carefully covering them up before returning to the sea. In about fourteen days she returns again to the same place to lay, and will come up about four times before stopping laying, thus giving some six hundred to eight hundred eggs. A native of Brazil will consume as many as twenty or thirty turtles' eggs at a meal, and a European will eat a dozen at a breakfast. They make an excellent omelet. The Indians frequently eat them raw, mixed with their cassava flour. The condition in which the egg of the turtle is best fit to be eaten is when taken from the slain animal, before the formation of the glaze and the surrounding parchment-like skin, which answers the purpose of a shell.

The eggs of a large lizard (*Varanus vivitattus*) are eaten in Java. In the West Indies the eggs of the iguana are thought a delicacy. One of these lizards will sometimes contain as many as fourscore eggs, which, when boiled, are like marrow. They are about the size of a pigeon's egg, but with a soft shell. The eggs of the common teguexin (*Teius teguexin*), and of other large species of lizards, are eaten in South America.

In the Antilles and on the west coast of Africa the eggs of the alligator are eaten. They resemble in shape a hen's egg, and have much the same taste, but are larger. More than a hundred eggs have been found in one alligator.

The large eggs of the boa constrictor are regarded as a dainty by the Africans from the Congo. One of these snakes, killed on an estate in British Guiana in 1884, had fifty eggs, which were eaten by the negroes.

The eggs of various fishes differ remarkably in external appearance. Some would scarcely be believed to be eggs at all. Take, for instance, the skate's egg. It looks like a flattened leather purse, with four horns or handles at the corners. The yolk is in the shape of a walnut, larger or smaller according to the species. In the *Elasmobranchii*, sharks and rays, the ova are not so numerous as those of other fishes, the eggs being generally inclosed in coriaceous or leathery capsules, familiarly known to sea-side visitors as mermaids' purses and the like.

The egg of the picked dog-fish, the yolk of which is about the size of a pigeon's egg, is used by the inhabitants in parts of Sweden and Norway as a substitute for other eggs in their domestic economy. Cod-roe is sold in London in a dried form, smoked, and thus darkly colored. It is a delicious dish when partly salted, parboiled, and then fried. Cod-roes are exported in tins to Australia and India in the salted state. The late Frank Buckland examined

a cod-roe weighing seven pounds and three quarters, and found the average was one hundred and forty eggs to the grain. This gives 67,200 eggs to the ounce, so that in the whole mass of this one cod-roe, allowing three quarters of a pound for skin, membrane, etc., there were no less than 7,526,400 eggs.

Caviare is the common name for a preparation of the dried spawn or salted roe of fish. The black caviare is made from the roe of sturgeon, and a single large fish will sometimes yield as much as one hundred and twenty pounds of roe. A cheaper and less prized red kind is obtained from the roe of the gray mullet, and some of the carp species, which are common in the rivers and on the shores of the Black Sea. It is of interest to Turkey and the Levant trade only.

Botargo is a preparation made on the coasts of the Mediterranean, of the ovaries full of the mature eggs of the mullet (*Mugil cephalus*). The eggs are salted, crushed, reduced to a paste, and then dried in the sun. Sometimes spices or other ingredients are added. Botargo is eaten like caviare.

There is also a destruction by mankind of the ova or spawn of the *Crustacea*—lobsters, crabs, and shrimps—which are carried under their tail. The lobster produces from 25,000 to 40,000 eggs, the crayfish upward of 100,000. As much as six ounces of eggs can be taken off in May from a lobster weighing three to three pounds and a half, and there are about 6,720 eggs in an ounce of lobster spawn. The lobster is never so good as when in the condition of a "berried hen."

The eggs of some insects are eaten in Siam, Egypt, and Mexico, but those most valuable commercially are the eggs of the silk-moth.

The trade in silk-worms' eggs from Japan has become an extensive and profitable one. In 1868 £1,000,000 was paid to Japan by the "graineurs" of Europe for silk-worms' eggs. In 1869 two million cards, costing on an average 12*s.* 6*d.* each, were sent to Europe. In other years three millions of these cards, packed in cases of about three hundred, thickly studded with these tiny specks, have been shipped from Japan by the various steamers.

In China and Japan the moths are placed to lay their eggs on cardboard or thick paper, which they cover regularly and closely with a secretion which glues them to the spot and acts as a preservative from heat or other accidents. Hence the cards may be transported many thousands of miles safely, in a ship with a properly regulated temperature, so as to prevent their hatching too soon. They should be arranged, and the cards thickly covered, without being overlaid, and having no unpleasant smell. A first glance at one of these cards would lead one to suppose that the eggs were artificially attached to the card, but the regularity is

obtained by careful management of the moths at the time of laying the eggs. A vigorous moth will usually lay four or five hundred eggs. When the laying is terminated the peasants examine the cards, and, if there are any vacant places, attach a moth, by pins through its wings, so that the eggs may be deposited in the right place.—*Abridged from the Journal of the Society of Arts.*

BOTANICAL GARDENS.

By Dr. FR. HOFFMANN.

NOTWITHSTANDING its size, prosperity, and luxury, the commercial metropolis of the United States has been hitherto a less fruitful soil for the rise and growth of humanistic and scientific institutions of learning, and museums, than Boston, Washington, Philadelphia, and, through its university, Baltimore. Movements, donations, and beginnings for the building up of such institutions have not been wanting, but they have usually been hindered by the predominance of mercantile interests and tendencies, unfortunate starts, misadministration, seizure by political aspirants, or lack of competent, skilled, unselfish management, and have fallen short of their intended and possible aims. Centenarian Columbia College, with its professional branch schools, has been left far behind by Harvard, Yale, and Johns Hopkins universities. The Astor and Lenox libraries can not compete with those of other cities of like importance with New York, and are surpassed by libraries in Boston and Washington. The Museum of Natural History in Central Park has only recently acquired importance and value; and the Art Museum has not till within a short time, by means of a few large bequests and gifts, overcome its previous failures. Ethnographical, zoölogical, botanical, and pharmacological museums are, except for the sporadic collections in scientific institutions, and for the ethnographic collection in the Historical Society, not existent, nor have we a botanical and zoölogical garden. The museums of the medical schools do not exceed the measure of demonstration objects, and the small pharmacological collection of the College of Pharmacy is one of the most neglected and insignificant of all.

The creation of higher institutions of learning and of scientific collections has hitherto been left for the most part to private enterprise and munificence; the latter has, as everywhere else in our country, accomplished much in New York that is good and useful, and has given large sums. But the givers have too often lacked correct understanding, and have failed to secure the qualified and experienced agents that were needed in order to put their rich

gifts to the best use. Men of the stamp of Louis Agassiz and Asa Gray do not readily grow up and flourish in the intellectual atmosphere of a commercial and partly political metropolis; or they are less appreciated; and therefore the endowers of large foundations want the stimulating and authoritative influence and the correct intelligence to apply their gifts in the right direction, and to guard them against extravagance from injudicious expenditure, dilettanteism, and experimenting. Furthermore, Americans, in their lack of knowledge and of models, have been distinguished by a tendency to perpetuate their munificence and names preferably in monumental edifices; hence the excessive foundation of so-called universities with splendid buildings, but which have been usually destitute of what alone, with or without architectural luxury, gives them purpose and value—an efficient faculty, well-endowed apparatuses, and capable pupils. In consequence of this erroneous comprehension and consequent expenditure in buildings, and by the scattering of teaching force and means, most of our higher schools, libraries, museums, and collections have been weakened. We have no lack of imposing structures, but no real universities and technical high-schools; libraries, like those of the Astor and Lenox in New York, elegantly housed without a correspondingly general value and utility. The munificence of our founders directs itself, as Prof. James M. Hart has remarked in his book on "German Universities," mainly to brick and mortar. The rest is left to chance and the discretion of the administration; hence numerous experiments, often followed by a miserable, inefficient career.

In comparison with other cities of like size and population, New York is poor in public squares and parks. In size and natural beauty the Central Park can indeed well sustain a comparison with the parks of other cities, and it might, if the money poured out upon it since its creation in 1857 had been wisely and honestly expended, have been one of the best parks and botanical gardens in the world. If Nature had not done so much for it, it would stand, notwithstanding half a million dollars a year are expended upon it, far behind the parks of other great cities. If only a part of this sum had been systematically applied to the maintenance of a competent, experienced botanical and landscape gardener as director of the plantations, and the necessary palm- and plant-houses had been erected, the Central Park might have been, not only one of the largest but one of the handsomest public parks and botanical gardens; for, with its superficies of eight hundred and forty acres, it has a much greater area than, for example, Regent's Park, with its beautiful botanical and zoölogical gardens, Kensington Garden, and the Kew Gardens of London, taken together. The last-named, a famous botanical garden, contains

only sixty-seven acres, and has nothing like the diversity of formation that the Central Park contains.

The plan for making Central Park, like those parks, a botanical garden as well, has existed since its foundation in 1857,* and has come up again from time to time; a costly beginning was projected under the Tweed *régime,* and the foundations were laid for a large glass house, by which the little lake on the east side of the park between Seventy-third and Seventy-fourth Streets was to be roofed for the cultivation of *Victoria regia* and other fresh-water plants. The money that was appropriated found takers enough, but no building came out of it.

Much might be accomplished in the Central Park with its rich flora under expert and artistic administration, without great cost, if only the majority of the trees and shrubs were marked with their botanical and English names, as is done in the squares of Philadelphia, Boston, and other cities; and the people of the city might thus be put in the way of becoming acquainted with at least the native trees and bushes, and excited to some interest in botany. The daily thousands of summer visitors pass by these abundant groups of plants without any information to their names, and without any means or motive for informing themselves respecting these objects that make the park attractive and beautiful. This, however, is one of the most important purposes of the botanical gardens of our time; and the Central Park could fulfill it as well as and even better than Regent's Park and Kensington Garden and the plant-houses in Hyde Park in London.

Of the eight hundred and forty acres in the Central Park, four

* It may be of interest to mention here that after the once famous Hamilton Garden near Philadelphia, which was managed for three years toward the end of the last century by the famous botanist, Friedrich Pursh, New York has had the first botanical garden in North America. It was established in 1801 by Dr. David Hosack, a physician, who came to this country from Scotland, on a tract of about twenty acres, which he bought from the city. It was situated several miles north of the city at the time, on the place of the present square between Fifth and Sixth Avenues and Forty-sixth and Forty-seventh Streets. The wooded, hilly land was cleared and laid out and surrounded by a stone wall, along which the tall forest-trees were allowed to remain. In 1805 the garden was under high cultivation, and contained over fifteen hundred species of American useful, medicinal, and ornamental plants, a good hot-house, and an audience-room for botanical teaching. In 1806 and 1807 two hot-houses were added, and a number of West Indian and European plants were put under cultivation. A catalogue printed in 1807 gave the names of two thousand species. The garden—which Dr. Hosack had named the Elgin Garden, after his Scottish home—was regularly taken care of during the following years by the owner and some wealthy lovers of plants; but was sold in 1810, for want of means to carry it on, to the State of New York, for seventy-three thousand dollars. With this, skillful direction of the garden seems to have come to an end. It was committed in turn to the Regents of the University of New York, the faculty of the College of Physicians and Surgeons, and finally to Columbia College. This wealthy corporation, by an arrangement with the State Legislature in 1816, annexed the garden, which had fallen into decay, and with this the once widely known Elgin Botanical Garden, of New York, ceased to be.

hundred acres are wooded with trees and shrubs; forty-three and a quarter acres, besides the reservoirs, are covered with water in the six lakes; and of the many meadows the largest contains nineteen acres. The size, conditions of soil, natural beauty, and central location are therefore far more favorable and more diversified than in the famous parks and botanical gardens of London, Paris, and Berlin. Only a proper beginning, a scientific and artistic organization, and the wise application of the means that are at hand, are needed to combine the useful with the agreeable in the park, and make it also one of the handsomest of botanical gardens.

One is therefore involuntarily reminded of Schiller's words—

"Warum in die Ferne schweifen, sieh' das Gute liegt so nah?"

("Why wander into the far, seeing the good lies so near?") when he regards the present movement and efforts to create a "great botanical garden" in certain territory in the northern annex to the city, on the Bronx River, beyond Mount Vernon. A committee of the Torrey Botanical Club is trying and hopes to collect a million dollars for that purpose. It is given among the purposes to be attained by this garden that it will furnish the city with living plants as demonstration objects for botanical instruction in the medicinal, pharmaceutical, and other institutions. But smaller gardens and houses for the cultivation of tender and half-hardy plants, like the little botanical garden created by Prof. Asa Gray and his pupils in Cambridge, the Arboretum in Boston, and Shaw's Gardens in St. Louis, would be abundantly sufficient for this purpose. Instead of utilizing that which is at hand and near us, we must, in a fashion characteristic of New York, have something new and grand for a botanical garden—a scheme that will bring money among the people, give position and name to politicians, feed the mills of land-speculators and contractors, and therefore find favor everywhere.

The project is not objectionable in itself. But why not apply it to the already existing Central Park, which has abundant room and all that is needed for the establishment of a complete botanical garden, and would gain immensely by it in usefulness and beauty? With a million dollars all could be provided on the same grand scale that the Kew Garden of London possesses in plantations, hot-houses, and botanical museums; moreover, a large sum of money alone will no more make a great botanical garden than it will a great university. It requires, first of all, the intellectual creators and the scientifically and artistically competent organizers and architects.

Without reverting in this short article to the history of botanical gardens, which may be found in every large encyclopædia, we will confine ourselves to the discussion of their scientific importance. This is not so much in the drift of modern botanical sci-

ences than it was formerly. With the popularization of science and the rise of landscape gardening on an extensive scale in or near all the great cities, botanical gardens have acquired more and more importance and perhaps greater value for the awakening and instruction of the masses, and should therefore be made easily accessible to them and as instructive as possible. Hence the public parks that are most easily within reach of the largest numbers of people are the peculiarly favorable territory on which to place botanical gardens. Their importance and usefulness in this sense were recently expounded in a striking manner by Prof. Schwendener in his address on assuming the rectorate of the University of Berlin, when, having described the present condition of botany and its aims and purposes, he said: "If we ask how botanical gardens stand in reference to this new direction, it can not be denied that they are in general behind the progress of science. They still exhibit, aside from a few unimportant changes, the impress of an earlier time. Certain fashionable plants, like palms, orchids, camellias, azalias, cactuses, heaths, etc., are cultivated in extravagant numbers, and grow, bloom, and decay without bearing any fruit for science. Where there are specialists, who work up some group in monographs, as rich a representation of its forms in living examples as possible may be justified; but we should not forget in this case that most systematic research must rest for the greater part on herbarium material, for the whole number of cultivated forms constitute only a fraction of what is already described. The largest collections of living plants in the gardens of the great cities may contain sixteen thousand or eighteen thousand species; but the flora of the whole earth includes ten times as many. The phytographer is not willing to depend upon garden specimens, because they sometimes vary considerably from plants collected in nature and afford no certain guarantees of their origin. It is therefore not to be supposed that the demands of the new system can be satisfied with specimens that have grown under cultivation. Hardly anything else can be expected of the future than that the enormous stock of living plants which all the great gardens now exhibit will suffer a gradual reduction.

"But if the vegetable kingdom is gradually giving up the charm which it has exercised so long, what shall take its place? The gardens as such stand in no other relation to the now dominant microscopical and experimental physiological research than that of furnishing the necessary material and a certain number of plants for experiment, and for that no particular efforts or large gardens are needed. In this direction, therefore, no one will probably desire extensive enterprises or set up new aims.

"As little does it lie in the province of botanical gardens to deal with problems in the geography of plants. What has hith-

erto been done in this direction by the arrangement of geographical groups, and which is all that can be done in the future, belongs to the domain of popular demonstration and the instruction of wider circles, not to that of science. It may be of real interest to the garden-visiting public to find Japanese, Chinese, American, or Australian plants, etc., together in greater numbers, and the administration of the gardens are not to be blamed if they meet this popular desire as practically as they can, only they must not conceive that they are thereby solving any scientific problem.

"The one thing that remains for the directors of botanical gardens, if they would keep up with the progress of science and to make them something more than mere magazines of living plants, is to engage themselves in the questions that concern the variability of organic forms, the influence of changed life-conditions on the form, the phenomena of hybridization and reversion, and especially the factors that are conducive to the further development of the vegetable kingdom and of its history.

"If we raise the question, in conclusion, of what will be the consequences of the perspective we have defined for the botanical gardens, it is hardly to be feared for the smaller gardens, serving principally for the purposes of instruction, that they will be seriously affected by it, for their stock of plants does not at most exceed the present requirements for demonstration.

"But a profounder change concerning the scientific side of botanical gardens may nevertheless be anticipated in the future. The fashionable plants of the trade-gardens and the monotonous forms of certain genera which require whole houses in their aimless fullness of species do not deserve such a preference; and the time is at hand for botanical gardens to break with these old traditions and to carry out a stricter selection connected with necessary reforms in nomenclature. For this is demanded an expert and energetic administration which recognizes modern problems and knows how to overcome the hindrances that stand in the way."

What evidently is wanted and should be created in New York is what the botanical gardens of London, Paris, Berlin, and other great cities principally are, a "magazine" of cultivated native and exotic plants, in which botanists and lovers of plants as well as the masses can enjoy themselves and be instructed, and by means of which a perception of and interest in the beauty and endless richness of forms and colors of the plant-world can be awakened and advanced in the populace. The Central Park is eminently adapted for such an establishment, has the right location for it, abundant space, and therefore all the prerequisites that are needed. Should it seem desirable, in the course of the growth of the city northward, at some later time to have more and new

parks with botanical gardens, future generations will know how to provide them, probably with better means and service, and in any case with closer-lying interest and benefit. At present it would be an extravagance, a vain illusion, and a needless and costly experiment, to go for the establishment of a botanical garden beyond the Central Park, which is so well adapted to the purpose, and to create from the beginning a "grand botanical garden" at a considerable distance in a wholly unprepared territory. —*Translated and abridged for the Popular Science Monthly from the March number of Pharmaceutische Rundschau.*

THE DESERT OF GOBI AND THE HIMALAYAS.

By Lieutenant F. E. YOUNGHUSBAND.*

THE Royal Geographical Society enjoyed a profitable evening a few months ago in hearing an account by Lieutenant F. E. Younghusband of a journey which he had made across Central Asia from Manchuria and Peking to Kashmir, over the Mustagh Pass, and the discussion upon it, in which officers learned in Indian geography took part. The author started in the summer of 1885, with Mr. H. E. M. James, who has since published in the book called "The Long White Mountain" the best account of Manchuria that we have. The travelers separated, after a pleasant and profitable journey, at Newchang, Mr. James to return home by way of Chifu and America, and Lieutenant Younghusband to travel back to India through Mongolia and Chinese Turkistan.

Respecting the field of the earlier journey, the author asserts that "few countries could repay the traveler better for his labors than Manchuria. It is a noble country, and well worthy of being the birthplace of the successive dynasties which issuing from it have conquered all the countries round, and of that dynasty which to-day holds sway over the most populous empire in the world. The fertility of the soil is extraordinary; the plain country is richly cultivated and dotted over with flourishing villages and thriving market towns, and the hills are covered with magnificent forests of oak and elm. The mineral resources are at present undeveloped, but coal and iron, gold and silver are known to be procurable. The climate is healthy and invigorating, but very cold in winter, when the temperature varies from 10° below zero Fahr. in the south to 40° or more below zero in the north. Rivers are numerous and large." The principal river is the Sun-

* Condensed from the author's paper in the "Proceedings of the Royal Geographical Society."

gari, which is navigable for vessels of three or four feet draught as far as Kirin, and whose rich valley is every year attracting thousands of colonists from China. The drawback is brigandage, which is very rife in northern Manchuria, and on account of which the people have to collect, for their own protection, in large villages and towns, so that small hamlets and detached farm-houses are never seen. Though it is Manchuria, the country is not inhabited by Manchus. They have been drained off to China proper, and their places are taken by immigrants from the Chinese provinces. The people of the original race have lost their old warlike spirit, and are a laughing-stock to the Chinese colonists. Unable to make headway against the brigands, they depend on the Chinese regiments to do that work for them.

A great many things had to be thought of in preparing for a long journey over an almost unknown country, in which were included the crossing of the terrible Desert of Gobi and of the Himalaya Mountains. Bills could not be obtained on any town in Turkistan, and it was necessary to carry money in bulk. If the Chinese copper coinage were taken, it would require a train of mules to carry a sufficient sum. The problem was solved by taking sixty pounds of solid silver, stowed away in the baggage. Clothing must be provided in anticipation both of great heat and of intense cold; and medicines had to be laid in, for the people as well as for the traveler and his party, "for they are always useful for giving to the natives. It is well I did so, for Mr. Dalgleisch's fame as a medicine-man had spread throughout Turkistan, and the Turkis thought that I, being also English, must be able to cure them instantly of any illness they had."

Ascending the valley of the Yangho from Kalgan, "the country presented a desolate and deserted appearance, for the villages were half in ruins; numerous watch-towers, now falling in pieces, were scattered over the country; and the inhabitants, looking ill-fed and badly clothed, were attempting in a half-hearted way to cultivate fields which were constantly being covered with layers of dust by the horrible sand-storms that used to occur almost daily at this time of the year. The country is of the formation called loess—a light, friable soil which crumbles to dust when the slightest pressure is put upon it. In consequence of this the roads are sunk thirty to forty feet below the level of the surrounding country; for when a cart passes along a road the soil crumbles into dust, the wind blows the dust away, and a rut is formed. More traffic follows, more dust is blown away, and gradually the roadway sinks lower and lower below the surrounding level; for the Chinese here, as elsewhere, never think of repairing a road. . . . On the 14th of April, 1886, I emerged on to the real steppes which are the characteristic features of Mongolia proper. Stretch-

ing far away in the distance there was a great, rolling, grassy plain, on which the flocks and herds and the *yurtas*, or felt tents, of the Mongols were scattered about. These people offered a striking contrast to the Chinese inhabiting the districts I had just left. They were strong and robust, with round, ruddy faces, very simple-minded, and full of hearty good humor. They are entirely pastoral and nomadic in their habits, and do not take to agricultural pursuits. The old warlike spirit which made them so powerful in the days of Genghis Khan has now disappeared completely. The Chinese Government has purposely encouraged the men to become Lamas, and now it is said that as many as sixty per cent of the whole male population are Lamas, who, by their religion, are neither allowed to marry nor to fight. In consequence, there is a great decrease in the fighting strength of the Mongols, as well as in the whole population. A recent famine carried away numbers more, and the country, it seems, would almost become depopulated were it not that Chinese immigrants are now invading it, and these are even outdoing the Mongols in their own callings, for I met Chinese in Mongolia who owned flocks of sheep which they were fattening for the Peking market."

In order to avoid the heat of the day, and to let the camels feed by daylight, when they could be watched and kept from straying, the usual plan of the journey was to start at about three o'clock in the afternoon, and travel on till midnight or later. The nights were often extremely beautiful, and the stars shone out with an unwonted magnificence. "Venus was a resplendent object, and guided us over many a mile of that desert. The Milky Way, too, was so bright that it looked like a bright phosphorescent cloud, or as a cloud with the moon behind it. This clearness of the atmosphere was probably due to its being so remarkably dry. Everything became parched up and so charged with electricity that in opening out a sheep-skin coat or a blanket a loud crackling noise would be given out, accompanied by a sheet of fire. The temperature used to vary considerably. Frosts continued to the end of May, but the days were often very hot, and were frequently hottest at nine or ten in the morning, for later on a strong wind would usually spring up, blowing sometimes with extreme violence, up till sunset, when it generally subsided again. If this wind was from the north, the weather was fine but cold. If it was from the south, it would be warmer, but clouds would collect, and rain would sometimes fall; generally, however, the rain would pass off into steam before reaching the ground. Ahead of us we could see the rain falling heavily, but before it reached the ground it would gradually disappear—vanish away—and when we reached the spot over which the rain had been falling there would not be a sign of moisture on the ground." Instead of the rain, the sand

found its way everywhere. Occasionally the march had to be given up because the camels could not make head against the violence of the wind.

A great ridge of bare sand, destitute of vegetation, at the western end of the Husku Hills, about forty miles long and nine hundred feet high, is associated with a tradition of a large military force having once been collected and preparing to march to China, when a mighty wind arose, blowing the sand against them and burying them all, together with several villages and temples.

The Altai Mountains are perfectly barren, with the upper portion composed of bare rock and the lower of long gravel slopes, formed of the *débris* of the rocks above. This *débris* is formed under the influence of the extremes of the climate upon the unprotected rock, with no rainfall sufficient to wash it away. So it accumulates in a uniform slope, often thirty or forty miles in length, leaving only a few hundred feet of the original jaggy outline of the mountain visible at the top. A prominent Altai peak was pointed out to the traveler as covering a grassy hollow which is frequented by wild camels. The Mongols are said to shoot these animals for the sake of their skins, and also to catch the young ones and train them to be ridden. They will go two hundred miles a day for a week, but can not be broken to carry a load. They are smaller than the tame camels, and are said to have short, smooth hair, in place of the long hair of the ordinary Mongolian camel. Considerable numbers of wild asses, and wild horses, the *Equus Prejevalski*, were seen roaming around the plains.

The most trying march in the desert was that of the last day, which was performed in sight of the Tian Shan, or "Heavenly Mountains." It was seventy miles in length, "and not a sign of water could be found throughout, while the heat was intense, for the wind blew off the heated gravel as from a furnace, and I used to hold up my hand to protect my face from it, in the same way as one would in front of a fire." On the next evening a friendly voice welcomed the party as it was ascending the lower slopes of the Tian Shan to a Turki house, with a stream of water running by it. The country on the southern slope of the range still continued desert, but with a small oasis every fifteen or twenty miles, containing a village and cultivated lands. A difference was at once observed between the Turki and ordinary Chinese towns. "In China the houses are, as a rule, large and well built, with pent roofs and overhanging eaves. The shops are of a respectable size, with plenty of room inside for the storage of goods for sale, and for several bustling shopkeepers, who serve their customers from behind good solid counters. In Turkistan the houses and shops are more after the Indian style. They are built of mud, low, and flat-roofed, and the shops small and heaped up all round with goods,

so that there is little room left for the shopkeeper. . . . If you could get a bird's-eye view of Chinese Turkistan, you would see a great, bare desert, surrounded on three sides by barren mountains, and at their bases you would see some vivid green spots, showing out sharp and distinct, like blots of green paint dropped on to a sepia picture." The oases are extraordinarily fertile; every scrap of land that can be cultivated is used up, and every drop of water is drained off and used for irrigation. The inhabitants are industrious, but not so good cultivators as the Chinese. They seem peaceful and contented, dress simply and well, and live in houses which, though built of mud, are kept remarkably clean inside. They are, however, much lacking in spirit, and stand in great awe of the Chinese, who produce upon them, as well as upon all the people of these regions, an impression of their overwhelming strength and importance. They are perfect masters of the art of impressing Orientals; their officials are scarcely known as human beings, but "are presences inhabiting a great walled-in inclosure, entrance to which is barred by massive gates, and they never appear in public except in state and accompanied by an escort. China, too, is regarded by the Turkis as an almost fabulous country." They never go there, and "only hear of it from the Chinese, who give the most exaggerated descriptions of it, telling them that the emperor has an untold number of soldiers at his command, and has a hill of gold and a hill of silver, from which he obtains inexhaustible wealth." Turfan, being seated at a very low elevation and surrounded by the desert, suffers from an intense heat, and the people, to avoid it, dig underground rooms, and live in them during the day.

The Kirghiz, whose country came next in order, were found more well-to-do than the Mongols or Kalmucs, dressing better, living in better tents, and keeping them clean; fine, strong men, not so industrious as the Turkis, but a great deal more so than the Mongols. "We put up every night in their tents, and they were generally very civil, though naturally rather curious to know who I was and see all my things. The Afghan had a hard time answering all the questions, so, when he found it monotonous, he used to spread a rug and solemnly say his prayers. He was a Hadji, and, to keep up his religion properly, had to pray five times a day. When he had been traveling all day, and had not been able to say his prayers, he used to make up for it in the evening by repeating them once every half-hour or so." On the plain called the Syrt were large fields of wheat grown by the Kirghiz, who had built houses to store their grain in, but continued to live themselves in their tents. "They said they preferred not living in houses, as they were always afraid of their tumbling down upon them." The author himself, when crossing the Himalayas

a few days afterward, had to guard against the dangers of living in a tent. In that region the Kanjutis are on the watch for the traveler, and, learning his ways in the day, attack him at night. If he pitches a tent, they cut the ropes and catch him inside it. "So, as I wished to end my journey in India, and not in Kanjut, I gave up using a tent, and for three weeks, while crossing the Himalayas, bivouacked out, spreading my rugs on the ground on the least windy side of any friendly rock I could find, and always changing my position after dark."

A complete outfit had to be procured for crossing the lofty range—good, sound, hard ponies, spare shoes for them, and tools for shoeing them; pack-saddles and blankets, and long sheep-skin coats for the men, and, as there would be no paths, pick-axes and spades for road-making. "As we got further into the mountains, I noticed that the heavy haze which perpetually hangs over the Kashgar and Yarkand districts faded away. This haze must, I think, be formed of dust stirred up by the strong winds which blow almost daily in those districts, for I noticed that there was a thin, permanent coating of dust on the rocks in the valley of the Tisuaf River, where there is practically no natural dust, but over which this haze continually hangs, and that, as we advanced inland and the haze disappeared, so also did this coating of dust on the rocks."

From the summit of the Aghil Darvan Pass (sixteen thousand or seventeen thousand feet high) the author had a view of the great Mustagh Range, or Karakorum Mountains, which form the water-shed between the rivers that flow into the Indian Ocean and those which take their way toward central Asia, with an immense glacier flowing down from the main range. "The appearance of these mountains is extremely bold and rugged as they rise in succession of needle peaks, like hundreds of Matterhorns collected together; but the Matterhorn, Mont Blanc, and all the Swiss mountains would have been several hundred feet below me, while these mountains rose up in solemn grandeur thousands of feet above me. Not a living thing was seen and not a sound was heard; all was snow and ice and rocky precipices, while these mountains are far too grand to support anything so insignificant as trees or vegetation of any sort. They stand bold and solitary in their glory, and only permit man to come among them for a few months in the year, that he may admire their magnificence and go tell it to his comrades in the world beneath. As I looked on the scene, I felt as if I were intruding on the abode of some great, invisible, but all-pervading deity."

After ascending the Sarpo Laggo River for a few miles toward the Mustagh Pass, "we came in view of the great peak K2, the second highest mountain in the world, 28,250 feet in height. We

could see it through a break in the mountains, rising up straight, bold, and solitary, covered from foot to summit with perpetual snow. The upper part, for perhaps five thousand feet, was a perfect cone, and seems to be composed entirely of ice and snow, the accumulation of ages. The lower part was more precipitous, but steep enough to throw off the snow altogether, while at the base was a great glacier formed by the masses of snow which fell from its sides. It was a magnificent sight, and I could scarcely tear myself away from it." The name K2 has been given to this mountain by the Trigonometrical Survey, waiting the discovery of a native name for it, for this enlightened corps always prefers native names when they can be found. Probably, however, like Mount Everest,* it has no name, not being familiar enough to the people to receive one, for both summits can be seen only from almost inaccessible places. The name Peak Godwin-Austen, after the officer who first surveyed the Mustagh Range and glaciers, was proposed for it at this meeting of the Royal Geographical Society.

The thrilling description of the crossing of the Mustagh Pass, where the party reached the height of nineteen thousand feet above the sea, is too long to be quoted here. It simply includes the usual adventures of icy Alpine climbing intensified, and adds no new facts. General Strachey, President of the Geographical Society, remarked, in the discussion of Lieutenant Younghusband's paper, that this pass appeared to be the center of the most wonderful accumulation of glaciers on the face of the earth. Some of them, which Colonel Godwin-Austen described, and which Lieutenant Younghusband must have passed over, were from thirty to forty miles in length, and probably, by passing from one to another, the traveler should be able to go over a glacier surface of seventy or eighty miles.

SKETCH OF RUDOLF CLAUSIUS.

THE name of Prof. Clausius—"one of the most brilliant lights of the nineteenth century," as he is called by one of the Vice-Presidents of the British Association—is conspicuously associated, along with those of Rankine and Prof. William Thomson, in the development of the science of thermodynamics, or the demonstration of the mechanical theory of heat; and to him is credited the first placing of the kinetic theory of gases on a secure scientific basis. England and France mourned almost equally with Germany in his death—England, because of his association with the great British

* The name commonly given as the native name of Mount Everest is not the name of the pinnacle itself, but of one of the satellite peaks by which it is surrounded, and which shut it off from ordinary view.

students of the nature of heat; and France, because he completed a work begun by her own Sadi Carnot, and because of a sentimental affection to which she had already given a unique expression.

RUDOLF JULIUS EMANUEL CLAUSIUS was born in Cöslin, Pomerania, January 12, 1822, and died in Bonn, August 24, 1888. He began his course of studies at the gymnasium in Stettin, where he made such marked progress as to attract the attention of his teachers and secure for him an early transfer to the University of Berlin. Here he evinced a predominant taste for the mathematical branches. He afterward went to the University of Halle, and received its doctor's degree in 1848. He then won the position of a *Privat Docent* at the University of Berlin, and a few months afterward was appointed Instructor of Natural Philosophy in the School of Artillery. At about this time he began his contributions of scientific papers to Poggendorff's "Annalen," some of the earliest of which were selected for translation in the first volume of Taylor's "Scientific Memoirs." In 1857 he was appointed by the Swiss Federal Government Professor of Natural Philosophy in the Polytechnic School at Zurich. His career at this place was distinguished by continued activity in his favorite fields of research, besides which "he published some short papers on some purely mathematical questions, suggested, however, by physical problems, and some papers dealing with what is generally known as physical chemistry." He gave up his chair in Zurich in 1867 to go to a similar position in Wurzburg, whence two years afterward he removed to become Professor of Natural Philosophy in the University of Bonn. He became dean of this institution in 1874, and continued there till his death.

The memoirs published by Clausius are estimated to number more than a hundred. Seventy-seven are recorded on the lists of the Royal Society up to 1873. Among his earlier papers the most famous are those "On the Nature of those Constituents of the Atmosphere by which the Reflection of the Light within it is effected," and "On the Blue Color of the Sky, and on the Morning and the Evening Red," which were published while he was in his tutorship at Berlin. While at Zurich he published "The Influence of Pressure on the Freezing-Point"; "The Mechanical Equivalent of an Electric Discharge, and the Heating of the Conducting Wire which accompanies it"; "Electrical Conduction in Electrolytes"; and "The Effect of Temperature on Electric Conductivity." In 1866 he published an important paper "On the Determination of the Energy and Entropy of a Body," in which a very valuable and suggestive conception was set forth. The idea of entropy, by which term is designated the available energy of a system, or that which can be converted into mechanical work, which he first conceived in 1854, and which led him to some extremely general and bold

conclusions concerning the universe, was developed and extended in his address before the Congress of German Physicians and Naturalists at Frankfort in 1867, eliciting the principle that the entropy of the universe tends toward a maximum.

The principal works of Clausius, on which his chief title to fame must rest, are those on "The Potential Function and the Potential" (1857), and on "The Mechanical Theory of Heat," the first volume of which was published in 1864. The properties of the potential function, while they had been neglected for a considerable time in France, had been put to their best use by all the philosophers of Germany and England who had treated of the natural forces of attraction and repulsion—particularly by such students as Gauss, Kirchhoff, and Thomson. In the preface to the second edition of his work on this subject, Prof. Clausius made the modest declaration that it was not his aim to institute new researches on the fundamental properties of the function, but simply to expound an existing theory. But it is evident through the treatise, as M. P. Langlois has shown, that while he takes up the ideas of Green and Gauss, he makes them his own by the simplifications which he has brought to them on one side and the extension which he has on the other hand given to some parts of the research. The work is distinguished beyond all other things, M. Langlois adds, by the strength of the analytic faculty displayed in it, which is carried to its ultimate limit. "Not contented with having established a formula, Clausius knew how to make it of remarkable utility. Two fundamental and particular ideas are developed in the treatise. First, the author fixes with precision the difference between the potential function and the potential, and shows the exact significance that should be given to the two, which are so much used in mathematical physics, and especially now in questions of electric dynamics; and he elucidates alike the idea of the potential of a mass upon itself and restores to the potential its true value, which had been erroneously doubled. . . . But it is not to this work that Clausius is indebted for his legitimate fame. His name is pre-eminently attached to the great problem of thermodynamics; and it is in his studies in this branch that his influence has made itself predominantly felt."

Thermodynamics may be said to date from 1824, when Sadi Carnot published his "Reflections on the Motor Power of Fire and on Machines suitable for developing it." The question of the nature of heat had already occupied Rumford and Davy, to say nothing of Bacon and Stahl; and being a dominating one in the problems into which it entered, arrested all physicists, who had only one step more to make to create thermodynamics. Carnot introduced the idea of mechanical work into the study, and sought to fix the relation that exists between the work of a thermic machine and

the heat which it employs. Waiving the too subtile question of the nature of heat, he devoted himself principally to fixing the conditions under which a maximum of work is yielded with a given quantity of heat. Guided by the purely philosophical idea of the equivalence of the work expended and the work produced, in perfect mechanics, he affirmed the analogous principle that the possible work is proportional to the quantity of heat employed and to certain functions of the temperatures of the vapor on coming in and going out. Carnot's annunciation of his theory was defective in that it took no notice of the fact that the hot body gives out more heat than the cold one receives from it, and that it regarded as equal the amount of heat received upon one isothermal side of a cycle and that emitted from the other side; a principle that may hold good for infinitely small cycles, but not for larger ones, in which a difference exists between the thermic quantities proportioned to the size of the cycle. This error and the true condition as pointed out by Clausius are defined by Prof. Rankine, who says, in his paper "On the Economy of Heat in Expansive Machines": "Carnot was the first to assert the law that the ratio of the maximum mechanical effect to the whole heat expended in an expansive machine is a function solely of the two temperatures at which the heat is respectively received and emitted, and is independent of the nature of the working substance. But his investigations, not being based on the principle of the dynamic convertibility of heat, involve the fallacy that power can be produced out of nothing. The merit of combining Carnot's law, as it is termed, with that of the convertibility of heat and power, belongs to Mr. Clausius and Prof. William Thomson; and, in the shape in which they have brought it, it may be stated thus: The maximum proportion of heat converted into expansive power by any machine is a function solely of the temperatures at which heat is received and emitted by the working substance, which function for each pair of temperatures is the same for all substances in nature." The law as thus modified and newly expressed might, as M. Langlois remarks, be designated as the equation of Clausius. But Clausius himself, acknowledging the influence which the Frenchman's ideas had exercised upon him, called it the theorem of Carnot. The second volume of the "Mechanical Theory of Heat" is almost wholly devoted to applications to electrical phenomena.

The reviewer in "Nature" of the English translation of this work says that the method of treatment pursued in it left hardly anything to be desired, "even from the point of view of a student previously ignorant of the subject. The reader is nowhere perplexed by uncouth symbols or analytical operations beyond those which are familiar to all acquainted with the principles of the differential and integral calculus. At the same time, . . . the reader is

never allowed to lose sight of the essential meaning of the symbols employed. . . . Any one wishing to gain a general acquaintance, thorough as far as it goes, with the subject, can scarcely do so with the expenditure of less time and labor than are required for the perusal of this book. As a mathematical study the book may replace some of the luxuriant growths of modern geometry and analysis with great advantage to the brains of the student."

In his later years Clausius was interested principally in the study of the questions raised by dynamo-electric machines. He published a theory of dynamo-motors in "La Lumière électrique," in 1884, in which he sought to fix more general equations, resting on more solid theories than those in use; but, notwithstanding his memoir is marked by his peculiar qualities, the theories have not been accepted, and have only been partly, if at all, confirmed by late researches. Yet it is to him that we owe a brilliant and clear exposition, and one of the first that was made, of certain phenomena of self-induction.

The Franco-German War occurred while Prof. Clausius was at Bonn. Although he was not liable to draft in the general mobilization, he was engaged in the ambulance service, and diligently interested himself in the care of the wounded. After the war was over, the German Government decorated him with the order of the Iron Cross, and the French with that of the Legion of Honor. The reason of the French awarding such a distinction upon an eminent German at such a time, when resentments still lively enough were at their height, is most probably to be found in the fact that he did not observe distinctions of nationality in his attentions. The incident affords a striking illustration of the effect of scientific studies in widening the range of thought and sympathy.

Prof. Clausius is described by M. Langlois as having been a teacher of remarkable clearness and simplicity in his explanations. His instruction was marked by a particular care to keep always within the limits of true physical principles. While he was remarkably versed in mathematical methods, he always kept the physical notations in the minds of his readers, and never allowed himself to be carried by his analyses into the regions of too vague conceptions. Mr. G. W. de Tunzelmann agrees with this conclusion in his obituary sketch in "Nature," saying that Clausius formed a center of attraction at Bonn, "not only as a great investigator, but as a teacher of almost unrivaled ability. The secret of his powers as a teacher may easily be guessed from the study of his published papers and treatises." The greater part of his work, the writer adds, had the additional advantage of being effected by the aid of comparatively simple analysis.

Prof. Clausius was elected a foreign member of the Royal Society in 1868, and received its Copley medal in 1879.

CORRESPONDENCE.

"PLAYING 'POSSUM."

Editor Popular Science Monthly:

IN your February issue Mr. S. F. Goodrich brings up the question whether animals ever "play 'possum." He suggests that the apparent helplessness of certain animals when attacked is real; that what is popularly ascribed to cunning is in reality due to fright—a *faint*, and not a *feint*.

This theory is new to the great majority of those who have observed the habit referred to; but its newness is not of itself a serious objection to it. Many familiar phenomena have waited long before receiving correct explanation. It has always been taken for granted that animals passive in the presence of danger were attempting deception. Rarely has any other explanation of their conduct been offered; but it does seem almost incredible that our far-away kinfolk should be using that distinctively human device—simulation.

Many of these acts can be satisfactorily explained on either assumption. The opossum may at times be unable to move because of his fright, or he may assume the passiveness of death as his surest hope for life. Which appears the more reasonable? Granted that it is difficult for us to credit the animals in question with sufficient intelligence and self-control to select deliberately such mode of defense, does not the other theory involve us in much greater difficulties?

Do the lower animals ever feign any condition? If this question can be answered positively, it seems to me that we shall have the solution to the other problem. The cat, when playing with a captured mouse, *appears* to feign unconcern and forgetfulness while looking away from its victim, and surprise on seeing it again. Probably there are very few persons who have not at least once been deceived by the disabled appearance of birds when their nests or young were approached. Very many of our birds under these circumstances act so as to draw attention to themselves, and when pursued keep just out of reach, luring the pursuer to his greatest efforts by seeming to have reached the maximum of their speed. Finally, the foolish one, with feelings injured, gives up the chase in disgust. Are the birds conscious that their appearance is deceptive? Fear certainly did not make them really helpless. If it be admitted that there is hypocrisy in such cases, then it may not seem impossible for even these stupid animals to feign other conditions, not excepting that of death.

If the opossum while in this passive state be thrown into water, its passiveness will be modified somewhat, but will still be maintained. Its nose will be kept above the surface, and it will paddle away so very gently that the motion is hard to detect. If while "dead" a stick be put into its open mouth, it will quietly close on it with its teeth, and may then be carried long distances swinging from the stick, but showing no other signs of consciousness; or it may be carried by the tail, it doing the holding. Do these facts, which none acquainted with the habits of opossums will question, sustain the theory of paralyzing fear?

The fox also appears helpless sometimes when caught, and there are instances recorded of men being severely bitten because of too much faith in its apparent innocence.

The toad when captured frequently makes a complete surrender, closing its eyes and settling down to apparent listlessness. If everything remains quiet, its eyes will soon open very gradually, closing again if danger be still visible; if not, it will prepare to move. If the enemy be discovered while it is trying to escape, it again assumes its former submissiveness.

The actions of the spreading adder are also curious. If approached, it makes a hissing noise and starts forward, looking as hideous as possible, as though it would frighten its enemy. These motions it will repeat several times if touched with the finger or a stick; but finally it seems to despair of relief by that method, and throws itself on its back and utterly refuses to make further defense. On first observing this peculiar position, I was sure the reptile was dead; but on returning a few minutes later to the box in which I had it, found it looking all right. The same effect followed the repetition of the teasing. When I turned it right side up, it immediately turned back again. Repeated experiment since with these snakes has shown that they even resist with muscular effort a change from their unnatural position.

Many beetles have habits similar to those of the animals named, and, like them, their pretense is overdone. When the Colorado beetle, or potato-bug, falls from the potato-vine on being approached, it nearly always comes to the ground with the feet up.

Many other examples might be given; but the above, I think, are sufficient to show that the theory that in the phenomena under consideration the animals are helpless from fright is untenable. In almost every case the animal manifests consciousness, shows itself cognizant of the situation, and betrays its anxiety to escape. H. L. ROBERTS.

LEWISTOWN, ILL., *February* 23, 1889.

SENSE OF DIRECTION IN ANTS.

Editor Popular Science Monthly:

A short article on the "Sense of Direction in Insects," in the February number of "The Popular Science Monthly," served to remind me of an account of the travels of an ant told me by my father, the late Prof. Lyford. His attention was drawn to the insect by a very heavy load which it was carrying. When first noticed it was traveling along a gravel walk in most approved fashion, and, while occasionally avoiding a large pebble, was pursuing in the main a very straight line. But soon it turned from the walk, and taking a different direction entered a grass-plat. Here a different mode of proceeding was adopted. Finding it difficult to walk around the grass-stalks, it would climb to the top of the blade, let it bend down with its weight, then get off and climb a second, and so on. Besides making quite satisfactory progress in this manner, the top of the grass-blade seemed to furnish a convenient point of observation, like a tree-top in a forest. Through the grass the route was very direct until it reached its "*hill*," when it disappeared. A careful calculation of the distances traveled on the gravel and through the grass, and of its rate of progress over the two, indicated that, while the total distance was greater than if measured in a straight line, yet that the insect had actually selected, very nearly if not exactly, the route which could be traversed in the shortest time, seeming to realize that in this case at least "the longest way round was the shortest way home."

Edwin F. Lyford.

Springfield, Mass., *February* 20, 1889.

JAPANESE MAGIC MIRRORS.

Editor Popular Science Monthly:

In the February number of the "Monthly," in the "Miscellany," page 572, Prof. Mendenhall's account of the Japanese "magic mirror" is quoted. The reason which he gives for the peculiar property that a few accidentally possess of reflecting upon a screen an enlarged image of the figures in relief on the back of the mirror seems to me, to say the least, questionable.

While in Japan I became intensely interested in the phenomenon, which has been explained in many ways. By the process of exclusion, all for the time being were discarded but two. The first of these is given by Prof. Mendenhall, viz., "When the mirror is cast the cooling process has the effect of drawing it slightly out of shape"; and the second endeavored to answer the question by supposing that in the casting there was produced a difference of density opposite the ornamentations, which are in decided relief. It was argued that the more dense portions would be abraded less in the operations of grinding and polishing than the softer parts, hence leaving them a very little in relief. There is no design, in the mind of the artist, for an unequal density in the casting, and, so far as I am aware, there is no proof that it exists. In observing the mode of grinding the face for the final polish, it appeared quite evident that all "drawing" and differences in density would be reduced to quite the same level. The process of final finish seemed to me to solve the puzzling riddle, which is as follows: When the moderately convex surface has been brought to a satisfactory and equable condition, the casting is placed upon a solid base, on which the figures in relief firmly rest, leaving the intervening spaces practically unsupported. In order to get all the "drawing" and unevenness out of the face of the casting, some are ground thinner than others. The final polish is given by violently rubbing the surface with the rather small end of a soft-wood stick, applied with heavy pressure. It seems evident that when the stick passes from the thick supported to the thin unsupported parts, the latter would be slightly depressed, and the continued rubbing pressure would fix these depressions, leaving slightly raised lines exactly opposite the ornamentations in relief on the back. These are so slight as not to be detected by the eye, but when cast from the convex surface on a screen at some distance the diverging rays would enlarge the image, so as to produce the fact of the phenomenon.

G. O. Rogers.

Apam, Mexico, *February* 1, 1889.

SELF-POISONING BY SNAKES.

Editor Popular Science Monthly:

In your January number you say, "To what extent a poisonous serpent's bite is noxious to itself is doubtful"; and the testimony of Dr. Stradling there given tends to settle the doubt in the negative. Bearing upon this question is the following from Lieutenant Michler's report to Major W. H. Emory, United States Army, and bearing date July 29, 1856. It is to be found in Major Emory's report of the "United States and Mexican Boundary Survey," vol. i, pp. 121, 122.

"The glare of our fires attracted a large number of rattlesnakes; the whole place" (the "Sierra del Poso Verde") "seemed infested with them. We judged them to be a new species from their tiger-colored skins; they were exceedingly fierce and venomous. On the deserts of the Colorado we had often seen others with horns, or small protuberances above the eyes; and Dr. Abbott has taken from the body of still another species quite a number of small ones, among which was a monstrosity with two perfectly formed heads attached to one neck. When you lie down on your blankets stretched on the ground, you know not what strange bedfellow you may have when you awake in the

morning. My servant insisted upon encircling my bed with a *riata* of horse-hair to protect me from their intrusions. Snakes are said to have a repugnance to being pricked by the extremities of the hair. The *paisano*, or chaparral cock, surrounds his antagonist, while asleep, with a chain of cactus-thorns. When the preparations are all made, the bird flutters over the head of the snake to arouse it to action; the latter, in its vain efforts to escape, is irritated to such a degree by running against the barrier encompassing it, *that it ends its existence by burying its fangs in its own body.*"

To what end or purpose is all this wonderful strategy on the part of the bird? Is it simply to imprison the snake? Is it for the fun of seeing the reptile fooled? Is it merely that the snake should "inflict only mechanical injury upon its own body" which would not be at all likely to prove fatal; or is the whole story false?

A. J. WILLIAMS.

CLEVELAND, OHIO, *February* 21, 1889.

EDITOR'S TABLE

INTELLECTUAL INTEGRITY.

MILL'S "Essay on Liberty" and Darwin's "Origin of Species" mark the opening of what we may regard as the latest chapter in the history of modern thought. Mill vindicated for all men the right, not only of using their individual judgment, but of expressing their individual opinions, upon all subjects whatsoever, and proclaimed it to be at once the duty and the interest of society at large to see that no impediments were cast in the way of such exercise of intellectual liberty. Darwin furnished almost at the same moment a theory which ran so strongly counter to received opinions that to espouse it demanded no small amount of intellectual courage, and to discuss it fairly on its merits, without any appeal to theological prejudices, a somewhat rare degree of liberality. Darwin seemed to say to a society that had just received Mr. Mill's essay with acclaims of praise: "Well, here is a touchstone of your sincerity; here is a doctrine which I have carefully thought out, and which, if true, involves a complete reconstruction of many of your most cherished ideas: can you do it justice? Can you do justice to those who may accept it?" Outside of the theological colleges the world responded fairly well to the appeal, and "The Origin of Species," though keenly criticised, received the treatment due to a serious intellectual effort. How far the theological colleges, or the theologically governed colleges, lagged behind may be judged from the comparatively recent period at which a professor of eminence was removed from his chair in a Southern college because he had embraced and taught Darwinism in a very mild and inoffensive form.

The question, however, at which we wish to glance very briefly, is not as to the merits of Darwinism, but as to whether a better basis for the claims of modern thought might not be found on the lines of Mill's famous essay than upon that profession of "agnosticism" to which so many nowadays betake themselves. A passage that falls under our eye, from a French moralist of the seventeenth century, may help to illustrate our meaning. "There is," says Nicole, the friend of Pascal, "a duty of *conviction*, which arises when we are face to face with *evidence;* a duty, also, of *doubt*, because it is absurd not to be in doubt regarding doubtful things; and a duty of *opinion*, because we are obliged to affirm that one thing is more probable than another, if proof to that effect is offered." Now, what a modern thinker may justly claim is, liberty to do what Nicole calls his "duty" in these three particulars: to believe in things certain, to doubt of things doubtful, and to have an opinion where the evidence, though not demonstrative, is sufficient to establish a probability. But from which of these three phases of duty should he choose a name for himself? Would it

not be equally absurd for him to call himself a "believer," or a "doubter," or an "opiner"? Surely he is all three, each in its turn; and, whether in believing, or in doubting, or in opining, he is equally maintaining his intellectual integrity. Taking this view of the matter, we have not hitherto been able to regard the "agnostic" position as very well or happily chosen by many, at least, of those who profess to hold it. We think, for example, that "agnostic" is a poor name for such a man as Prof. Huxley to be known by. Prof. Huxley is a man of a decidedly positive and constructive cast of mind, a man eager to affirm all the truths that he can establish. If he makes a stand for anything, it is for intellectual integrity. To him it is a crime to believe without evidence, or to disbelieve in spite of evidence. In this respect he is entirely at one with the excellent Nicole, whose words we have quoted. Why should a man of this kind be separated by any badge or party nickname from the community at large? His one great interest is the truth, and what nobler interest can any man have? Or, again, what profounder basis of sympathy and union can any two men, or any body of men, have, than a common and ardent love of the truth? Mere outward agreement in opinion counts for little, unless there is sincerity at the back of it. It is impossible, at least for any enlightened man, to derive satisfaction from the support of those who, he knows, have no interest in the truth, and who are prepared to defend the opinions they have embraced by all kinds of party strategy.

The highest profession any man can make is a profession of intellectual integrity; and to us it seems to be sufficient for all purposes. It is one which a man can summon others to share. It becomes at once the basis of a true apostolate. "Believe what you may," cries the true modern thinker, "disbelieve what you may, only make it a sacred principle that your beliefs shall be honest, and shall be advocated and defended by honest arguments and none other." It may seem to some that this is an appeal easily made, a programme easily realized. Possibly, but it demands this: that underneath every opinion and belief shall be a fundamental sense, acquiring gradually the force of an instinct, that the ultimate object of loyalty and devotion is the truth. Truth, if we may so express it, must own the soil of the mind, and opinions and beliefs must be merely tenants occupying according to the terms of their several leases. Loyalty to an opinion is a misleading phrase, and one that ought to be banished from the vocabulary of honest men. The only true and worthy loyalty is to that which alone can vitalize any opinion—namely, the truth.

If it be objected that there is no convenient name by which the brotherhood of truth-lovers could be known, we answer that the objection seems to us of trifling importance. The great thing is that a man should be a truth-lover, not that he should have any special appellation. The Christians "were first called Christians at Antioch"; and St. Paul founded churches without, apparently, using or recognizing the name, which is not once mentioned in his epistles. The "Methodists" of the last century took a name that was applied to them mainly in derision by their opponents, and one which certainly did not bind them to any set of opinions. Let a man profess and, still better, let him practice honesty in all his beliefs, and let the world dub him as it may. He will then be prepared to say, when duly questioned, what those things are which, following the pious Nicole, he finds it a duty to *believe*, the evidence being what it is; what those things are which to his honest apprehension are *doubtful;* and what those in regard to which he is moved by a greater probability to entertain an *opinion*. The things that he disbelieves he will also with equal frank-

ness declare, and his disbelief will be governed by a sense of duty as much as every other attitude of his mind. There is great need in the present day for those who love the truth in sincerity to seek one another out, and to strengthen one another for the great conflict that has incessantly to be waged with the forces of error, of falsehood, and of moral indifference. What can separate any man, against his will, from the love of the truth? And what should separate from one another men who, though differing momentarily in opinion, love the truth with constant and equal devotion?

AN UNCANDID CRITICISM.

We find in the March number of the "Canada Educational Monthly," published at Toronto, the following remarks about Dr. Andrew D. White and "The Popular Science Monthly":

"The same number [of 'The Popular Science Monthly'] contains the concluding portion of Dr. Andrew White's article on 'Demoniacal Possession and Insanity.' Dr. Andrew White 'seemeth to be somewhat,' but, we think, many thoughtful readers will say, 'he addeth nothing to me.' Probably the best article in the number, for most of our readers, will be that on 'Natural Science in Elementary Schools.' Sometimes the 'Popular Science' is worth reading carefully, but at other times it is somewhat unsatisfactory, and many of its writers seem to have atheistical tendencies, so that its pages are occasionally disgraced by remarks about Christianity which are too spiteful to be scientific."

Dr. Andrew D. White is what he is, and whatever he "seemeth to be" to the editor of the "Canada Educational Monthly" will not alter the facts. The ex-President of Cornell and our late Minister to Germany does not need that we should sound his praises as a man of wide and accurate knowledge and of philosophic habit of mind. What must have struck every careful reader of his recent articles is, that he handled his subject with the utmost regard for the feelings of those to whom some of his conclusions might have been unwelcome; and it seems proper to remark that, if he "added" nothing else to the editor of the "Canada Educational Monthly," he might have added—had his example been sufficiently heeded—a tone of respect in dealing with the opinions of opponents. It is easier, however, to sneer than to argue, to insinuate than to prove or disprove. If Dr. White has presented his subject in a false light, let the "Canada Educational Monthly" demonstrate the fact. It is hard to "add" anything to people who do not want to have anything added to them except, perhaps, an extra layer of prejudice; but, in the way of adding information, that writer does his own full duty who states relevant facts in a lucid and candid manner. If Dr. White has not done this, let his critics show it. We are not responsible for our contributors' opinions; but, in the name of intellectual honesty and literary morality, we protest against such criticism as that quoted from our Toronto contemporary.

As to "The Popular Science Monthly," we have no doubt that our habit of letting the leading thinkers of the world express their opinions through our pages is very distasteful to many who still cling, more or less tenaciously, to the slowly decaying superstitions of the past. But the columns of the "Monthly" will bear witness that these discussions, though in the main outspoken, have always been dignified in tone, and as considerate of the feelings of others as the utmost courtesy can require.

"The Popular Science Monthly" endeavors to represent the scientific culture of the age in all its fullness and variety; and it is happy to know that, in doing so, it has the sympathy and support of a very wide circle of readers, including most of the prominent edu-

cators of this continent. Our firm belief is, that the truth can take care of itself—that it does not need any bolstering or hedging round or underpinning; and we therefore throw our pages open to any one who can discuss a timely subject bearing upon the progress of human interests in a scientific manner. We know of no other principle upon which a "Popular Science Monthly" could be honestly or successfully conducted; and, as to our pages being 'disgraced by remarks about Christianity which are too spiteful to be scientific," we can only say that an unsupported charge of this kind, in the face of the record made by the magazine from its beginning, need give us extremely little concern. Some time ago we had occasion to remark that a single number of the "Canada Educational Monthly" contained two articles borrowed from "The Popular Science Monthly"—one of them without acknowledgment. We think that such practical approval of the wares we offer the public goes far to set off the illiberal criticism above quoted from the same quarter.

LITERARY NOTICES.

THE FOLK-LORE OF PLANTS. By T. F. THISELTON DYER. New York: D. Appleton & Co. Pp. 328. Price, $1.50.

FOLK-LORE is always a fascinating study, and no branch of it offers more of peculiar interest than that of plants. Prof. Dyer, therefore, has chosen a popular theme, one that has engaged the attention of many writers before him, and the present volume is a condensation in large part from previous books and papers upon the subject. In the author's own prefatory words it is "a brief, systematic summary, with a few illustrations in each case of the many branches into which the subject naturally subdivides itself." The book before us is, therefore, a hand-book to all who are interested in the subject upon which it treats. A mention of some of the twenty-three chapters into which the work is divided will help to present a faint idea of the scope and success of Prof. Dyer's compilation. Plants in witchcraft, plants in fairy lore, love-charms, plant language, doctrine of signatures, sacred plants, plants in folk-medicine, and mystic plants; these are suggestive of the careful systematic work done by the author. It is impossible to epitomize a work of this kind which in itself is an epitome of a vast subject. The foot-notes and references, one or more on nearly every page, illustrate how very wide has been the gleaning of the painstaking author. Open the book at any page, and a pleasing, succinct statement will be found of some ancient superstition of plant spirit, plant worship, plant witchery, plant demonology, or plant legend.

Darwin, in his famous work upon "Movements of Plants," says: "Why a touch, slight pressure, or any other irritant such as electricity, heat, or the absorption of animal matter should modify the turgescence of the affected cells in such a manner as to cause movement we do not know." In the light of this frank confession of ignorance by one of the wisest of Nature's modern students it is not strange that during the early ages of the world every living thing was believed to be under the direct control of some spirit, good or evil, which was none the less real to the ignorant people because unseen. It was natural for the ancients to ascribe causes to well-established effects, and the world of plant life came in for its full share. They believed blindly in the vegetable origin of the human race—that is, man sprang from some sacred world-tree. In modern times the belief is not altogether different from this, but the method is through the gradual unfolding of the higher from the lower by the slow process of evolution. In like manner the ancients, in seeking for a divinity, ascribed superhuman power to the mighty oak, and clothed other trees as with the garb of gods. The worship of to-day is often of structures far less lofty and inspiring than the forest giants. In our time we can with profit glance back and note the growth of ideas as they broaden with the ages and see that our own idols must be broken in pieces by the relentless wheels of progress. This is one of the good features of such books as the one before us, and should make them popular, because being a history of the people in every-day life—their common thought and conversation.

We must remember that the day of folk-lore is not past; superstition has not given place to science, and the reign of isolated absurdities still holds sway in many minds in place of law and order. It may be no worse to attribute the hidden evil of the world to plants possessed of Satan than to believe that there is a creature with horns and a cloven foot seeking for the innocent to satisfy his capacious maw.

Some of the most charming examples of plant lore are found in that portion having to do with fairies. Of course, the fairy itself is a pleasing myth that will require many ages to eradicate from the human mind, because it adds so much of innocent beauty to a majority of the nursery rhymes and children's tales. The whole deception of Santa Claus is one born to an endless earthly life, because having only a happy and healthful influence upon both the old who practice it and the young who are so delightfully deceived. There is a perennial pleasure in the thought that a tulip-blossom is a cradle in which mother fairies lull their little ones to sleep. To this day the finder of a four-leaved clover is considered by many as a person born to good luck—a notion that has descended from an older idea, namely, that the monstrous leaf was a talisman which enabled its wearer to detect the haunts of fairies. Much of fairy lore clusters around the so-called fairy rings, that is, the green circles in old pastures within which the elfs were supposed to dance at night by the light of the moon. Modern science has extracted the last breath of poetry from this common phenomenon and left it as a dry fact in the cyclopædias.

Flowers play no insignificant *rôle* in love-making at the present day, and no school-girl's botany is complete unless she can discourse fluently upon the language of flowers. Some plants are naturally symbolic of certain ideas. Thus, grass readily may stand for usefulness and the cypress for mourning, the poppy for sleep, and the trembling aspen for fear. Other plants do not carry their florigraphical meaning in plain sight, but have acquired their adopted meaning in ways that are lost in oblivion while the symbol remains. Thus the rose was dedicated to Venus by the early Romans and Greeks, and now stands for love, especially the deep red varieties. The constancy of the violet and the curiosity of the sycamore are far less evident than the weeping nature of the drooping willow.

The degree of credence given by many to the strange stories of fabulous plants is one of constant surprise to those whose knowledge shows up the traditions in their true light. The barnacle-tree is an instance to the point, and the following is a sixteenth-century description of it: "There are found in the north of Scotland and the isles adjacent, called Orcades, certain trees whereon do grow small fishes of a white color, tending to russet, wherein are contained little living creatures; which shells in time of maturity do open and out of them grow those little living things which, falling into the water, do become fowls whom we call barnacles, in the north of England brant geese, and in Lancaster tree geese; but the others that do fall upon the land perish and do come to nothing." There is more foundation in fact for this exaggeration of trees which, overhanging and dipping into water at high tide, may bear barnacles than in the wonder-working moonwort which would open locks, and unshoe horses treading upon it—certainly a very unsafe herb in the hands of unscrupulous house-breakers—providing the fable were true. Under the "doctrine of signatures" the author brings together a large amount of interesting matter illustrating the old idea that each medicinal plant has some sign of color, shape, etc., which indicates its healing power either for the whole body or for some particular organ. For example, red juice is for the blood, yellow for jaundice, the liver leaf—shaped like a liver—for the liver, etc. This doctrine was carried to an almost amusing excess. Thus, the shell of walnut, which resembles a human skull somewhat, was used for troubles of the brain. The aspen was employed for palsy; and mistletoe, a plant that grows in a suspended position, was good for dizziness.

Young people even could find much amusement in the chapter upon games, having plant lore as the basis and often set to rhyme.

Folk-lore in medicine is a vast subject receiving its full measure of treatment. Strange are many of the rhymes in this section of the subject. A single couplet is here indulged in:

"Eat an apple going to bed,
Make the doctor beg his bread,"

which is only a striking way of saying—

That apple eaten upon retiring
Is better than the doctor hiring—

a statement that may not be in accord with the teaching of the theory and practice of modern medicine.

The book before us is full of weird things that cast a peculiar light upon the past, and add new luster to the present. The human mind in the early centuries was saturated with unaccountable notions of the wildest sort. Prof. Dyer has shown a master's hand in dealing with the occult theme. He has been happy in his selections, conscientious in treatment, and clever in the grouping of the otherwise almost isolated and independent fables, superstitions, and legends.

INTERNATIONAL LAW. By HENRY SUMNER MAINE, K. C. S. I. New York: Henry Holt & Co. Pp. 234. Price, $2.75.

THE series of twelve lectures here published was delivered before the University of Cambridge in 1887, by the late Sir H. Maine, then Professor of International Law on the foundation of Dr. Whewell. In speaking of the sources of international law the author says that a great part of it is Roman law spread over Europe by a late stage of the process by which the general body of Roman law had obtained authority over the same territory. It was the part of Roman law which had been called "Law of Nations," or "Law of Nature," and which was originally a collection of rules and principles common to the institutions of the various Italian races. The author next considers the history of the conception of sovereignty, and how a state acquires unappropriated territory, also what degree of occupancy constitutes a valid claim over a given area. A consideration of the law in regard to jurisdiction in territorial waters, and on board merchant ships on the high seas, leads up to the subject of naval or maritime belligerency. The Declaration of Paris occupies part of the chapter on this subject and also a separate chapter. The author thinks that the condition on which the United States offered to assent to the prohibition of privateers in this document, namely, that all private property be exempt from capture, would be a very favorable arrangement for Great Britain, whose food-supplies and the goods sent to pay for them have to travel such long distances by sea. The mitigation of war is next taken up, and the means of injuring an enemy commonly prohibited are named, the subject of spies and stratagems is discussed, and the disposal of the wounded and other prisoners is treated. Certain relations of belligerents on land, comprising military occupation, capitulation, and flags of truce, together with the subjects of captures and requisitions, occupy the next two chapters. In the statute regulating his professorship, Dr. Whewell enjoined upon the occupant of the chair that he should make it his aim, in all parts of his treatment of the subject, to lay down such rules and suggest such measures as might tend to diminish the evils of war, and finally to extinguish war among nations. Accordingly, the professor devotes his closing lecture to the measures for the abatement of war proposed within recent years. In this chapter are considered the opposition to war on religious grounds, the substitution of arbitration for war, touching upon the defects of international courts, with a mention of De Molinari's proposal that it should be one of the duties of neutrals to combine to thwart the spirit of belligerency. These lectures were not prepared for publication by the author, but have passed through the press under the direction of Mr. Frederic Harrison and Mr. Frederick Pollock.

THE ECONOMIC INTERPRETATION OF HISTORY. By JAMES E. THOROLD ROGERS. New York: G. P. Putnam's Sons. Pp. 547. Price, $3.

PROF. ROGERS develops English history from the standpoint of an economist, and brings to his task a rich mine of records hitherto neglected. As readers of his "Six Centuries of Work and Wages" are aware, he has been a diligent delver into the elaborate accounts kept in England since the thirteenth century by farmers, builders, and landlords. These and the court rolls of manors have enabled him to ascertain the variations for six hundred years in prices, wages, rents, and taxes. We are told what people ate and drank, how they were housed and clothed, and what some of them were able to save. This new light shed upon the hearth, wardrobe, and dinner-table evidences in a very

striking way how progress and retrogression have succeeded one another in England. Prof. Rogers's work is a notable contribution to the modern view of history, which looks not so much at the conspicuous and picturesque elements of national life, the contests of courts and battle-fields, as at the daily life of the common people; which busies itself with their progress in the arts and sciences, their success in translating justice into law, and the consequences due to change of conviction as to the rights of the citizen and as to truth in religion.

Prof. Rogers shows that in many ways the common people in the middle ages were better off than they are now. Although the standard of living was low, want was rare. The best workmen, associated together as guilds, purchased lands and houses throughout England for charitable service to their order, and so in a spontaneous, wholesome way effected an insurance for old age and infirmity. In the fifteenth century skilled workmen, such as carpenters, and masons, worked but eight hours a day; this, too, without invoking legislation for the purpose. So skilled were some of these men that they combined the talents of both design and execution, and planned the churches, guild-halls, and cathedrals they afterward helped to build.

Rent was at first a tax imposed by the lord for the protection he extended. For arable land in six centuries rent has been multiplied tenfold in comparison with the price of grain. Competitive rents were of very gradual introduction by the landed classes, who in the main have been grossly unjust in evading taxation and in increasing privileges while ignoring the responsibilities originally attached thereto. Once, property was almost universally diffused, and at that time Prof. Rogers believes the respect for property, still so characteristic of Englishmen, to have been implanted. Because its sheep-pastures were secure from the invader and untouched by the thief, England for three centuries enjoyed a monopoly of wool production in Europe, enormous in value. Prof. Rogers is of those who accord a supreme molding potency to circumstances and conditions; he holds the drunkenness and unthrift of the English working people to be largely chargeable to the demoralization of unjust poor-laws, and the oppressions of a landlordism which at last extorted famine rents. While he has devoted his life to the study of political economy, he sees that that science takes but a partial view of man and not the highest view; and that no one can understand political economy who does not take some trouble to understand human nature—its sentiments, affections, passions, and hopes. It is refreshing to find an economist who has had the expanding experience of a long parliamentary career and a varied knowledge of men and things the world over. Such a man, possessed of a new and rich store of fact, brings a new treatment to the well-worn themes of currency, pauperism, colonial policy, and the extension of the sphere of government into the field of business. His chapters, delivered as lectures at Oxford, have the freedom if albeit the dogmatism of a veteran discoursing to his juniors. Still they have a ring of manliness and humanity which much heightens the effect of his teaching. He has some plain words for the economists of the arm-chair who give verbal symmetry to incomplete and second-hand impressions—men who are plainly in sympathy with those who have wealth and comfort rather than with those who create these things.

BEAUTY, HEALTH, AND STRENGTH FOR EVERY WOMAN. By OSCAR B. MOSS, M. D. Ann Arbor, Mich.: The Register Printing and Publishing House. Pp. 376.

"I AM not able to recall," says Miss Catherine E. Beecher, "in my immense circle of friends and acquaintances all over the Union, so many as ten married ladies, born in this century and in this country, who are perfectly sound, healthy, and vigorous." A large share of the women in any one's acquaintance in America are delicate, or have frequent fits of sickness, or general poor health, or are chronic invalids. There is little of this disease that is not preventable by faithful use of the medical knowledge that we now possess. To make this knowledge known to the women of America, and to impress them with the importance of guiding their mode of life by it, are the objects of Dr. Moss's volume. The first practical subject which the author treats is diet, and this is followed by a chapter on the dress of young girls. In the next chapter the physio-

logical and psychological changes that occur when the girl attains the age of puberty are described. Mental and physical culture are the next two subjects considered, and under the latter head certain gymnastic exercises adapted to develop various parts of the body are specified. Woman's dress, the hygiene of the monthly period, marriage, the hygiene of pregnancy, and the change of life, are treated in a simple practical fashion. The last chapter is devoted to beauty, and tells women the most effective ways of securing beauty for themselves, and of transmitting it to their children. The treatment is plain, practical, and popular throughout.

MENTAL EVOLUTION IN MAN. ORIGIN OF HUMAN FACULTY. By GEORGE JOHN ROMANES, M. A., LL. D., F. R. S. 8vo. Pp. 452. D. Appleton & Co. Price, $3.

THIS is the most important scientific work that has appeared in many months. It follows in logical sequence upon the author's former book, "Mental Evolution in Animals," and is intended to be the first installment of a series which the writer says will deal with the intellect, emotions, volition, morals, and religion. The present volume is concerned chiefly with the *origin* of human faculty, as distinguished from its development, and is mostly limited to the psychology of the subject, postponing anthropological evidences for the next installment.

Dr. Romanes takes for granted the general theory of evolution, including the evolutional doctrine of descent "as regards the whole of organic nature, morphological and psychological, with the one exception of man." Even with man this assumption is continued so far as his bodily organization is concerned; it being thus only with reference to the human mind that this exception is allowed. The effort is then made to show that the same doctrine is applicable also to the mind of man, or to "human faculty."

In the last number of "The Popular Science Monthly" extracts were given from the work before us sufficient to indicate the main positions taken and the line of argument pursued, which circumstance renders it unnecessary for us to give in this place even an outline of the course of exposition. One thing, however, ought to be observed, which did not appear in the article referred to. The controversy centers around the problem of language and the mental acts involved in predication. The task of proving that these require and exemplify nothing more than higher and more perfect developments of powers the same in kind as those found lower down in the scale of animal life, is pursued with great ability and thoroughness, and with a conclusiveness which will impress itself upon every thoughtful and candid mind. The greater part of the volume is taken up with this examination of language and the mental processes involved therein. The result is to bring out in a manner never hitherto accomplished that language itself, its formation and constitution, furnishes a demonstration of the necessary continuity of development from the animal intelligence, to explain the "origin of human faculty."

This splendid work of scientific achievement brings forward into full view of the world of science a second Darwin. No doubt such an assertion is a bold one, but we are persuaded that it is just. Not only is the work done a continuation of that of the author of "The Descent of Man"; but in his single-mindedness in the search for truth, in his careful, conservative judgment, in the thoroughness of his analysis, in his readiness to hear and patiently examine objections, in his plain, clear style of expression, Dr. Romanes more nearly approaches Darwin than has any other scientific writer. The present work is a magnificent one, and we shall await with eagerness the others that are to follow.

DAYS AND NIGHTS IN THE TROPICS. By FELIX L. OSWALD. Illustrated. Boston: D. Lothrop Company. Pp. 186.

THE young or old reader who takes up this book can not fail to be charmed with the vivid scenes of animal life which it portrays. It contains the experiences of the author in a trip through the forests of Brazil to collect native natural history specimens for a national museum in Rio Janeiro. Both entertainment and information are afforded by its accounts of the doings and habits of monkeys, boas, various members of the cat family, birds, manatees, insects, ant-eaters, and the scarcely more domesticated children of the forest—the Indians. The surprising toleration which pet-keepers and pet-dealers

exercise for the mischief and impudence of their charges is well portrayed in several places. The text is not burdened with technical names, and the many spirited illustrations, together with the tasteful cover, add to the attractiveness of the book.

SOCIAL PROGRESS: AN ESSAY. By DANIEL GREENLEAF THOMPSON. London and New York: Longmans, Green & Co. Pp. 161. Price, $2.

THIS work forms a part of the same series of philosophical discussions to which the author's earlier volumes belong. Its special object is to present the principles that control the progress of society, a knowledge of which will enable men to direct their movements as social units so as to produce the most useful work with the least friction. The essay is substantially the introduction to a longer work, on which the author is engaged, entitled "The Fundamental Rights of Man." The two chief topics of this book are the conditions and the promotion of social progress. Every individual desires his own advancement, says the author, and closely bound up with this ideal of individual betterment is an ideal of social improvement. If there be either individual or social progress, there must be *liberty* for action. But the conflicting efforts of antagonistic individuals will neutralize each other if they are not restrained. This restraint is furnished by *law*. But too much restraint is as destructive as none. Hence the general condition essential to social progress is the establishment of an equilibrium between liberty and law. Men dwell together in the organic relations of society because this state allows each individual to attain a greater number of desires than he could in a solitary and hostile existence. The existence of society requires a social liberty—that is, the recognition of rights due each member of the community, and the limitation of the acts of every one by those rights. The nature of men makes necessary the defense of social liberty by positive law, with machinery to enforce it unfailingly and consistently. No government can be stable that does not insure equality in rights at least between those of the same class, and a government which depends upon the existence of classes tends to instability as knowledge becomes diffused among the least favored classes. Inequality of power, whether political or ecclesiastical authority or wealth, is dangerous to security and should be resisted. One more condition essential to the progress of society is fraternity—a disposition to prefer the good of the whole to the selfish interest of the individual.

In the part of the volume devoted to discussing the promotion of social progress Mr. Thompson calls attention to the fact that in every community there are observable two opposed tendencies with regard to the existing order of things: one toward change, the other resistance to change. The terms *radicalism* and *conservatism* have been used to express these antagonistic forces. Men unfortunately tend to range themselves as adherents of one tendency or the other, and any idea which bears the name of one party is scouted by the other. In the social organism, as in the human body, change is essential to life, and, when the changes which constitute the vital processes stop, death ensues and disintegrative changes begin. Mr. Thompson states as the general principles governing the promotion of social progress, that opportunity should be afforded for the action of evolutionary forces; that changes favoring the common freedom should be aided; and that equal enjoyment and security of life, liberty, and property are the test of common freedom. Further, in order to decide whether to aid or oppose a given change, we should examine the motives of its proponents and its opponents, estimate both the immediate and the remote consequences of the proposed change, consider the result of leaving things as they are, and calculate the probabilities of accomplishing the change and the results of failure. For the formation of opinions that will be reliable guides to conduct, self-knowledge and self-control in individuals are prime necessities. The habit of being suspicious of the correctness of one's positions and of the justice of one's sympathies and antipathies ought to be systematically cultivated. Opinions should be expressed freely though judiciously, in order to get the benefit of criticism, upon them. Action should be controlled by an extension and more careful application of the same rules which ought to govern expression of opinion. Compromise and forbearance are sometimes the most effective action. While Mr. Thompson in his

opening chapters insists on the necessity of regulation for the world as it now exists, he says in closing: "As we draw nearer to perfect social conditions positive law will grow less necessary. If all men had the true altruistic disposition, there would be no need of government. The course of progress is from the anarchy of the primitive state through law and government to the anarchy of the perfect state. We should aim, then, to diminish the restraints of authority, and, though working cautiously and tentatively, should seek ever to contract the sphere and minimize the duties of government. Only thus can that City arise into which the glory and honor of all the nations may be brought." Mr. Thompson's "Social Progress" will be a very helpful book to the student of public affairs who desires to look below the foaming, eddying surface of the stream of events, and see the strength and direction of the currents that determine the course in which society may advance.

A Study of Man, and the Way to Health, by *J. D. Buck*, M. D. (Clarke, $2.50), may be described as a series of essays philosophical in character, though popular in style. The body of the work opens with a chapter on the nature of evidence; then follow sections on the relations of matter and force, the universal ether, the character of phenomena, polarity, the matter of life, the forms of life, and the functions of organisms; or a brief outline of the principles of biology. An important chapter is devoted to a concise outline of the structure and functions of the human body, from which is deduced the philosophy of physiology, and upon which is laid the foundation of the science of psychology. Then follows a section on consciousness and psychic phenomena in general; a chapter on health and disease; a section on sanity and insanity; and the work closes with a section on the higher self, the archetypal man. The author is not at war with either science or religion, though he aims to get rid of both ignorance and superstition.

The little book entitled *Living Matter*, by *C. A. Stephens* (The Laboratory Company, Norway Lake, Me., $1), is an attempt to explain the constitution of the universe on the supposition that matter is sentient. The author credits to matter only "a sentience of low degree, in quantity far, very far beneath that evinced by even the lowest forms of life." Biogen, or living matter, forms all tissues of the animal body. Mr. Stephens gives an explanation of the method in which animal organisms are developed on the biogen hypothesis. He accounts for aging and death as resulting from changes in biogen, every one of which "is of the nature of an ordinary physical cause fairly within human power to avoid or remedy, and many of which in fact we are every day avoiding and remedying." This leads up to a suggestion of the possibility of learning how to prevent death altogether.

There has been printed *A Classified List of Mr. S. William Silver's Collection of New Zealand Birds*, with short descriptive notes by Sir *Walter L. Buller* (London, E. A. Petherick & Co.). A part of this collection, which is one of the most complete in Europe, formed a very attractive feature in the New Zealand Court, at the Colonial and Indian Exhibition in London, in 1886, and was awarded a diploma and medal. To the eight cases then exhibited, four have since been added, containing many of the rarer birds of New Zealand. Many of the genera and most of the species are strictly confined to New Zealand and the neighboring islands. The volume is copiously illustrated with heads, and in many cases full figures, of the typical species, besides many cuts of nests. An interesting object included in this collection is a frame of feathers of the moa, discovered in a cave in New Zealand by Mr. Taylor White in 1874.

The Forty-first Report on the New York State Museum of Natural History contains the reports of the trustees and the director, which relate the general progress and changes in the museum during 1887. In the report of the botanist it is stated that since the summer was unusually favorable to the production of fleshy fungi, the hymenomycetes, special attention was given to the collection and sketching in colors of these plants. The document is accompanied by reports of finding a large number of plants in various localities; by a paper on "Fungi destructive to Wood," contributed by P. H. Dudley, C E.; and by a botanical index to the museum reports Nos. 22–28. The report

of the entomologist occupies the greater part of the volume, and contains more or less extended notes on a large number of insects of economic importance. The report of the geologist is brief. It is accompanied by an account of the finding of the bones of mastodon associated with charcoal and pottery at Attica, and by descriptions of new species of *Fenestellidæ* of the lower Helderberg, with Plates VIII to XV.

Part II of the *Report of the Chief Signal Officer* for 1887 (War Department) consists of a "Treatise on Meteorological Apparatus and Methods," by Prof. Cleveland Abbe. The subdivisions of the subject are: the measurement of atmospheric temperature, of atmospheric pressure, of the motion of the air, of aqueous vapor, and of precipitation, all of which are treated with great fullness. Plates containing ninety-eight illustrations are appended to the volume.

A *Star Atlas*, with explanatory text by Dr. *Hermann J. Klein* (E. and J. B. Young & Co.), has been issued, containing maps of all the stars from 1 to 6·5 magnitude between the north pole and 34° south declination, and of all nebulæ and star-clusters in the same region which are visible in telescopes of moderate powers. The volume contains a little preliminary text, followed by descriptions of the more interesting fixed stars, star-clusters, and nebulæ contained in the maps, arranged in order of right ascension. Of the eighteen double-page maps, twelve are devoted to stars and six to the other objects. The atlas is finely printed on heavy paper.

A little volume of *Chemical Lecture Notes* has been published by Prof. *Peter T. Austen* (Wiley, $1), which the author says is "simply a collection of notes and observations on certain topics which experience as a teacher has shown me often give the student more or less trouble." Explanations are given of most of the principles of chemical philosophy, and about one fourth of the volume is devoted to an essay on "The Chemical Factor in Human Progress."

A former zealous propagator of Volapük, Prof. George Bauer, has invented what he deems a still better universal language, which he calls *Spelin*. A pamphlet giving a sketch of this language, translated and abridged from an exposition of the system by the author, has been issued by *Charles T. Strauss*, 424 Broadway, New York. The principal advantages claimed for Spelin over Volapük are that it contains no sound not occurring in all three languages, English, German, and French; it has no declension, no subjunctive mode, only five tenses, nearly twice as many monosyllabic words in flowing sentences as Volapük, fewer letters for expressing the same thoughts by seventeen per cent, more frequent vowel termination, and no words of five, six, or more syllables. The brief summary of its grammar in this pamphlet shows that Spelin is well worth examination by any one who is in search of the best universal language.

The Patriotic Reader, compiled by *Henry B. Carrington* (Lippincott, $1.20), is a large collection of "utterances that inspire good citizenship," in prose and verse. The selections are classified in sixteen parts, the first referring to the Hebrew and related nations, the second to the Greeks and Romans, and most of the others to different periods in American history. One division is composed of national hymns, songs, and odes, both of America and other countries. None of the grand and eloquent utterances in behalf of freedom for the slaves and the preservation of the Union, spoken before and during our civil war, are included. A biographical index of authors and persons whose deeds are celebrated is appended. The mechanical features of the volume are substantial and tasteful.

A book which is being very widely read is *Max O'Rell's* latest production, *Jonathan and his Continent* (Cassell, $1.50). The author gives hurried glimpses at a multitude of subjects, as if himself entered on the frantic race which he accuses Jonathan of running. His comments are light and entertaining, though many of his impressions have evidently been gathered from the funny columns of American newspapers.

Lessing: Ausgewalte Prosa und Briefe ("Selected Prose and Letters"), edited, with notes, by *Horatio Stevens White*, is the sixth of Dr. J. M. Hart's series of "German Classics for American Students" (G. P. Putnam's Sons). It presents typical specimens of the works of one of the most catholic and versatile of German authors—the one, perhaps,

who stands on a level with Goethe. The editor describes him as having been of "multifarious activity as fabulist, literary and dramatic critic, philosopher, and theologian." His "Laocoon" is one of the recognized classics in the literature of art. He was eminent as a classical scholar, archæologist, antiquary, poet, and dramatist — "a pioneer in the development of modern German literature." And there has been no figure in that literature "whose life is more laborious and fruitful, no character in an age of sentimentality which was more sane, stalwart, and manly." The selections present him in these various aspects, and the letters reveal features of his personality.

A translation of *Testa*, an instructive book for boys, by *Paolo Mantegazza* (Heath, $1.25), has just been issued. Its character may be quickest indicated by comparing it to "Sanford and Merton," though it has the advantage of being written for the present generation. Before this book appeared nothing of note, except De Amicis's "Cuore," had been written for children in Italy. "Testa" is a story of a boy who was sent to live for a year with a sagacious old uncle, a retired sea-captain, who, by telling anecdotes and by commenting upon various incidents, teaches his nephew many lessons in regard to the operations of nature, the ways of the world, and especially manners and morals. There is also some good counsel on the choice of a profession. In an early chapter is given a set of model resolutions for a month, and succeeding chapters contain blank pages for the young reader to fill with his own good resolutions for each remaining month of a year. The great variety of the book, and its Italian and, therefore, unfamiliar flavor, are enough to make it interesting to the average American boy, though only serious-minded boys will appreciate its full meaning.

The treatise on *The Psychic Life of Micro-organisms*, by *Alfred Binet* (the Open Court Publishing Company, 50 and 75 cents), has for its object to prove the existence of psychological faculties in the simplest organisms, and to describe their modes of manifestation. The sensibility and power of reacting possessed by these simple creatures is commonly called irritability. But M. Binet asserts that, "in these inferior beings, which represent the simplest forms of life, we find manifestations of an intelligence which greatly transcends the phenomena of cellular irritability." The author describes in successive chapters the psychic phenomena connected with the use of motory organs and organs of sense, with nutrition and fecundation, and he treats also the physiological function of the nucleus. He even goes further than is indicated above, and ascribes psychic faculties to the cells which make up the tissues of higher animals. He states that "the faculty of seizing food and of exercising a choice among foods of different kinds—a property essentially psychological—appertains to the anatomical elements of the tissues just as it does to all unicellular beings." In his views on the subject of this volume the author takes issue especially with M. Richet, and also with Prof. Romanes.

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POPULAR MISCELLANY.

Preserving Timber from Moisture.—The following recommendations are given by the Forestry Division of the Department of Agriculture in regard to the cheaper coatings for keeping moisture out of timber: Never apply paint or any other coating to green or unseasoned timber. If the wood was not well dried or seasoned, the coat will only hasten decay. Good coatings consist of oily or resinous substances which make a smooth coat capable of being uniformly applied. They must cover every part, must not crack, and possess a certain amount of plasticity after drying. Coal-tar, with or without sand or plaster, and pitch, especially if mixed with oil of turpentine and applied hot (thus penetrating more deeply), answer best. A mixture of three parts coal-tar and one part clean unsalted grease, to prevent the tar from drying until it has had time to fill the minute pores, is recommended. One barrel of coal-tar (three to four dollars per barrel) will cover three hundred posts. Wood-tar is not serviceable because it does not dry. Oil paints are next in value. Boiled linseed-oil, or any other drying *vegetable* oil, is used with lead or any other body, like powdered charcoal, which will give substance to it. Immersion in crude petroleum is also recommended. Charring of those parts which come in contact with the ground can be considered only as an imperfect preservative, and unless it is carefully done, and a considerable layer of charcoal is formed, the effect is often detrimental, as the process both weakens the timber and produces cracks, thus exposing the interior to ferments. Lastly, in communities where durable timber is scarce, it will pay to establish a plant for impregnating timber with antiseptics by the more costly processes described in "Forestry Bulletin" No. 1.

Geological Progress.—In reviewing the progress made by geological science during the last twenty-four years, Prof. W. Boyd Dawkins mentions the advantages which it has drawn from microscopic analysis of the rocks, in the study of metamorphism, and of the crushing and shearing forces that were brought to bear on the cooling crust of the earth; and from deep-sea explorations, revealing the structure and deposits of the ocean abysses. From a comparison of these deposits with the stratified rocks, we may conclude that the latter are marginal, and deposited in depths not greater than one thousand fathoms, or at the shore end of the globigerina ooze, and most of them at a less depth—and that consequently there is no proof in the geological record of the ocean depths having ever been in any other than their present places. In North America, the geological survey of the Western States has brought to light an almost unbroken series of animal remains, ranging from the Eocene down to the Pleistocene age. In these we find the missing links in the pedigree of the horse, and sufficient evidence of transitional forms to enable Prof. Flower to restore to its place in classification the order *Ungulata* of Cuvier. These may be expected to occupy the energies of American geologists for many years, and to yield further proof of the truth of the doctrine of evolution.

Yucatan Hammocks.—With a couple of straight poles, a shuttle, a thin slab of zapoli-wood, and a pile of heniquen-leaves at hand, says Consul Thompson, of Merida, the Yucatecan is ready to accept contracts for hammocks by the piece, dozen, or hundred. The poles are placed a distance apart, according to the required length of the hammock. The thin slab of hard wood is fashioned into a stripper, by the aid of which the fiber of the thick heniquen-leaf is denuded of its envelope, and a wisp of rasped fiber is obtained. This having been bleached, the fibers are separated into a certain number, and these are rolled into a strand. Two or more of these strands are then taken out, and by a similar dexterous manipulation converted into a *han* or cord, from which the hammock is made. The cord is riven rapidly around the two upright poles, and the shuttle, worked by the women, seems to move and seek the right mesh, says Consul Thompson, with a volition of its own—and in a very short space of time the hammock is made and laid with its kind, to await the coming of the contractor. Almost the entire exportation of hammocks from Yucatan is absorbed by the United States. All the districts of the State produce hammocks, but that of Tixcoco more than all the other districts combined. Chemax hammocks are noted for their fineness, and do not have to seek a market abroad.

What is Fire-proof?—The idea that theatrical appurtenances of wood and cloth can be made efficiently fire-proof by soaking them with certain chemical solutions is, in the opinion of Mr. Walter Emden, a serious error. Theoretically, the soaking works beautifully, and in practice for a time secures immunity against the spread of fire. "But for how long? Of the majority of these preservative solutions, it is a question if anything is left at the end of a certain time. They evaporate or sublimate or pass off into the atmosphere. No one can say with any degree of certainty for what length of time a beam or a cloth will be fire-proof as the result of soaking in any non-inflammable solution. Now, miscalculations in respect to this may lead to the most terrible catastrophes." A further point of the greatest moment is that gas-flames raise the temperature of wood and canvas in their vicinity to 140° F., and dry them to tinder. Obviously, actual contact with a naked flame must, under such circumstances, produce results altogether different from those of the experiments usually made with preservative solutions. It is the materials themselves which are used in the construction that must be proof against fire. The aim should be, not to make some combustible material incombustible, but to use only fire-proof materials.

Bread of Water-Lily Seeds.—The seeds of various species of water-lilies form the food of thousands of people in Asia and some parts of America. The most important species for this purpose are those belonging to the genus *Trapa*, which are known in India as *Singhara*, in China as *Ling*, and generally as water-chestnut. The fruit of the *Trapa bicornis*, which grows in the lakes of

China, is collected by women and children who paddle about among the plants in small circular boats resembling wash-tubs. Other species are grown in Cashmere, where the lakes become so crowded with the plants that navigation is made impossible, and the Government derives £12,000 a year from the taxes on the crop of a single lake; and in India, where the cultivation is systematically carried on. The fruit abounds in starch, which has the flavor of a chestnut, and may be eaten raw or cooked. The dried nuts will keep for many years. The meal may be made into cakes or into a porridge. If the kernels are soaked overnight in cold water, they will be ready in the morning to be boiled or steamed into food. The seeds of the lotus (*Nelumbo*) were much used as food in ancient Egypt, but seem to be neglected now. The tuberous roots resemble the sweet potato and are starchy. The root-stalks when boiled are farinaceous and agreeable, and those of the American species are employed as food by Western Indians. The seeds of the lotus, in India, are eaten raw when green, and roasted or boiled when ripe and hard. The root, which is two or three feet long, is eaten, boiled, as a vegetable. The Klamath Indians live chiefly on the *tookow*, or seeds of the yellow water-lily (*Nuphar lutea*). The capsules are broken, and the seeds are separated from their husks.

The Philosophy of Waist-Belts and Corsets.—In the course of an investigation upon the work of the heart in health and disease certain facts were observed by Prof. Roy and Mr. J. G. Adams which throw light upon the physiological bearing of waist-belts, etc. By means of a cardiometer, they register accurately the changes in volume of the heart and the amount of blood propelled by it, under varying conditions. In the dog, even a slight compression of the abdomen caused an increase in volume of the heart, and with this a greatly increased amount of blood, passed through the heart in a given time. These phenomena can be explained without difficulty. The abdominal vessels are capable of containing all, and more than all, the blood in the organism. Slight compression of the abdomen will, without disturbing the arterial supply, drive out from the abdominal veins and venous capillaries a large amount of blood; and this blood will be of use for the other regions of the body. Now, the functional activity of any organ depends directly upon its blood-supply. Increase the arterial blood-supply of any part, and, other things being equal, the activity and power of work of that part are increased. The abdominal walls in front and at the sides are formed of soft, elastic tissues. In health, pressure is, through these, exerted upon the abdominal contents, and at the same time upon the abdominal veins and venous capillaries, by means of the muscles contained in these walls. If, however, the muscles lose their tone, the walls become flaccid, and the veins dilate, and thus holding a larger amount of blood than is necessary, act as reservoirs for this blood, and so deprive the rest of the body of an amount of fluid necessary for its due nutrition. Here, then, we have an explanation of the use of some form or other of waist-belt by all nations who have passed beyond the stage of absolute barbarism. The waist-belt is of use, and has constantly been used, in cases of sudden and great exertion, and in those cases where it becomes necessary to counteract the tendency to a useless storing up of blood in the abdomen; and by persons in health, in bringing more blood into the service of the brain and muscles to produce a condition of increased mental and muscular activity. Flaccid abdominal walls are rather the rule than the exception with women, and among men occur in those leading sedentary lives. We are, therefore, brought to conclude that among women some form of waist-belt is advantageous. Moderate constriction does no harm; extreme constriction is absurd and dangerous.

The Scilly Islands.—Scillonians is what the inhabitants of the Scilly Islands call themselves. Though politically attached to Cornwall, and nearer to it than to any other part of the world, they are not Cornish, but of high-blooded English stock, being to a large extent descended from the Godolphins and from royalists who had suffered from the English civil wars. There are, however, considerable local differences between the people of the several smaller islands. In the days of sailing ships the Scilly Islands were an important naval outpost and a place

of refuge for vessels in stormy seasons. The people were skillful ship-builders and prosperous ship-owners. Steam has deprived them of most of their old advantages, and they have had to turn their attention to other pursuits. The mild climate and the good soil of the islands are favorable to all kinds of vegetation. Raising early potatoes and vegetables for the English markets has been a remunerative occupation. Recently the raising of narcissus and other bulbs has promised to be still more profitable, and the people are every year giving more and more attention to it. In 1887 more than a hundred tons of flowers were exported. The small extent of the islands bringing them into close relations, and almost inevitably under one another's eye, the Scillonians are quite sociable and considerably prone to gossip. They give occasional dinners, at which heavy cake and clotted cream are favorite dishes; but they object to dancing and card-playing, and abhor jesting and flippancy. They are great readers, and keep in the current of English periodical literature; and, having had George Eliot and Tennyson to visit them, they are "not to be awed by the prestige of any literary magnate." Finally, Mr. Frank Bonfield says of them, "Most of them seem to have had a tradition of having come in from somewhere at no very remote period of the past, and I am very doubtful if there is any aboriginal population—that is to say, families who have no record or reminiscence handed down of having lived somewhere else."

Chemical Bibliographies.—The report of the American Association's Committee on Indexing Chemical Literature mentions as published, the "Provisional List of Abbreviations of Titles of Chemical Journals," Dr. A. Tuckerman's "Index to the Literature of the Spectroscope," and Prof. Clarke's "Table of Specific Gravities"; as completed, Prof. Traphagen's "Index to the Literature of Columbium," and Prof. Bolton's "Bibliography of Chemistry" for 1887; and as in preparation, indexes on "Ethylene," by Mr. A. A. Noyes; "Methane," by Prof. W. P. Mason; "Cæsium and Rubidium," by Mr. William Rupp; "Tantalum," by Prof. Traphagen; a "Bibliography of the History of Chemistry," by Dr. Bolton; and "Thermodynamics," by Dr. A. Tuckerman. Bibliographies are mentioned of "Food Adulteration and its Detection," by Dr. J. P. Battershall; "Milk," by E. W. Martin; and "Butter," adulterations, testing, etc., by Prof. Elwyn Waller and others. Among lists of patents relating more or less to applied chemistry are those of Mr. C. T. Davis on the manufacture of leather; of bricks, tiles, and terra-cotta; of paper; and his "Treatise on Boiler Incrustations"; and Mr. William T. Braunt's "Treatise on Animal and Vegetable Fats and Oils." B. Tollen's "Handbuch der Kohlenhydrate," Breslau, 1888, contains about fifteen hundred references to the literature of carbohydrates. Dr. A. B. Lyons is publishing, in the "Pharmaceutical Era," a monthly "Index Pharmaceuticus." The work of the committee is now being supplemented by chemists in Great Britain.

Old and New-Fashioned Ideas in Medicine.—Dr. Malcolm Morris has indicated some points in medical practice in which a mysticism, which was one of its predominant features in the middle ages, still lingers around it. "There remains in the people," he says, "a belief in the efficacy of drugs as drugs—a belief that, as for every bane there must be an antidote, so for every disease there must be a curative leaf or root. Nature is distrusted; disease is still represented as some evil influence to be exorcised. In the popular mind Disease walks the earth as a devouring fiend, and has a personality about it as of old. The phrases 'Stricken with disease,' 'visitations,' and 'seizures,' are survivals of the conceptions of primitive times. . . . The mysticism survives in the courtly phrase and the ambiguous language of the practitioner of modern times. When sorely pressed by the sick man, the physician's only armory is equivocation, from which he draws such verbal weapons as 'the state of the constitution,' 'the tone of the body,' 'the general health,' 'lowered vitality,' and all that kind. . . . Are these not in some sort a survival of the circle of the horoscope?" The profession is also at a disadvantage because of a skepticism, reacting from the implicit faith in drugs of the olden time, which "repudiates all aids and accessories; briefly, it states its deliberate opinion that disease is infinitely better left to itself. The natural

physiological energy of the body is the prime element in the healing process. This is neither more nor less than modern fatalism —waiting on events. Such a doctrine, if successful, would be fatal to medicine." A third evil under which it suffers is materialism, which "in medicine may be carried to an injurious extreme. In modern pathology, for example, as originated by the German school and taught by its apostles, while men are actively contesting as to the nature or formation of a certain cell—whether it be spindle-shaped, round, or ovoid; whether it be derived from this tissue or from that—they are likely to lose sight of the real bearings of the case. By all means respect facts, and you can not show better respect for them than by using them. A medical inquirer is not a mere collector. Collect your facts, and then reason from the data you have established. A collection teaches nothing till it has been arranged. The tendency at present is, in the majority of instances, to collect everything, and to arrange and therefore to adduce nothing."

Sanitary Science and Children's Health. —Among the greatest gains that have recently been made in sanitary science, Mr. Edwin Chadwick counts the power that has been obtained of preventing children's diseases. "In the larger district schools," he says, "the districts of the poor-law unions, the children's chief diseases are now practically abolished. These institutions may be said to be children's hospitals, in which children, orphans of the lowest type from the slums, are taken in large proportions with developed diseases upon them, often only to die from constitutional failure alone. Yet in a number of these separate schools there are now no deaths from measles, whooping-cough, typhus, scarlatina, or diphtheria. The general death-rate is about ten in one thousand, and of those who are not in the probationary wards, of those who come in without developed disease upon them, the death-rates are now less than three in one thousand, or less than one third of the death-rates prevalent among the children of the general population of the same ages." In an institution where the old death-rate was twelve in one thousand, by drainage and clearance of sewage-smells the rate was reduced by more than one third; then, after improving the ventilation of the rooms and providing a separate bed for each child, the rate was reduced to less than three in one thousand, "and that with children of the lowest type. In a visit to one of these half-time schools, after an interval of several years, I was so struck with the appearance of the children as less pallid and with less of the dull, leathery look that I had seen before—they were bright and fresh-looking —that I observed to the manager that he must have had a new class of children since my last visit. His answer was 'No,' but that since the sanitary improvements had been made in the lower districts the children received from them were of the improved type which had struck me."

American India-Rubber. — The India-rubber of Central America is obtained from varieties of *Castilloa*, which yield rubber very little inferior to that obtained from the *Siphonia*. To raise India-rubber plants which are indigenous to one place in another where the conditions are at all favorable is no difficult task, but to make the same plant successfully productive is another matter altogether. Mr. Thomas B. Warren has called attention to the influence which handling raw rubber with sweaty or dirty hands has in promoting its decay. The less the raw article is fashioned by the hands in handling, the better. Grease of any kind, even in small quantity, is pernicious to the durability of the substance. When handled too much in manufacturing, it is sure to show signs of decay after a short time in the parts most exposed to manipulation. It makes a great difference in the quality of the raw product whether it has been collected by a relatively clean Brazilian creole or by a fatty-perspiring African. When rubber shows signs of decay from this cause, dusting over with raw sulphur tends to arrest it.

Whisky no Antidote for Rattlesnake-Poison.—The popular opinion that whisky is an antidote to rattlesnake-bite is controverted by Dr. A. T. Hudson, of Stockton, Cal., on the authority of experiments by Dr. S. Weir Mitchell. Dr. Mitchell mixed the virus of the rattlesnake with alcohol and with other reputed antidotes, and found,

on injecting the solution into animals, that its power was not altered. He found also that the effect of the virus was subject to very well defined limits, and that a quantity which would kill an animal of a certain size was much less powerful, or inert, upon larger animals. If a large snake should bite a goat of about fifty pounds' weight, and afterward two children of corresponding weight, he might kill the goat, while the children would survive, because not enough virus was left after the goat was bitten seriously to harm the children; then, if whisky were given to the children, their recovery would be attributed to it, while it really had nothing to do with the matter. It is rare that an adult person dies from the bite of a rattlesnake. Whisky may, however, be regarded as physiologically antidotal, in so far as it will sustain the flagging powers while the poison is being eliminated by the excretory organs.

The Teak-Tree.—Teak-wood is the most important of the forest products of Siam. It is used in immense quantities throughout the East for house-building, and is largely exported to China and Europe for ship-building purposes. It is said to be unsurpassed for resisting the ravages of the white ants and the effects of the weather. It grows in the northern part of Siam and Burmah at a height of 1,200 feet and more above the sea, and reaches its greatest perfection in about a hundred and twenty years; but a good-sized tree that can be cut down when quality of wood is not an object, can be grown in ten or fifteen years. The teak district is from 100 to 150 miles wide. The forests are in charge of the governors of the provinces in which they are situated. They are generally leased for a term of ten years, and the lessee is obliged to fell and remove the greatest number of logs possible, paying a definite royalty to the governor. The trees are girdled, and are left standing for two years to allow the sap to run out and the wood to become perfectly dry. The cutting down takes place in the dry season, and the logs are left until sufficient rain has fallen to allow of their being dragged to the river with the help of elephants. After the logs are made up into rafts, they are delivered to the raftsmen to convey to Bangkok; when all is ready, the evil spirits of the river must be propitiated, the cost of which is paid by the owner of the timber. This custom remains in force, despite the efforts of the foreign and educated classes to stop it, and should any one ignore it he would be unable to procure raftsmen.

Discovery by Observation.—The circumstances attending an archæological discovery recently made in German Altenburg, on the Danube, illustrate in the most striking manner the value of intelligent observation. Prof. Hauser was interested for a month in watching the colors of an extensive cornfield, which varied in every part. He found an elevated post of observation, and, after a week's close attention, declared it to be his opinion that the corn was growing over the site of an ancient amphitheatre. His drawings showed that the oblong centerpiece was somewhat concave, and the corn was quite ripe in that part, because there was much soil between the surface and the bottom of the theatre. Elliptical lines of green, growing paler the higher they rose, showed the seats, and lines forming a radius from the center showed the walls supporting the elliptical rows of seats. Excavations were made as soon as the corn had been harvested, which confirmed the professor's theory in nearly every particular. At six inches below the soil the top of the outer wall was found, and from there the soil gradually grew thicker until the bottom of the arena was reached, the pavement of which is in perfect condition. From the theatre a paved road leads to the Camp of Carnuntum.

The Buddhist Story of the Partridge.—Among the Buddhist stories which Mr. T. W. Rhys Davids has made known to the public is a legend of 400 B. C., pertinent to the question of the standards of precedence. It runs to the effect that a partridge, a monkey, and an elephant, friends, dwelling near a great banyan-tree, discussing which should be considered first, inquired which was the oldest among them. The elephant, when asked how far back he could remember, replied that when he was a little elephant he used to walk over the banyan-tree, and its topmost twig just grazed his belly. The monkey, when quite a little monkey, could gnaw

the topmost twig of the tree as he squatted on the ground. But the partridge said: "Friends, there used to be another banyan-tree. One day, after eating of its fruit, I voided a seed here. Hence this tree." So they agreed, the story continued, to honor and reverence the partridge, as he was the oldest, and he trained the others in obedience to the Five Precepts. Thenceforward they lived together in so beautiful a harmony that it became a proverb, and was known as "the beautiful life of the partridge." And they all three went, after death, to heaven. The story accords with the general idea among the ancients that the birds were of very old lineage.

Asphalt and Petroleum in Venezuela.—A part of the department of Colon, in Venezuela, is very rich in asphalt and petroleum. At one place a thick bitumen is ejected from the mouth of a cave, in globules which explode with considerable noise. The place called the *infernito*, or little hell, is a mound of sand, from twenty-five to thirty feet high, on the surface of which are numerous holes of different sizes, whence petroleum and hot water are ejected with a noise equal to that caused by two or three steamers blowing off at once. Considering the immense amount of inflammable gases that accompany such flows of petroleum, it is suggested that something of the kind may be connected with the *Taro* of Maracaybo—a constant lightning without thunder, which is observed from the foot of the bar at the entrance to the lake. Croppings of asphalt and coal appear at the foot of the mountains in the department of Sucre; and near the mountains is a flow of a black liquid, distinct from asphalt or petroleum, and apparently identical with a substance which occurs among anthracite deposits.

Habits of Turtles.—Turtles are described as sleepy creatures that rest at intervals throughout the day and become abnormally active at night. When asleep they lie upon the bottom of their habitat, with their heads downward and eyes closed, and are not easily disturbed. Their weight is considerable, and precludes them from moving constantly in the water; and, as a rule, when swimming they keep near the surface, and stretch their heads out, in order to gulp in air readily. Upon land they are helpless, almost as powerless as the seal in a similar situation. They capture their prey with great agility, for, with their long necks, they can thrust their heads forward very rapidly. The head, fin, and tail are independent of the shell, and move freely, but can not be drawn wholly under the shell, like those of the tortoise. Turtles, especially young ones, are very pugnacious, and fight by striking their adversary's head with their fins and biting. Mr. Carter, of the British National Fish-Culture Association, thinks it practicable to propagate them artificially. The eggs should be placed in sand, heated from beneath by water-pipes to a constant temperature of 70° F., which could be raised in the daytime to 100° by concentrating the temperature from without. The young turtles will seek for water at once, and this should be provided, warmed to 100°. While propagation in this way might be profitable, it would not be easy to domesticate the animals to our cool latitudes.

Influence of Antiseptics on Foods.—It has become common in trade to apply antiseptics to perishable foods, in order to preserve them, salicylic acid being probably the most used. It is important to ascertain what the effect of the addition is upon the quality of the food, and upon the digestive functions. Lehmann has shown that salicylic acid does not usually contribute any injurious quality to food, but apprehends that the indiscriminate use of such substances may be dangerous. Experiments have been made in our Department of Agriculture to determine what effect in retarding digestion may be possessed by such substances as salicylic acid, boric acid, sodium acid sulphite, saccharine, beta-naphthol, and alcohol. It was found that salicylic acid prevents the conversion of starch into sugar under the influence of either diastase or pancreatic extract, but does not very seriously interfere with peptic or pancreatic digestion of albumen. Saccharine holds about the same relation as salicylic acid. Sodium acid sulphite and boric acid are practically without retarding effect. Beta-naphthaline interferes decidedly with the formation of sugar by diastase, but not with the action of pancreatic extract

on starch. Peptic and pancreatic digestion of albuminoids were almost prevented by it. The experiments show that the indiscriminate use of these agents, without sanitary inspection, should not be allowed.

Bells as Weather Indicators.—M. P. J. de Ridder, of Lebbeke, Belgium, has observed that bells are heard further away when the atmosphere is in cyclonic motion, and that a calm atmosphere, saturated with moisture, favors the transmission of sound, while contrary winds are not always an obstacle. Certain small bells six and eight kilometres southeast from Lebbeke are called water bells by the people there, because their being heard at Lebbeke is immediately followed by a season of rain. And, generally, the hearing of a distant sound, like that of a bell or the rumbling of a railway train, is regarded as portending the end of fine weather and the approach of rain. One bell, which is ten kilometres away, is heard twice a year—in March or April, and in September or October—and always in identical conditions of the sky.

NOTES.

We are indebted to the kindness of the Tiffany Glass Company, of New York, for the use of the photographs from which the illustrations were engraved for Prof. Henderson's article on "The History of a Picture-Window," in this issue of the "Monthly."

Alaska is commonly thought of as an exceedingly cold place, but, except in the northern part, this reputation is not justified. To be sure, in the Yukon district, comprising the country north of the Alaskan Mountains, the mean annual temperature is about 25° Fahr., and the ground thaws in summer only two or three feet down from the surface, remaining frozen continually below. In the Aleutian Peninsula and Islands, however, the mean is from 36° to 40°, and in a series of observations, extending over five years, the greatest cold was found to be zero, while the highest temperature was 77°. A still warmer and a moist climate belongs to the Sitka district, the strip extending down along the coast of British America. Here the mean is 44·7°, and the temperature during the winter seldom goes so low as the freezing-point. The mean annual temperature of the State of New York is 46·49°.

The French Academy of Sciences has awarded its Cuvier medal to Prof. Joseph Leidy, of Philadelphia, for his eminent services in zoölogy. The medal was accompanied by a letter recognizing Dr. Leidy as a leader in his specialty.

The report of the United States Commissioner of Education shows the following percentages of increase in ten years (1876–'77 to 1886–'87), in the five divisions of the Union, in population, school enrollment, and school expenditure:

DIVISIONS.	Population.	Enrollment.	Expenditure.
North Atlantic division.....	16·5	5·7	21·7
South Atlantic division.....	26·7	58·7	50·4
South Central division.	36·8	83·4	65·4
North Central division..	32·0	29·7	51·1
Western division.....	72·1	58·3	75·9
United States.....	29·0	31·1	41·1

Some erroneous opinions respecting reptiles are corrected by Arthur Ayling in "Science Gossip." Thus, the slow-worm or blind-worm (*Anguis fragilis*) is not blind, but has eyes which, though small in comparison with its size, are very bright, and are in fact the prettiest part of its body; and it can not inflict a poisonous bite. Snakes do not "sting" with their forked tongues. Reptiles can live a long time without food—a triton, for instance, has been kept in that condition for six months—but they die in the end; and stories of toads having been imprisoned in rocks for years or ages under circumstances where air was excluded from them are false. Toads can not "spit fire," and newts and lizards can not inflict dangerous bites.

Dr. F. B. Jessett, of London, claims to have shown, from a comparison of the number of deaths in England and Wales in various years, that the mortality from cancer increased from 4,966 in 1850 to 13,542 in 1881, and the death-rate per million inhabitants from 320 to 520. In view of these facts, he suggests that, instead of shirking the subject, it should be met, the cause of the mortality studied, and a remedy sought.

Nervelessness is mentioned by the "North China Herald" as the distinguishing quality of the yellow race. A Chinaman can go through the most tedious and monotonous work from hour to hour and from day to day, without any appreciable sense of weariness or irritation; and a school-boy can do the same with his lessons without even longing to be at play. The Chinese can also sleep under conditions which would make a European very uncomfortable and restless. This quality is one of the things that make the Chinese such unwelcome competitors in the labor markets.

The hamlet of Nivezé, near Spa, in Belgium, is infested with what the inhabitants call "bad-air wells," or outlets whence carbonic-acid gas exhales. Dr. Parkin, of Spa, describes eight spots whence the exhalations are abundant, and most so in times of storm

and seasons of low barometer. In some the escaping gas makes noises that can be heard from sixty feet away. The ground presents no peculiar appearance, except that nothing will grow immediately around the outlets. Some of these places are under houses, or near them, and cause considerable inconvenience. Dr. Parkin believes that the phenomena are connected with the volcanic region of the Eifel. Prof. Lancaster, of Brussels, thinks that the source of the gas is deeply seated in the earth.

An experiment has been tried at Guildford, England, to test Mr. Conder's system for treating and purifying sewage with a list of ingredients, a principal one of which is sulphate of iron. An open wire-work cage containing the purifying material was let down into the sewer and immersed for about an inch and a half in depth into the flowing sediment. The result is reported to have been a vast improvement in the character of the liquid flowing from the drains into the river, and an abatement of nuisance at points where heretofore nuisances and offensive smells had been complained of.

"Omitting articles in which its occurrence has been purely accidental," says Mr. A. W. Stokes, in "The Chemical News," "arsenic has been found of late years to be present in some samples of muslins, cretonnes, wall-papers, playing-cards, the glaze of some enameled stew-pans, the paper of fancy boxes, and in some furs. These last are usually the furs prepared by amateurs. . . . One has no wish to be an alarmist, or in any way to harass trade, and it must freely be acknowledged that cases of any ill results whatever being traced to the use of these articles are very rare. None the less, seeing how unnecessary they are, and how each year arsenic seems to be finding its way into new quarters, it seems advisable to stop its further progress."

To furnish the French railroads with cross-ties — 10,000 a day and 3,650,000 a year—more than a thousand fine trees have to be cut down every day. In the United States more than 15,000,000 cross-ties are used yearly, to furnish which requires the destruction of 197,600 acres of forests. The "Bulletin du Musée Commercial" estimates the number of logs required for the railways of the world at more than 40,000,000.

OBITUARY NOTES.

The Rev. John George Wood, one of the most popular and instructive of natural history writers, died March 3d, while on a visit to Coventry, England. He was born in London, the son of a surgeon, in 1827, and was graduated from Merton College, Oxford, in 1848. He served for two years in the Anatomical Museum at Christ Church, Oxford; held two chaplaincies, and was Precentor of the Canterbury Diocesan Choral Union. His best efforts were given to his books, most of which were on natural history. The chief of them was his large "Natural History," in three volumes; the best known, the "Common Objects of the Seashore." Among the others, besides those of the "Common Objects" series, were his "Popular Natural History," "Sketches and Anecdotes of Animal Life," "The Boys' Own Natural History Book," "My Feathered Friends," "Homes without Hands," "Insects at Home," "Our Garden Friends and Foes," several educational works, and a series of "Natural History Readers" for schools. He edited for some time "The Boys' Own Magazine," and was a popular lecturer.

Sir William O'Shaughnessy Brooke, F. R. S., who was distinguished by his connection with electric telegraphs, died in England in January. He was Director-General of Telegraphs in India for ten years, and received a knighthood for his services in establishing telegraphs in that empire.

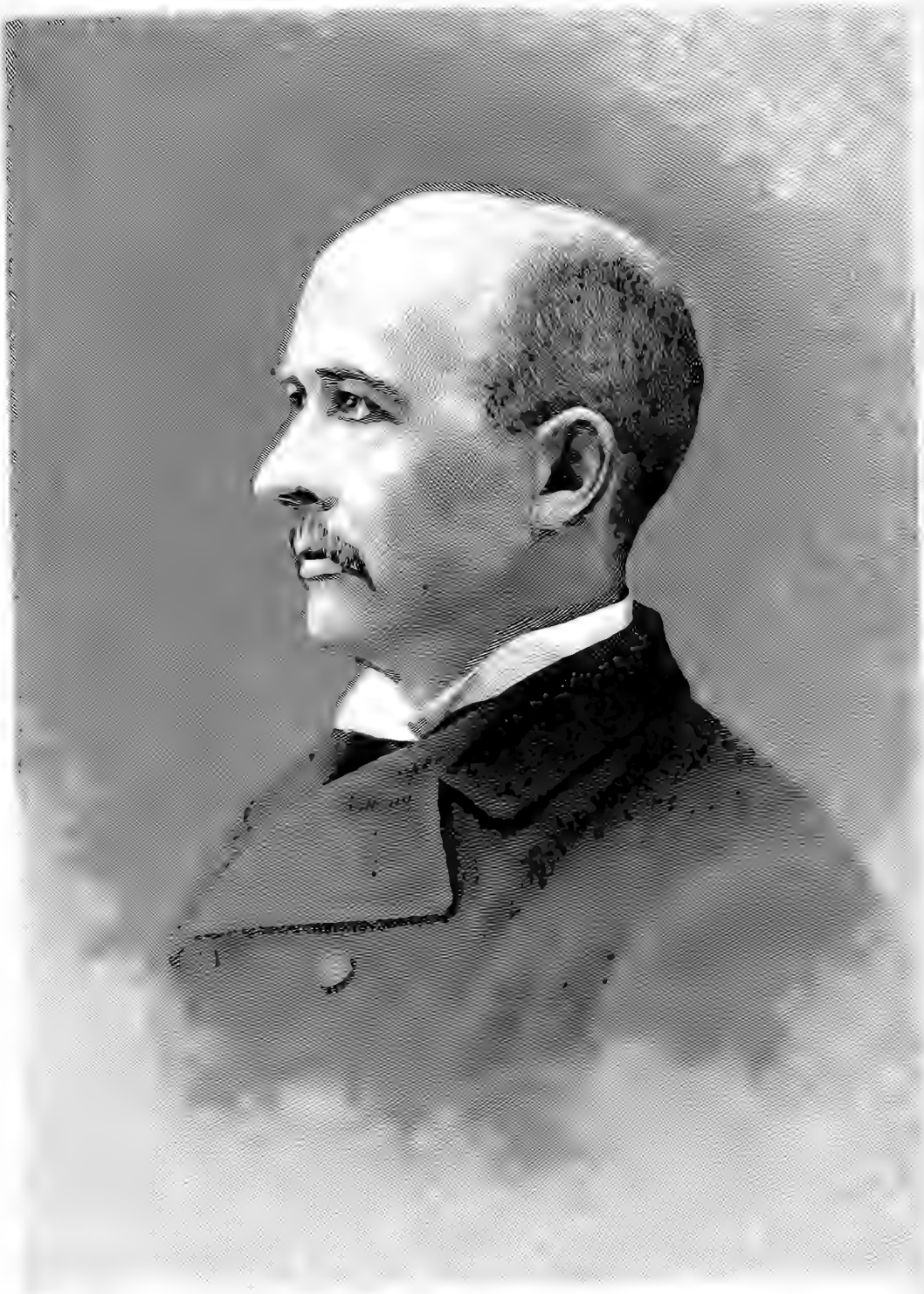
Alexander Pagenstecher, Director of the Museum of Natural History at Hamburg, died January 5th, of heart-disease, in his sixty-fourth year. He was for many years Professor of Zoölogy at Heidelberg, and was the author of a well-known work on "Universal Zoölogy" ("Allgemeine Zoologie") in four volumes (1875–1881).

Dr. Johannes Brock, appointed Professor of Natural Science at Göttingen, has recently died there. He was formerly Professor of Zoölogy at Dorpat, and was well known by reason of a scientific journey to the Indian Archipelago which he undertook under the auspices of the Berlin Academy.

Dr. J. Soyka, Professor of the German University of Prague, and formerly of the University of Munich, and author of books on bacteria, died by suicide, February 23d.

Captain John Ericsson, the inventor of the caloric engine, the Monitor, and other useful or warlike agents, died in this city, March 8th, in the eighty-sixth year of his age. He was a native of Sweden and came of a family of engineers. He showed his inventive capacity at an early age. He came to this country in 1839, and two years afterward began the Princeton, the first naval vessel to carry her machinery under the water-line and out of the reach of the enemy's shot. His name is also identified with the invention of the submarine boat Destroyer, sun motor, and submarine motor; and some of his unpatented inventions are in the hands of the Delamater Iron Company.

The Rev. Dr. Churchill Babington, an English botanist, died January 12th, at Cockfield Rectory. He was a contributor to Sir J. Hooker's "Journal of Botany and Kew Miscellany."



WILLIAM GRAHAM SUMNER.

THE

POPULAR SCIENCE MONTHLY.

JUNE, 1889.

NEW CHAPTERS IN THE WARFARE OF SCIENCE.

VI.—DIABOLISM AND HYSTERIA.

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PART II.

ABOUT forty years later than the New England epidemic of "possession" occurred another typical series of phenomena in France. In the year 1727 there died in the city of Paris a simple and kindly ecclesiastic, the Archdeacon of Paris. He had lived a pious, Christian life, and was endeared to multitudes by his charity; unfortunately, he had espoused the doctrine of Jansen on the subject of grace and free will; and, though he remained in the Gallican Church, he and those who thought like him were opposed by the Jesuits, and finally condemned by a papal bull.

His remains having been buried in the cemetery of St. Medard, the Jansenists flocked to say their prayers at his tomb, and soon miracles began to be wrought there. Ere long they were multiplied. The sick being brought and laid upon the tomb, many were cured. Wonderful stories were attested by eye-witnesses. The myth-making tendency—the passion for developing, enlarging, and spreading tales of wonder—came into full play and was given free course.

Many thoughtful men satisfied themselves of the truth of these representations. One of the foremost English scholars came over, examined into them, and declared that there could be no doubt as to the reality of the cures.

This state of things continued for about four years, when, in 1731, more violent effects showed themselves. Sundry persons approaching the tomb were thrown into convulsions, hysterics, and catalepsy; these diseases spread, became epidemic, and soon

multitudes were similarly afflicted. Both religious parties made the most of these cases. In vain did such great authorities in medical science as Hecquet and Lorry attribute the whole to natural causes; the theologians on both sides declared them supernatural —the Jansenists attributing them to God, the Jesuits to Satan.

Of late years such cases have been treated in France with much shrewdness. When, about the middle of the present century, the Arab priests in Algiers tried to arouse fanaticism against the French Christians by performing miracles, the French Government, instead of persecuting the priests, sent Robert Houdin, the most renowned juggler of his time, to Algiers, and for every Arab miracle Houdin performed two; did an Arab marabout turn a rod into a serpent, Houdin turned his rod into two serpents, and afterward showed the people how this was done.

So, too, at the last International Exposition, the French Government, observing the evil effects produced by the mania for table turning and tipping, took occasion, when a great number of French schoolmasters and teachers were visiting the Exposition, to have public lectures given in which all the business of dark closets, hand-tying, materialization of spirits, presenting the faces of the departed, and ghostly portraiture, was fully performed by professional mountebanks, and afterward as fully explained by them.

So in this case. The Government simply ordered the gate of the cemetery to be locked, and, when the crowd could no longer approach the tomb, the miracles ceased. A little Parisian ridicule helped to end the matter. A wag wrote up over the gate of the cemetery:

"De par le Roi, défense à Dieu
De faire des miracles dans ce lieu"—

which, being translated from doggerel French into doggerel English, is—

"By order of the king, the Lord must forbear
To work any more of his miracles here."

But the theological spirit remained powerful. The French Revolution had not then intervened to bring it under healthy limits. The agitation was maintained, and, though the miracles and cases of possession were stopped in the cemetery, it spread. Again full course was given to myth-making and the retailing of wonders. It was said that men had allowed themselves to be roasted before slow fires, and had been afterward found uninjured; that some had enormous weights piled upon them, but had supernatural powers of resistance given them; and that, in one case, a voluntary crucifixion had taken place.

This agitation was long, troublesome, and no doubt robbed

many temporarily or permanently of such little brains as they possessed; it was only when the violence had become an old story and the charm of novelty had entirely worn off, and the afflicted found themselves no longer regarded with especial interest, that the epidemic died away.*

But in Germany at that time the outcome of this belief was far more cruel. In 1749 Maria Renata Sänger, sub-prioress of a convent at Würzburg, was charged with bewitching her fellow-nuns. There was the usual story—the same essential facts as at Loudun—women shut up against their will, dreams of Satan disguised as a young man, petty jealousies, spites, quarrels, mysterious uproar, trickery, utensils thrown about in a way not to be accounted for, hysterical shrieking and convulsions, and, finally, the torture, confession, and execution of the supposed culprit.†

Various epidemics of this sort broke out from time to time in other parts of the world, though happily, as modern skepticism prevailed, with less cruel results.

In 1760 some congregations of Calvinistic Methodists in Wales became so fervent that they began leaping for joy. The mania spread and gave rise to a sect called the "Jumpers." A similar outbreak took place afterward in England, and has been repeated at various times and places since in our own country.‡

In 1780 came another outbreak in France; but this time it was not the Jansenists who were affected, but the strictly orthodox. A large number of young girls between twelve and nineteen years of age, having been brought together at the church of St. Roch, in Paris, with preaching and ceremonies calculated to arouse hysterics, one of them fell into convulsions. Immediately other children were similarly taken, until some fifty or sixty were engaged in the same antics. This mania spread to other churches and gatherings, proved very troublesome, and in some cases led to results especially painful.

About the same period came a similar outbreak among the Protestants of the Shetland Isles. A woman having been seized with convulsions at church, the disease spread to others, mainly women, who fell into the usual contortions and wild shriekings. A very effective cure proved to be a threat to plunge the diseased into a neighboring pond.

But, as we near the end of the eighteenth century, a fact very

* See Madden, "Phantasmata," chap. xiv; also Sir James Stephen, "History of France," lecture xxvi; also Henry Martin, "Histoire de France," chap. xv, pp. 168 *et seq.*; also Calmeil, liv. v, chap. xxiv; also Hecker's "Essay," iv, 5; and, for samples of myth-making, see the apocryphal "Souvenirs de Créquy."

† See Soldan, Scherr, Diefenbach, and others.

‡ See Adams's "Dictionary of All Religions," article on "Jumpers"; also Hecker's "Essay," iv, 6.

important for science is established. It was found that these manifestations do not arise entirely from religious sources. In 1787 came the noted case at Hodden Bridge, in Lancashire. A girl working in a cotton-manufactory there put a mouse into the bosom of another girl, who had a great dread of mice. The girl thus treated immediately went into convulsions, which lasted twenty-four hours. Shortly afterward three other girls were seized with like convulsions, a little later six more, and finally, in all, twenty-four were attacked. Then came a fact throwing a flood of light upon earlier occurrences. This epidemic, being noised abroad, soon spread to another factory five miles distant. The patients suffered from strangulation, danced, tore their hair, and dashed their heads against the walls. There was a strong belief that it was a disease introduced in cotton, but a resident physician amused the patients with electric shocks, and the disease died out.

In 1801 came a case of similar import in the Charité Hospital at Berlin. A girl fell into strong convulsions. The disease proved contagious, several others becoming afflicted in a similar way; but nearly all were finally cured, principally by the administration of opium, which appears at that time to have been a fashionable remedy.

Similar to this was a case at Lyons in 1851. Sixty women were working together in a shop, when one of them, after a bitter quarrel with her husband, fell into a violent nervous attack. The other women, sympathizing with her, gathered about to assist her, but one after another fell into a similar condition, until twenty were thus prostrated, and a more general spread of the epidemic was only prevented by clearing the premises.*

But, while these cases appeared to the eye of Science fatal to the old conception of diabolic influence, the great majority of such epidemics, when unexplained, continued to give strength to the older view.

In Roman Catholic countries these manifestations, as we have seen, have generally appeared in convents, or in churches where young girls are brought together for their first communion, or at shrines where miracles are supposed to be wrought.

In Protestant countries they appear in times of great religious excitement, and especially when large bodies of young women are submitted to the influence of noisy and frothy preachers. Well-known examples of this in America are seen in the "Jumpers," "Jerkers," and various revival extravagances, especially among the negroes and "poor whites" of the Southern States.

* For these examples and others, see Tuke, "Influence of the Mind upon the Body," vol. i, pp. 100, 277; also Hecker's "Essay," chap. iv.

The proper conditions being given for the development of the disease—generally a congregation composed mainly of young women—any fanatic or overzealous priest or preacher may stimulate hysterical seizures, which are very likely to become epidemic.

As a recent typical example on a large scale, I take the case of diabolic possession at Morzines, a French village on the borders of Switzerland; and it is especially instructive, because it was thoroughly investigated by a competent man of science.

About the year 1853 a sick girl at Morzines, acting strangely, was thought to be possessed of the devil, and was taken to Besançon, where she seems to have fallen into the hands of kindly and sensible ecclesiastics, and, under the operation of the relics preserved in the cathedral there—especially the handkerchief of Christ—the devil was cast out and she was cured. Naturally, much was said of the affair among the peasantry, and soon other cases began to show themselves. The priest at Morzines attempted to quiet the matter by avowing his disbelief in such cases of possession; but immediately a great outcry was raised against him, especially by the possessed themselves. The matter was now widely discussed, and the malady spread rapidly; myth-making and wonder-mongering began; amazing accounts were thus developed and sent out to the world. The afflicted were said to have climbed trees like squirrels; to have shown superhuman strength; to have exercised the gift of tongues, speaking in German, Latin, and even in Arabic; to have given accounts of historical events they had never heard of; and to have revealed the secret thoughts of persons about them. Mingled with such exhibitions of power were outbursts of blasphemy and obscenity.

But suddenly came something more miraculous, apparently, than all these wonders. Without any assigned cause this epidemic of possession diminished, and the devil disappeared.

Not long after this Prof. Tissot, an eminent member of the medical faculty at Dijon, visited the spot and began a series of researches, of which he afterward published a full account. He tells us that he found some reasons for the sudden departure of Satan which had never been published. He discovered that the Government had quietly removed one or two overzealous ecclesiastics to another parish, had sent the police to Morzines to maintain order, and had given instructions that those who acted outrageously should be simply treated as lunatics and sent to asylums. This policy, so accordant with French methods of administration, cast out the devil: the possessed were mainly cured, and the matter appeared ended.

But Dr. Tissot found a few of the diseased still remaining, and he soon satisfied himself by various investigations and experi-

ments that they were simply suffering from hysteria. One of his investigations is especially curious. In order to observe the patients more carefully, he invited some of them to dine with him, gave them without their knowledge holy water in their wine or their food, and found that it produced no effect whatever, though its results upon the demons when the possessed knew of its presence had been very strikingly marked. Even after plentiful doses of holy water had been thus given, the possessed remained afflicted, urged that the devil should be cast out, and some of them even went into convulsions, the devil apparently speaking from their mouths. It was evident that Satan had not the remotest idea that he had been thoroughly dosed with the most effective medicine known to the older theology.*

At last Tissot published the results of his experiments, and the stereotyped answer was soon made. It resembled the answer made by the clerical opponents of Galileo when he showed them the moons of Jupiter through his telescope, and they declared that the moons were created by the telescope. The clerical opponents of Tissot declared that the non-effect of the holy water upon the demons proved nothing save the extraordinary cunning of Satan; that the arch-fiend wishes it to be thought that he does not exist, and so overcame his repugnance to holy water, gulping it down in order to conceal his presence.

Dr. Tissot also examined into the gift of tongues exercised by the possessed. As to German and Latin, no great difficulty was presented: it was by no means hard to suppose that some of the girls might have learned some words of the former language in the neighboring Swiss cantons where German was spoken, or even in Germany itself; and as to Latin, considering that they had heard it from their childhood in the church, there seemed nothing very wonderful in their uttering some words in that language also. As to Arabic, had they really spoken it, that might have been accounted for by the relations of the possessed with Zouaves or Spahis from the French army; but, as Tissot could discover no such relations, he investigated this point as the most puzzling of all.

On a close inquiry he found that all the wonderful examples of speaking Arabic were reduced to one. He then asked whether there was any other person speaking or knowing Arabic in the town. He was answered that there was not. He asked whether any person had lived there, so far as any one could remember, who had spoken or understood Arabic, and he was answered in the negative. He then asked the witnesses how they knew that the language spoken by the girl was Arabic; no answer was vouch-

* For an amazing delineation of the curative and other virtues of holy water, see the Abbé Gaume, "L'Eau bénite au XIX^me^ Siècle," Paris, 1863.

safed him, but he was overwhelmed with such stories as that of a pig which, at sight of the cross on the village church, suddenly refused to go further—and he was denounced thoroughly in the clerical newspapers for declining to accept such evidence.

At Tissot's visit in 1863 the possession had generally ceased, and the cases left were few and quiet. But his visits stirred a new controversy, and its echoes were long and loud in the pulpits and clerical journals. Believers insisted that Satan had been removed by the intercession of the Blessed Virgin; unbelievers hinted that the main cause of the deliverance was the reluctance of the possessed to be shut up in asylums.

Under these circumstances the Bishop of Annecy announced that he would visit Morzines to administer confirmation, and word appears to have spread that he would give a more orthodox completion to the work already done by exorcising the devils who remained. Immediately several new cases of possession appeared; young girls who had been cured were again affected; the embers thus kindled were fanned into a flame by a "mission" which sundry priests held in the parish to arouse the people to their religious duties—a mission, in Roman Catholic countries, being akin to the "revivals" among some Protestant sects. Multitudes of young women, excited by the preaching and appeals of the clergy, were again thrown into the old disease, and at the coming of the good bishop it culminated.

The account is given in the words of an eye-witness:

"At the solemn entrance of the bishop into the church, the possessed persons threw themselves on the ground before him, or endeavored to throw themselves upon him, screaming frightfully, cursing, blaspheming, so that the people at large were struck with horror. The possessed followed the bishop, hooted him, and threatened him, up to the middle of the church; order was only established by the intervention of the soldiers. During the confirmation the diseased redoubled their howls and infernal vociferations, and tried to spit in the face of the bishop and to tear off his pastoral raiment. At the moment when the prelate gave his benediction a still more outrageous scene took place. The violence of the diseased was carried to fury, and from all parts of the church arose yells and fearful howling; so frightful was the din that tears fell from the eyes of many of the spectators, and many strangers were thrown into consternation."

Among the very large number of these diseased persons there were only two men; of the remainder only two were of advanced age. The great majority were young women between the ages of eighteen and twenty-five years.

The public authorities shortly afterward intervened and sought to cure the disease and to draw the people out of their mania by

singing, dancing, and sports of various sorts, until at last it was brought under control.*

Scenes similar to these, in their essential character, have arisen more recently in Protestant countries, but with the difference that what has been generally attributed by Roman Catholic ecclesiastics to Satan is attributed by Protestant ecclesiastics to the Almighty. Typical among the greater exhibitions of this were those which began in the Methodist chapel at Redruth in Cornwall—convulsions, leaping, jumping, until some four thousand persons were seized by it. The same thing is seen in the ruder parts of America at "revivals" and camp-meetings.

And in still another great field these exhibitions are seen, but more after a mediæval pattern. In the Tigretier of Abyssinia we have epidemics of dancing which seek and obtain miraculous cures.

Reports of similar manifestations are also sent from missionaries from the west coast of Africa, one of whom sees in some of them the characteristics of cases of possession mentioned in our Gospels, and is therefore inclined to attribute them to Satan.†

But happily, long before these latter occurrences, science had come into the field and was gradually diminishing this class of diseases. Among the earlier workers to this better purpose was the great Dutch physician Boerhaave. Finding in one of the wards in the hospital at Haarlem a number of women going into convulsions and imitating each other in various acts of frenzy, he immediately ordered a furnace of blazing coals into the midst of the ward, heated cauterizing irons, and declared he would burn the arms of the first woman who fell into convulsions. No more cases occurred.‡

These and similar successful dealings of medical science with mental disease brought about the next stage in the theological development. The Church sought to retreat, after the usual manner, behind a compromise. Early in the eighteenth century appeared a new edition of the great work by the Jesuit Delrio which for a hundred years had been a text-book for the use of ecclesiastics in fighting witchcraft. But in this edition the part played by Satan in diseases was changed. It was suggested that, while diseases have natural causes, it is necessary that Satan enter the human body in order to make these causes effective. Delrio claims that

* See Tissot, "L'Imagination: ses Bienfaits et ses Égarements surtout dans le Domaine du Merveilleux," Paris, 1858, par. 7; "Les Possédés de Morzines"; also Constans, "Relation sur une Epidémie de Hystéro-Démonopathie," Paris, 1863.

† For the Tigretier, with especially interesting citations, see Hecker's "Essay," chap. iii, sec. 1; for the cases in western Africa, see the Rev. J. L. Wilson, "Western Africa," p. 217.

‡ See Figuier, "Histoire du Merveilleux," vol. i, p. 402.

Satan "attacks lunatics at the full moon, when their brains are full of humors," that in other cases of illness he "stirs the black bile," and that in cases of blindness and deafness he "clogs the eyes and ears." By the close of the century this compromise was evidently found untenable, and one of a very different sort was attempted in England.

In the third edition of the "Encyclopædia Britannica," published in 1797, under the article "Dæmoniacs," the orthodox view was presented in the following words: "The reality of demoniacal possession stands upon the same evidence with the gospel system in general."

This statement, though necessary to satisfy the older theological sentiment, was clearly found too dangerous to be sent out into the modern skeptical world without some qualification. Another view was therefore suggested, namely, that the personages of the New Testament "adopted the vulgar language in speaking of those unfortunate persons who were generally imagined to be possessed with demons." Two or three editions contained this curious compromise; but, as we come to the middle of the present century, the whole discussion is quietly dropped.

But science, declining to trouble itself with any of these views, pressed on, and toward the end of the century we see Dr. Rhodes at Lyons curing a very serious case of possession by the use of a powerful emetic; yet myth-making came in here also, and it was stated that, when the emetic produced its effect, people had seen multitudes of green and yellow devils cast forth from the mouth of the possessed.

The last great demonstration of the old belief in England was made in 1788. In the city of Bristol at that time lived a drunken epileptic, George Lukins. In asking alms he insisted that he was "possessed," and proved it by jumping, screaming, barking, and treating the company to a parody of the "Te Deum."

He was solemnly brought into the Temple Church, and seven clergymen united in the effort to exorcise the evil spirit. Upon their adjuring Satan, he swore "by his infernal den" that he would not come out of the man—"an oath," says the chronicler, "nowhere to be found but in Bunyan's 'Pilgrim's Progress,' from which Lukins probably got it."

But the seven clergymen were at last successful, and seven devils were cast out, after which Lukins retired, and appears to have been supported during the remainder of his life as a monument of mercy.

With this great effort the old theory in England seemed practically exhausted.

Science had evidently carried the stronghold. In 1876, at a little town near Amiens, in France, a young woman was brought

to the priest, suffering terribly with all the usual evidences of diabolic possession. The priest was besought to cast out the devil, but he simply took her to the hospital, where, under scientific treatment, she rapidly became better.*

The final triumph of science in this part of the great field has been mainly achieved during the latter half of the present century.

Following in the noble succession of Paracelsus and John Hunter and Pinel and Tuke and Esquirol, have come a band of thinkers and workers who have evolved out of the earlier forms of truths new growths, ever more and more precious.

Among the many facts and principles thus brought to bear upon this last stronghold of the Prince of Darkness, may be named especially those of "expectant attention," an expectation of phenomena dwelt upon until the longing for them becomes morbid and invincible, and the creation of them perhaps unconscious. Still another class of phenomena are found to arise from a morbid tendency to imitation which leads to epidemics. Still another group has been brought under hypnotism. Multitudes more have been found under the innumerable forms and results of hysteria. A study of the effects of the imagination upon bodily function has also yielded remarkable results.

And, finally, to supplement this work, have come in an array of scholars in history and literature who have investigated myth-making and wonder-mongering.

Thus has been cleared away that cloud of supernaturalism which so long hung over mental diseases, and thus have they been brought within the firm grasp of science.†

* See Figuier; also Collin de Plancy, "Dictionnaire Infernale," article Possédés.

† To go even into leading citations in this vast and beneficent literature would take me far beyond my plan and space, but I may name, among leading and easily accessible authorities, Brierre de Boismont on "Hallucinations," Hulme's translation, 1860; also James Braid, "The Power of the Mind over the Body," London, 1846; Krafft-Ebing, "Lehrbuch der Psychiatrie," Stuttgart, 1888; Tuke, "Influence of the Mind on the Body," London, 1884; Maudsley, "Pathology of the Mind," London, 1879; Carpenter, "Mental Physiology," sixth edition, London, 1888; Lloyd Tuckey, "Faith Cure," Nineteenth Century Magazine for December, 1888; Pettigrew, "Superstitions connected with the Practice of Medicine and Surgery," London, 1844.

As to myth-making and wonder-mongering, the general reader will find interesting supplementary accounts in the recent works of Andrew Lang and Baring-Gould.

A very curious evidence of the effects of the myth-making tendency has recently come to the attention of the writer of this article. Periodically, for many years past, we have seen, in books of travel and in the newspapers, accounts of the wonderful performances of the jugglers in India; of the stabbing of a child in a small basket in the midst of an arena, and the child appearing alive in the surrounding crowd; of seeds planted, sprouted, and becoming well-grown trees under the hand of the juggler; of ropes thrown into the air and sustained by invisible force. A short time since Count de Gubernatis, the eminent professor and Oriental scholar at Florence, informed the present writer that he had recently seen and studied these exhibitions, and that, so far from being wonderful, they were much inferior to the jugglery so well known in all our Western capitals.

Conscientious men still linger on who find comfort in holding fast to some shred of the old belief in diabolic possession. The sturdy declaration in the last century by John Wesley, that "giving up witchcraft is giving up the Bible," is echoed feebly in the latter half of this century by the eminent Catholic ecclesiastic in France who declares that "to deny possession by devils is to charge Jesus and his apostles with imposture," and asks, "How can the testimony of apostles, fathers of the Church, and saints who saw the possessed and so declared, be denied?" And a still fainter echo lingers in Protestant England.*

But, despite this conscientious opposition, science has in these latter days steadily wrought hand in hand with Christian charity in this field, to evolve a better future for humanity. The thoughtful physician and the devoted clergyman are now constantly seen working together; and it is not too much to expect that Satan, having been cast out of the insane asylums, will ere long disappear from monasteries and camp-meetings, even in the most unenlightened regions of Christendom.

GLACIERS ON THE PACIFIC COAST.†

By G. FREDERICK WRIGHT, D. D., LL. D.

NORTHWARD from Washington Territory the coast is everywhere very rugged, being formed by the lofty peaks of an extension of the Cascade Range; while the thousands of islands which fringe the coast of British Columbia and Alaska are but the partially submerged peaks of an extension of the Coast Range, from which the great glaciers of former times have scraped off nearly all the fertile soil. It is estimated that there are ten thousand islands between Washington Territory and Mount St. Elias, and all the larger of them bear snow-covered summits during the whole year. The water in the narrow channels separating these islands is ordinarily several hundred feet deep, affording, through nearly the whole distance, a protected channel for navigation.

Three great rivers interrupt the mountain barrier of British Columbia facing the Pacific—the Fraser, the Skeena, and the Stickeen—and the interior is penetrated for some distance by innumerable fiords. The Canadian Pacific Railroad follows the course of the Fraser for a long distance, and passes within sight of glaciers of considerable extent, and every fiord receives the drainage

* See the Abbé Barthélemi, in the "Dictionnaire de la Conversation"; also the Rev. W. Scott's "Doctrine of Evil Spirits proved," London, 1857.

† From advance sheets of "The Ice Age in North America, and its Bearings on the Antiquity of Man." In press of D. Appleton & Co.

of numerous decaying glaciers. But it is not until reaching the Stickeen River, in Alaska, in latitude 57°, that glaciers begin to

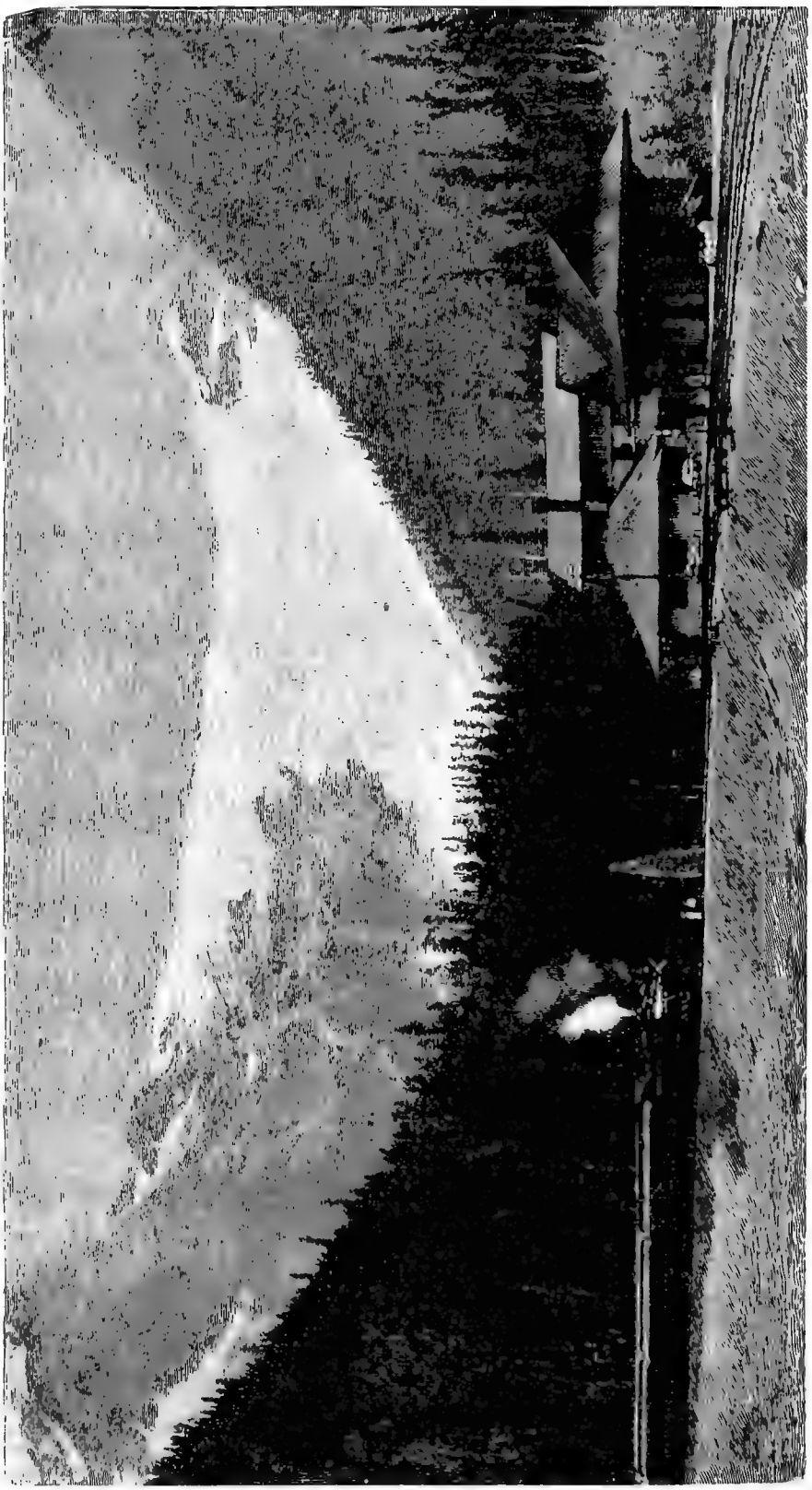


FIG. 1.—GLACIER STATION, SELKIRK MOUNTAINS, BRITISH COLUMBIA. (Courtesy of the Canadian Pacific Railroad.)

appear which are both easily accessible and large enough to invite protracted study. The water coming into the sound from the Stick-

een River is heavily charged with glacial mud, which spreads itself out over a great expanse. An extensive delta, forming almost the

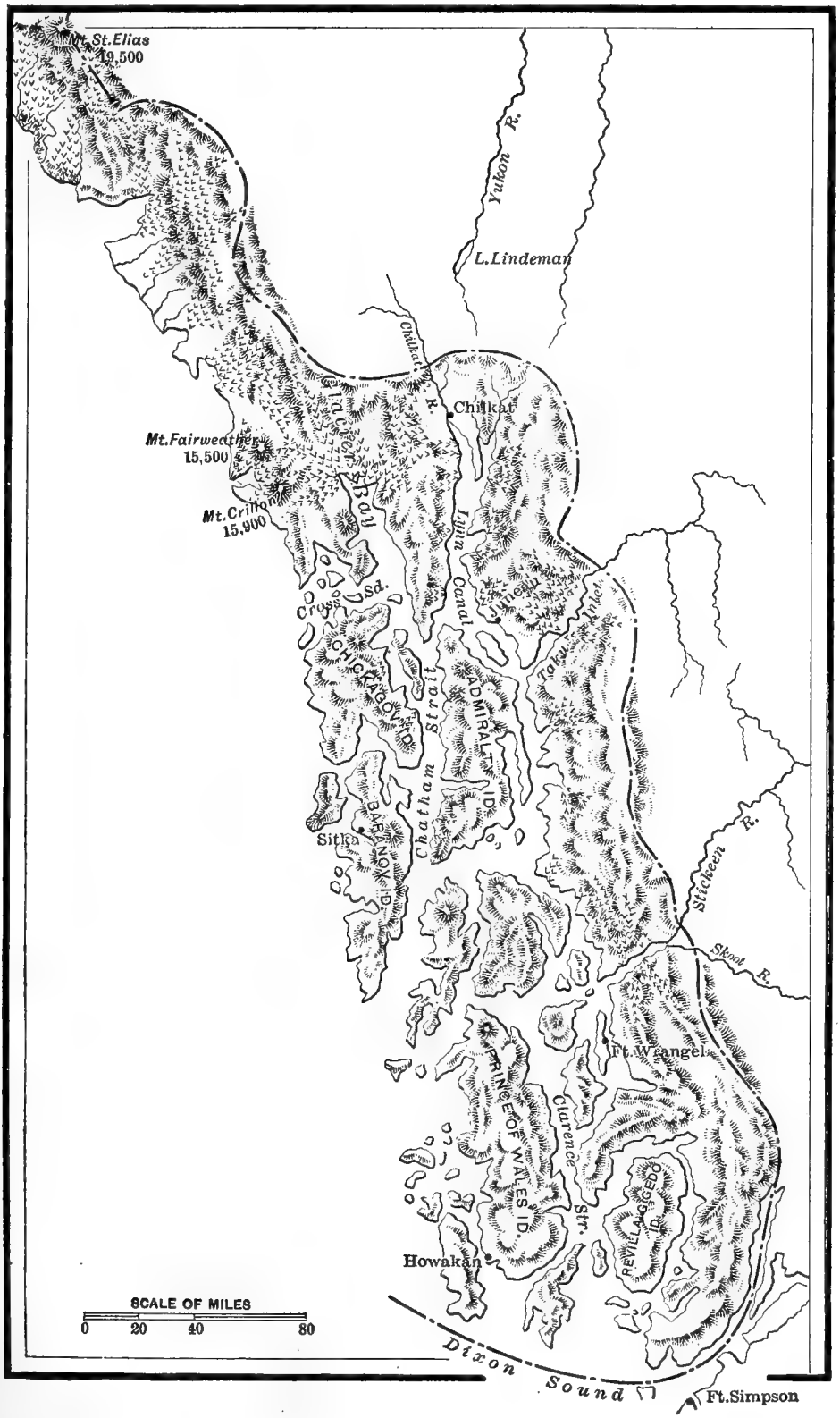


FIG. 2.—MAP OF SOUTHEASTERN ALASKA. The arrow-points mark glaciers.

only arable land in southeastern Alaska, has been built up by the deposit at the mouth of this river. The most accurate information

yet obtained concerning these glaciers is that gathered by Mr. William P. Blake in 1863. According to him, "there are four large glaciers and several smaller ones visible within a distance of sixty or seventy miles from the mouth" of the river. The second of these larger ones has attracted most attention. This "sweeps grandly out into the valley from an opening between high mountains from a source that is not visible. It ends at the level of the river in an irregular bluff of ice, a mile and a half or two miles in length, and about one hundred and fifty feet high. Two or more terminal moraines protect it from the direct action of the stream. What at first appeared as a range of ordinary hills along the river, proved on landing to be an ancient terminal moraine, crescent-shaped and covered with a forest. It extends the full length of the front of the glacier."*

This glacier has never been fully explored. A number of years since, a party of Russian officers attempted its exploration, and were never heard from again. Mr. Blake reports that, as usual with receding glaciers, a considerable portion of the front as it spreads out in the valley is so covered with bowlders, gravel, and mud that it is difficult to tell where the glacier really ends. But from the valley to the higher land it rises in precipitous, irregular, stair-like blocks, with smooth sides, and so large that it was impossible to surmount them with the ordinary equipment of explorers. The glacier is estimated to be about forty miles long.

Another glacier, upon the opposite side of the river, of which Mr. Blake does not speak, was reported to me by those familiar with the country as coming down to within about two miles of the bank. The Indians are very likely correct in asserting that these two glaciers formerly met, compelling the Stickeen River to find its way to the sea through a vast tunnel. It would then have appeared simply as a subglacial stream of great magnitude.

North of the Stickeen River, glaciers of great size are of increasing frequency, and can be seen to good advantage from the excursion steamer. The Auk and Patterson glaciers appear first, not far north of Fort Wrangel. On approaching Holkham Bay and Taku Inlet, about latitude 58°, the summer tourist has, in the numerous icebergs encountered, pleasing evidence of the proximity of still greater glaciers coming down to the sea-level. Indeed, the glaciers of Taku Inlet are second only in interest to those of Glacier Bay.

In going from Juneau to Chilkat, at the head of Lynn Canal, a distance of about eighty miles, nineteen glaciers of large size are in full sight from the steamer's deck, but none of them come down far enough to break off into the water and give birth to icebergs. The Davidson Glacier, however, comes down just to the water's

* "American Journal of Science," vol. xciv, 1867, pp. 96–101.

edge, and has there built up an immense terminal moraine all along its front.

An illustration of the precipitous character of the southeastern coast of Alaska is seen in the fact that it is only thirty-five miles

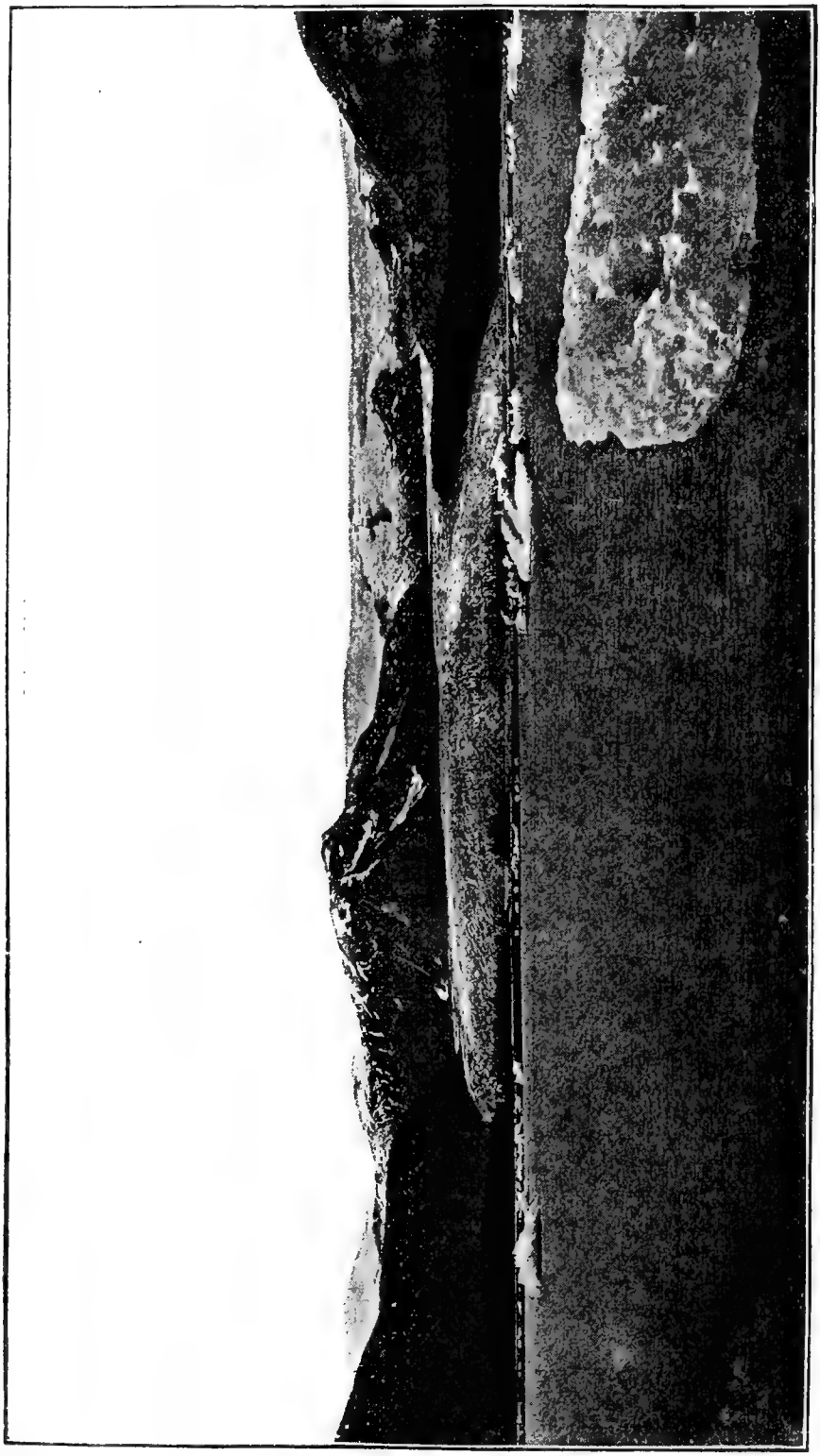


FIG. 3.—NORRIS GLACIER, TAKU INLET, ALASKA. Showing icebergs that have broken off from the front. Front about one mile wide. (Photograph by Partridge.)

from the head of Lynn Canal to the sources of the Yukon River, which then flows to the north and west for nearly three thousand miles before coming down to the sea-level. Lieutenant Schwatka

reports four glaciers of considerable size in the course of this short portage between Chilkat and Lake Lindeman.* The vast region through which the Yukon flows to the north of these mountains is not known to contain any extensive glaciers. But, according to the reports of Dall, Schwatka, and others, it is a most inhospitable country, where human life can be maintained only with the greatest difficulty; where the thermometer sinks to 60° below zero in winter, and rises for a short period to 120° in the summer; and where the ground remains perpetually frozen at a short depth below the surface.

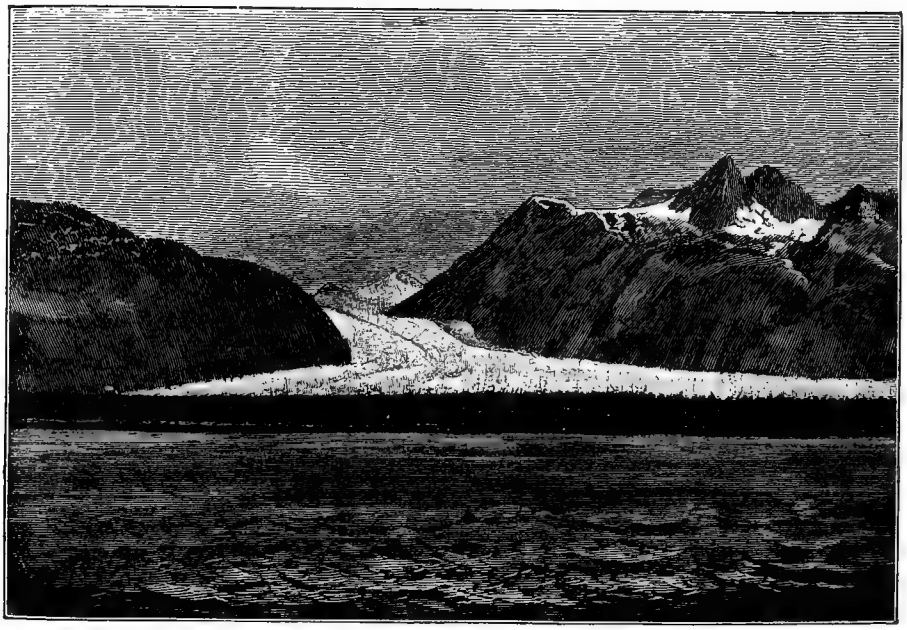


FIG. 4.—DAVIDSON GLACIER, NEAR CHILKAT, ALASKA, LATITUDE 59° 45′. The mountains are from five thousand to seven thousand feet high; the gorge about three quarters of a mile wide; the front of the glacier, three miles; the terminal moraine, about two hundred and fifty feet high. (View from two miles distant.)

From Cross Sound, about latitude 58° and longitude 136° west from Greenwich, to the Alaskan Peninsula, the coast is bordered by a most magnificent semicircle of mountains opening to the south, and extending for more than a thousand miles. Throughout this whole extent, glaciers of large size are everywhere to be seen. Elliott † estimates that, counting great and small, there can not be less than five thousand glaciers between Dixon's Entrance and the extremity of the Alaskan Peninsula.

Little is known in detail of the glaciers of this region. But those in the neighborhood of Mount St. Elias are evidently the largest anywhere to be found in the northern hemisphere outside of Greenland. This mountain rises 19,500 feet above the sea; and Lieutenant Schwatka, in his expedition of 1886, reported eleven glaciers as coming down from its southern side. One of these,

* "Science," vol. iii (February 22, 1884), pp. 220–227.

† See "Our Arctic Province," p. 91.

which is named the Agassiz Glacier, he estimates to be twenty miles in width and fifty miles in length, and to cover an area of a thousand square miles. Another, which he named Guyot Glacier, seemed to be about the same in dimensions. These come down to the sea-level in Icy Bay, and present a solid ice wall many miles in extent, which is continually breaking off into icebergs of great size.*

Vancouver's account of the glacial phenomena along this coast is still both instructive and interesting, and in places curious:

"Between these points (Pigot and Pakenham) a bay is formed, about a league and a half deep toward the north-northwest, in which were seen several shoals and much ice; the termination of this bay is bounded by a continuation of the above range of lofty mountains. On this second low projecting point, which Mr. Whidbey called 'Point Pakenham,' the latitude was observed to be 60° 59½′, its longitude 212° 29′. The width of the arm at this station was reduced to two miles, in which were several half-concealed rocks, and much floating ice, through which they pursued their examination, to a point at the distance of three miles along the western shore, which still continued to be compact, extending north 30° east; in this direction they met such innumerable huge bodies of ice, some afloat, others lying on the ground near the shore in ten or twelve fathoms water, as rendered their further progress up the branch rash and highly dangerous. This was, however, very fortunately, an object of no moment, since before their return they had obtained a distinct view of its termination, about two leagues farther in the same direction, by a firm and compact body of ice reaching from side to side, and greatly above the level of the sea; behind which extended the continuation of the same range of lofty mountains, whose summits seemed to be higher than any that had yet been seen on the coast.

"While at dinner in this situation they frequently heard a very loud, rumbling noise, not unlike loud but distant thunder; similar sounds had often been heard when the party was in the neighborhood of large bodies of ice, but they had not before been able to trace the cause. They now found the noise to originate from immense ponderous fragments of ice, breaking off from the higher parts of the main body, and falling from a very considerable height, which in one instance produced so violent a shock that it was sensibly felt by the whole party, although the ground on which they were was at least two leagues from the spot where the fall of ice had taken place. . . .

"The base of this lofty range of mountains (between Elias and Fairweather) now gradually approached the sea-side; and to the southward of Cape Fairweather it may be said to be washed by the ocean; the interruption in the summit of these very elevated

* "New York Times," November 14, 1886.

mountains, mentioned by Captain Cook, was likewise conspicuously evident to us as we sailed along the coast this day, and looked like a plain composed of a solid mass of ice or frozen snow, inclining gradually toward the low border; which from the smoothness, uniformity, and clean appearance of its surface, conveyed the idea of extensive waters having once existed beyond the then limits of our view, which had passed over this depressed part of the mountains, until their progress had been stopped by the severity of the climate, and that, by the accumulation of succeeding snow, freezing on this body of ice, a barrier had become formed that had prevented such waters from flowing into the sea. This is not the only place where we had noticed the like appearance; since passing the icy bay mentioned on the 28th of June, other valleys had been seen strongly resembling this, but none were so extensive, nor was the surface of any of them so clean, most of them appearing to be very dirty. I do not, however, mean to assert that these inclined planes of ice must have been formed by the passing of inland waters thus into the ocean, as the elevation of them, which must be many hundred yards above the level of the sea, and their having been doomed for ages to perpetual frost, operate much against this reasoning; but one is naturally led, on contemplating any phenomenon out of the ordinary course of nature, to form some conjecture and to hazard some opinion as to its origin, which on the present occasion is rather offered for the purpose of describing its appearance, than accounting for the cause of its existence." *

Beyond Mount St. Elias, in the neighborhood of the Copper River and Prince William Sound, glaciers are reported by Elliott as numerous and of great size. Mount Wrangel, in the forks of the Copper River, is estimated by him to be upward of twenty thousand feet in height. From the flanks of the Chugatch Alps, of which Wrangel is the eastern summit, immense glaciers descend to Prince William Sound, and add greatly to the gloomy grandeur of its scenery. Glaciers also extend throughout the Kenai and Alaskan Peninsulas, as far to the westward as longitude 162°, and one even has been observed upon the island of Unalaska.

The region in the interior north of the St. Elias and Chugatch Alps has been but imperfectly explored; but there seems pretty general agreement that there are no glaciers there at the present time, nor is there evidence that glaciers ever existed in the country. Much of the region is now covered with *tundra*—that is, with vast level areas which are so deeply frozen that they never thaw out below a few feet from the surface. These are covered with a dense growth of heath and arctic mosses, which afford food for the reindeer, but are useless for man.

* "Voyage of Discovery around the World," vol. v, pp. 312–314, 358–360.

At Eschscholtz Bay, on Kotzebue Sound, in latitude 66° 15′, Kotzebue discovered in 1818 a cliff of frozen mud and ice "capped by a few feet of soil bearing moss and grass."* Large numbers of bones of the "mammoth, bison (?), reindeer, moose-deer, musk-ox, and horse, were found" at the base, where they had fallen down from the cliff during the summer thaw. Sir Edward Belcher and Mr. G. B. Seeman afterward visited the same spot and corroborated Kotzebue's account. From their report it was evident that the conditions in northern Alaska are very similar to those in northern Siberia, where so many similar remains of extinct and other animals have been found in the frozen soil. The section described at Eschscholtz Bay seems to be simply the edge of the *tundra* which is so largely represented in the central portions of the Territory.

AGNOSTICISM: A REJOINDER.

By Prof. T. H. HUXLEY, F. R. S.

THE concluding paragraph of the Bishop of Peterborough's reply to the appeal which I addressed to him in the penultimate number of this review, leads me to think that he has seen a personal reference where none was intended. I had ventured to suggest that the demand that a man should call himself an infidel, savored very much of the flavor of a "bull"; and, even had the Right Reverend prelate been as stolid an Englishman as I am, I should have entertained the hope, that the oddity of talking of the cowardice of persons who object to call themselves by a nickname, which must in their eyes be as inappropriate as, in the intention of the users, it is offensive, would have struck him. But, to my surprise, the bishop has not even yet got sight of that absurdity. He thinks, that if I accept Dr. Wace's definition of his much-loved epithet, I am logically bound not only to adopt the titles of infidel and miscreant, but that I shall "even glory in those titles." As I have shown, "infidel" merely means somebody who does not believe what you believe yourself, and therefore Dr. Wace has a perfect right to call, say, my old Egyptian donkey-driver, Nooleh, and myself, infidels, just as Nooleh and I have a right to call him an infidel. The ludicrous aspect of the thing comes in only when either of us demands that the two others should so label themselves. It is a terrible business to have to explain a mild jest, and I pledge myself not to run the risk of offending in this way again. I see how wrong I was in trusting to the bishop's sense of the ludicrous, and I beg leave unreservedly to withdraw my misplaced confidence. And I take this course the more readily as there is

* See Prestwich's "Geology," vol. ii, p. 463 *et seq.*

something about which I am obliged again to trouble the Bishop of Peterborough, which is certainly no jesting matter. Referring to my question, the bishop says that if they (the terms "infidel" and "miscreant")

should not be so proved to be applicable, then I should hold it to be as unreasonable to expect him to call himself by such names as he, I suppose, would hold it to be to expect us Christians to admit, without better reason than he has yet given us, that Christianity is "the sorry stuff" which, with his "profoundly" moral readiness to say "unpleasant" things, he is pleased to say that it is.*

According to those "English modes of thought and expression," of which the bishop seems to have but a poor opinion, this is a deliberate assertion that I had said that Christianity is "sorry stuff." And, according to the same standard of fair dealing, it is, I think, absolutely necessary for the Bishop of Peterborough to produce the evidence on which this positive statement is based. I shall be unfeignedly surprised if he is successful in proving it; but it is proper for me to wait and see.

Those who passed from Dr. Wace's article in the last number of this review to the anticipatory confutation of it which followed in "The New Reformation," must have enjoyed the pleasure of a dramatic surprise—just as when the fifth act of a new play proves unexpectedly bright and interesting. Mrs. Ward will, I hope, pardon the comparison, if I say that her effective clearing away of antiquated incumbrances from the lists of the controversy reminds me of nothing so much as of the action of some neat-handed, but strong-wristed, Phyllis, who, gracefully wielding her long-handled "Turk's head," sweeps away the accumulated results of the toil of generations of spiders. I am the more indebted to this luminous sketch of the results of critical investigation, as it is carried out among those theologians who are men of science and not mere counsel for creeds, since it has relieved me from the necessity of dealing with the greater part of Dr. Wace's polemic, and enables me to devote more space to the really important issues which have been raised.†

Perhaps, however, it may be well for me to observe that approbation of the manner in which a great biblical scholar, for instance Reuss, does his work does not commit me to the adoption of all, or indeed of any of his views; and, further, that the disagreements of a series of investigators do not in any way interfere with the fact that each of them has made important contributions to the

* "Popular Science Monthly" for May, 1889, p. 83.

† I may perhaps return to the question of the authorship of the Gospels. For the present I must content myself with warning my readers against any reliance upon Dr. Wace's statements as to the results arrived at by modern criticism. They are as gravely as surprisingly erroneous.

body of truth ultimately established. If I cite Buffon, Linnæus, Lamarck, and Cuvier, as having each and all taken a leading share in building up modern biology, the statement that every one of these great naturalists disagreed with, and even more or less contradicted, all the rest is quite true; but the supposition that the latter assertion is in any way inconsistent with the former, would betray a strange ignorance of the manner in which all true science advances.

Dr. Wace takes a great deal of trouble to make it appear that I have desired to evade the real questions raised by his attack upon me at the Church Congress. I assure the reverend principal that in this, as in some other respects, he has entertained a very erroneous conception of my intentions. Things would assume more accurate proportions in Dr. Wace's mind if he would kindly remember that it is just thirty years since ecclesiastical thunderbolts began to fly about my ears. I have had the "Lion and the Bear" to deal with, and it is long since I got quite used to the threatenings of episcopal Goliaths, whose crosiers were like unto a weaver's beam. So that I almost think I might not have noticed Dr. Wace's attack, personal as it was; and although, as he is good enough to tell us, separate copies are to be had for the modest equivalent of twopence, as a matter of fact, it did not come under my notice for a long time after it was made. May I further venture to point out that (reckoning postage) the expenditure of twopence-halfpenny, or, at the most, threepence, would have enabled Dr. Wace so far to comply with ordinary conventions as to direct my attention to the fact that he had attacked me before a meeting at which I was not present? I really am not responsible for the five months' neglect of which Dr. Wace complains. Singularly enough, the Englishry who swarmed about the Engadine, during the three months that I was being brought back to life by the glorious air and perfect comfort of the Maloja, did not, in my hearing, say anything about the important events which had taken place at the Church Congress; and I think I can venture to affirm that there was not a single copy of Dr. Wace's pamphlet in any of the hotel libraries which I rummaged in search of something more edifying than dull English or questionable French novels.

And now, having, as I hope, set myself right with the public as regards the sins of commission and omission with which I have been charged, I feel free to deal with matters to which time and type may be more profitably devoted.

The Bishop of Peterborough indulges in the anticipation that Dr. Wace will succeed in showing me "that a scientist dealing with questions of theology or biblical criticism may go quite as far astray as theologians often do in dealing with questions

of science."* I have already admitted that vaticination is not in my line; and I can not so much as hazard a guess whether the spirit of prophecy which has descended on the bishop comes from the one or the other of the two possible sources recognized by the highest authorities. But I think it desirable to warn those who may be misled by phraseology of this kind, that the antagonists in the present debate are not quite rightly represented by it. Undoubtedly, Dr. Wace is a theologian; and I should be the last person to question that his whole cast of thought and style of argumentation are pre-eminently and typically theological. And, if I must accept the hideous term "scientist" (to which I object even more than I do to "infidel"), I am ready to admit that I am one of the people so denoted.

But I hope and believe that there is not a solitary argument I have used, or that I am about to use, which is original, or has anything to do with the fact that I have been chiefly occupied with natural science. They are all, facts and reasoning alike, either identical with, or consequential upon, propositions which are to be found in the works of scholars and theologians of the highest repute in the only two countries, Holland and Germany,† in which, at the present time, professors of theology are to be found, whose tenure of their posts does not depend upon the results to which their inquiries lead them.‡

It is true that, to the best of my ability, I have satisfied myself of the soundness of the foundations on which my arguments are built, and I desire to be held fully responsible for everything I say. But, nevertheless, my position is really no more than that of an expositor; and my justification for undertaking it is simply that conviction of the supremacy of private judgment (indeed, of the impossibility of escaping it) which is the foundation of the Protestant Reformation, and which was the doctrine accepted by the vast majority of the Anglicans of my youth, before that backsliding toward the "beggarly rudiments" of an effete and idolatrous sacerdotalism which has, even now, provided us with

* "Popular Science Monthly" for May, 1889, p. 84.

† The United States ought, perhaps, to be added, but I am not sure.

‡ Imagine that all our chairs of Astronomy had been founded in the fourteenth century, and that their incumbents were bound to sign Ptolemaic articles. In that case, with every respect for the efforts of persons thus hampered to attain and expound the truth, I think men of common sense would go elsewhere to learn astronomy. Zeller's "Vorträge und Abhandlungen" were published and came into my hands a quarter of a century ago. The writer's rank, as a theologian to begin with, and subsequently as a historian of Greek philosophy, is of the highest. Among these essays are two—"Das Urchristenthum" and "Die Tübinger historische Schule"—which are likely to be of more use to those who wish to know the real state of the case than all that the official "apologists," with their one eye on truth and the other on the tenets of their sect, have written. For the opinion of a scientific theologian about theologians of this stamp see pp. 225 and 227 of the "Vorträge."

the saddest spectacle which has been offered to the eyes of Englishmen in this generation. A high court of ecclesiastical jurisdiction, with a host of great lawyers in battle array, is and, for Heaven knows how long, will be, occupied with these very questions of "washings of cups and pots and brazen vessels," which the Master, whose professed representatives are rending the Church over these squabbles, had in his mind when, as we are told, he uttered the scathing rebuke:

> Well did Isaiah prophesy of you hypocrites, as it is written:
> This people honoreth me with their lips,
> But their heart is far from me:
> But in vain do they worship me,
> Teaching as their doctrines the precepts of men (Mark vii, 6, 7).

Men who can be absorbed in bickerings over miserable disputes of this kind can have but little sympathy with the old evangelical doctrine of the "open Bible," or anything but a grave misgiving of the results of diligent reading of the Bible, without the help of ecclesiastical spectacles, by the mass of the people. Greatly to the surprise of many of my friends, I have always advocated the reading of the Bible, and the diffusion of the study of that most remarkable collection of books among the people. Its teachings are so infinitely superior to those of the sects, who are just as busy now as the Pharisees were eighteen hundred years ago, in smothering them under "the precepts of men"; it is so certain, to my mind, that the Bible contains within itself the refutation of nine tenths of the mixture of sophistical metaphysics and old-world superstition which has been piled round it by the so-called Christians of later times; it is so clear that the only immediate and ready antidote to the poison which has been mixed with Christianity, to the intoxication and delusion of mankind, lies in copious draughts from the undefiled spring, that I exercise the right and duty of free judgment on the part of every man, mainly for the purpose of inducing other laymen to follow my example. If the New Testament is translated into Zulu by Protestant missionaries, it must be assumed that a Zulu convert is competent to draw from its contents all the truths which it is necessary for him to believe. I trust that I may, without immodesty, claim to be put on the same footing as the Zulu.

The most constant reproach which is launched against persons of my way of thinking is, that it is all very well for us to talk about the deductions of scientific thought, but what are the poor and the uneducated to do? Has it ever occurred to those who talk in this fashion that the creeds and articles of their several confessions; their determination of the exact nature and extent of the teachings of Jesus; their expositions of the real meaning of that which is written in the Epistles (to leave aside all questions con-

cerning the Old Testament) are nothing more than deductions, which, at any rate, profess to be the result of strictly scientific thinking, and which are not worth attending to unless they really possess that character? If it is not historically true that such and such things happened in Palestine eighteen centuries ago, what becomes of Christianity? And what is historical truth but that of which the evidence bears strict scientific investigation? I do not call to mind any problem of natural science which has come under my notice, which is more difficult, or more curiously interesting as a mere problem, than that of the origin of the synoptic Gospels and that of the historical value of the narratives which they contain. The Christianity of the churches stands or falls by the results of the purely scientific investigation of these questions. They were first taken up in a purely scientific spirit just about a century ago; they have been studied, over and over again, by men of vast knowledge and critical acumen; but he would be a rash man who should assert that any solution of these problems, as yet formulated, is exhaustive. The most that can be said is that certain prevalent solutions are certainly false, while others are more or less probably true.

If I am doing my best to rouse my countrymen out of their dogmatic slumbers, it is not that they may be amused by seeing who gets the best of it, in a contest between a "scientist" and a theologian. The serious question is whether theological men of science, or theological special pleaders, are to have the confidence of the general public; it is the question whether a country in which it is possible for a body of excellent clerical and lay gentlemen to discuss, in public meeting assembled, how much it is desirable to let the congregations of the faithful know of the results of biblical criticism, is likely to wake up with anything short of the grasp of a rough lay hand upon its shoulder; it is the question whether the New Testament books, being as I believe they were, written and compiled by people who, according to their lights, were perfectly sincere, will not, when properly studied as ordinary historical documents, afford us the means of self-criticism. And it must be remembered that the New Testament books are not responsible for the doctrine invented by the churches that they are anything but ordinary historical documents. The author of the third Gospel tells us as straightforwardly as a man can that he has no claim to any other character than that of an ordinary compiler and editor, who had before him the works of many and variously qualified predecessors.

In my former papers, according to Dr. Wace, I have evaded giving an answer to his main proposition, which he states as follows:

Apart from all disputed points of criticism, no one practically doubts that our Lord lived and that he died on the cross, in the most intense sense of filial relation to his Father in heaven, and that he bore testimony to that Father's providence, love, and grace toward mankind. The Lord's Prayer affords a sufficient evidence on these points. If the Sermon on the Mount alone be added, the whole unseen world, of which the agnostic refuses to know anything, stands unveiled before us. . . . If Jesus Christ preached that sermon, made those promises, and taught that prayer, then any one who says that we know nothing of God, or of a future life, or of an unseen world, says that he does not believe Jesus Christ.*

Again—

The main question at issue, in a word, is one which Prof. Huxley has chosen to leave entirely on one side—whether, namely, allowing for the utmost uncertainty on other points of the criticism to which he appeals, there is any reasonable doubt that the Lord's Prayer and the Sermon on the Mount afford a true account of our Lord's essential belief and cardinal teaching.†

I certainly was not aware that I had evaded the questions here stated; indeed, I should say that I have indicated my reply to them pretty clearly; but, as Dr. Wace wants a plainer answer, he shall certainly be gratified. If, as Dr. Wace declares it is, his "whole case is involved in" the argument as stated in the latter of these two extracts, so much the worse for his whole case. For I am of opinion that there is the gravest reason for doubting whether the "Sermon on the Mount" was ever preached, and whether the so-called "Lord's Prayer" was ever prayed by Jesus of Nazareth. My reasons for this opinion are, among others, these: There is now no doubt that the three synoptic Gospels, so far from being the work of three independent writers, are closely interdependent,‡ and that in one of two ways. Either all three contain, as their foundation, versions, to a large extent verbally identical, of one and the same tradition; or two of them are thus closely dependent on the third; and the opinion of the majority of the best critics has, of late years, more and more converged toward the conviction that our canonical second Gospel (the so-called "Mark's" Gospel) is that which most closely represents the primitive groundwork of the three.# That I take to be

* "Popular Science Monthly" for May, 1889, p. 68. † Ibid., p. 69.

‡ I suppose this is what Dr. Wace is thinking about when he says that I allege that there "is no visible escape" from the supposition of an "Ur-Marcus" (p. 82). That a "theologian of repute" should confound an indisputable fact with one of the modes of explaining that fact, is not so singular as those who are unaccustomed to the ways of theologians might imagine.

Any examiner whose duty it has been to examine into a case of "copying" will be particularly well prepared to appreciate the force of the case stated in that most excellent little book, "The Common Tradition of the Synoptic Gospels," by Dr. Abbott and Mr. Rushbrooke (Macmillan, 1884). To those who have not passed through such painful experiences I may recommend the brief discussion of the genuineness of the "Casket Letters" in my friend Mr. Skelton's interesting book, "Maitland of Lethington." The second edition of Holtzmann's "Lehrbuch," published in 1886, gives a remarkably fair and full account of

one of the most valid results of New Testament criticism, of immeasurably greater importance than the discussion about dates and authorship.

But if, as I believe to be the case, beyond any rational doubt or dispute, the second Gospel is the nearest extant representative of the oldest tradition, whether written or oral, how comes it that it contains neither the "Sermon on the Mount" nor the "Lord's Prayer," those typical embodiments, according to Dr. Wace, of the "essential belief and cardinal teaching" of Jesus? Not only does "Mark's" Gospel fail to contain the "Sermon on the Mount," or anything but a very few of the sayings contained in that collection; but, at the point of the history of Jesus where the "Sermon" occurs in "Matthew," there is in "Mark" an apparently unbroken narrative, from the calling of James and John to the healing of Simon's wife's mother. Thus the oldest tradition not only ignores the "Sermon on the Mount," but, by implication, raises a probability against its being delivered when and where the later "Matthew" inserts it in his compilation.

And still more weighty is the fact that the third Gospel, the author of which tells us that he wrote after "many" others had "taken in hand" the same enterprise; who should therefore have known the first Gospel (if it existed), and was bound to pay to it the deference due to the work of an apostolic eye-witness (if he had any reason for thinking it was so)—this writer, who exhibits far more literary competence than the other two, ignores any "Sermon on the Mount," such as that reported by "Matthew," just as much as the oldest authority does. Yet "Luke" has a great many passages identical, or parallel, with those in "Matthew's" "Sermon on the Mount," which are, for the most part, scattered about in a totally different connection.

Interposed, however, between the nomination of the apostles and a visit to Capernaum; occupying, therefore, a place which answers to that of the "Sermon on the Mount" in the first Gospel, there is, in the third Gospel, a discourse which is as closely similar to the "Sermon on the Mount" in some particulars, as it is widely unlike it in others.

This discourse is said to have been delivered in a "plain" or "level place" (Luke vi, 17), and by way of distinction we may call it the "Sermon on the Plain."

I see no reason to doubt that the two evangelists are dealing, to a considerable extent, with the same traditional material; and a comparison of the two "sermons" suggests very strongly that

the present results of criticism. At page 366 he writes that the present burning question is whether the "relatively primitive narration and the root of the other synoptic texts is contained in Matthew or in Mark. It is only on this point that properly informed (*sachkundige*) critics differ," and he decides in favor of Mark.

"Luke's" version is the earlier. The correspondences between the two forbid the notion that they are independent. They both begin with a series of blessings, some of which are almost verbally identical. In the middle of each (Luke vi, 27–38, Matthew v, 43–48) there is a striking exposition of the ethical spirit of the command given in Leviticus xix, 18. And each ends with a passage containing the declaration that a tree is to be known by its fruit, and the parable of the house built on the sand. But while there are only twenty-nine verses in the "Sermon on the Plain," there are one hundred and seven in the "Sermon on the Mount"; the excess in length of the latter being chiefly due to the long interpolations, one of thirty verses before, and one of thirty-four verses after, the middlemost parallelism with Luke. Under these circumstances, it is quite impossible to admit that there is more probability that "Matthew's" version of the sermon is historically accurate than there is that Luke's version is so; and they can not both be accurate.

"Luke" either knew the collection of loosely connected and aphoristic utterances which appear under the name of the "Sermon on the Mount" in "Matthew," or he did not. If he did not, he must have been ignorant of the existence of such a document as our canonical "Matthew," a fact which does not make for the genuineness or the authority of that book. If he did, he has shown that he does not care for its authority on a matter of fact of no small importance; and that does not permit us to conceive that he believed the first Gospel to be the work of an authority to whom he ought to defer, let alone that of an apostolic eye-witness.

The tradition of the Church about the second Gospel, which I believe to be quite worthless, but which is all the evidence there is for "Mark's" authorship, would have us believe that "Mark" was little more than the mouth-piece of the apostle Peter. Consequently, we are to suppose that Peter either did not know, or did not care very much for, that account of the "essential belief and cardinal teaching" of Jesus which is contained in the Sermon on the Mount; and, certainly, he could not have shared Dr. Wace's view of its importance.*

I thought that all fairly attentive and intelligent students of the Gospels, to say nothing of theologians of reputation, knew these things. But how can any one who does know them have the conscience to ask whether there is "any reasonable doubt"

* Holtzmann ("Die synoptischen Evangelien," 1863, p. 75), following Ewald, argues that the "Source A" (= the threefold tradition, more or less) contained something that answered to the "Sermon on the Plain" immediately after the words of our present Mark, "And he cometh into a house" (iii, 19). But what conceivable motive could "Mark" have for omitting it? Holtzmann has no doubt, however, that the "Sermon on the Mount" is a compilation, or, as he calls it in his recently published "Lehrbuch" (p. 372), "an artificial mosaic work."

that the Sermon on the Mount was preached by Jesus of Nazareth? If conjecture is permissible, where nothing else is possible, the most probable conjecture seems to be that "Matthew," having a *cento* of sayings attributed—rightly or wrongly it is impossible to say—to Jesus, among his materials, thought they were, or might be, records of a continuous discourse, and put them in at the place he thought likeliest. Ancient historians of the highest character saw no harm in composing long speeches which never were spoken, and putting them into the mouths of statesmen and warriors; and I presume that whoever is represented by "Matthew" would have been grievously astonished to find that any one objected to his following the example of the best models accessible to him.

So with the "Lord's Prayer." Absent in our representative of the oldest tradition, it appears in both "Matthew" and "Luke." There is reason to believe that every pious Jew, at the commencement of our era, prayed three times a day, according to a formula which is embodied in the present *Schmone-Esre** of the Jewish prayer-book. Jesus, who was assuredly, in all respects, a pious Jew, whatever else he may have been, doubtless did the same. Whether he modified the current formula, or whether the so-called "Lord's Prayer" is the prayer substituted for the *Schmone-Esre* in the congregations of the Gentiles, who knew nothing of the Jewish practice, is a question which can hardly be answered.

In a subsequent passage of Dr. Wace's article † he adds to the list of the verities which he imagines to be unassailable, "The story of the Passion." I am not quite sure what he means by this—I am not aware that any one (with the exception of certain ancient heretics) has propounded doubts as to the reality of the crucifixion; and certainly I have no inclination to argue about the precise accuracy of every detail of that pathetic story of suffering and wrong. But, if Dr. Wace means, as I suppose he does, that that which, according to the orthodox view, happened after the crucifixion, and which is, in a dogmatic sense, the most important part of the story, is founded on solid historical proofs, I must beg leave to express a diametrically opposite conviction.

What do we find when the accounts of the events in question, contained in the three synoptic Gospels, are compared together? In the oldest, there is a simple, straightforward statement which, for anything that I have to urge to the contrary, may be exactly true. In the other two, there is, round this possible and probable nucleus, a mass of accretions of the most questionable character.

The cruelty of death by crucifixion depended very much upon its lingering character. If there were a support for the weight of the body, as not unfrequently was the case, the pain during the

* See Schürer, "Geschichte des jüdischen Volkes," Zweiter Theil, p. 384.

† "Popular Science Monthly" for May, 1889, p. 69.

first hours of the infliction was not, necessarily, extreme; nor need any serious physical symptoms at once arise from the wounds made by the nails in the hands and feet, supposing they were nailed, which was not invariably the case. When exhaustion set in, and hunger, thirst, and nervous irritation had done their work, the agony of the sufferer must have been terrible; and the more terrible that, in the absence of any effectual disturbance of the machinery of physical life, it might be prolonged for many hours, or even days. Temperate, strong men, such as the ordinary Galilean peasants were, might live for several days on the cross. It is necessary to bear these facts in mind when we read the account contained in the fifteenth chapter of the second Gospel.

Jesus was crucified at the third hour (xv, 25), and the narrative seems to imply that he died immediately after the ninth hour (*v.* 34). In this case, he would have been crucified only six hours; and the time spent on the cross can not have been much longer, because Joseph of Arimathæa must have gone to Pilate, made his preparations, and deposited the body in the rock-cut tomb before sunset, which, at that time of the year, was about the twelfth hour. That any one should die after only six hours' crucifixion could not have been at all in accordance with Pilate's large experience in the effects of that method of punishment. It, therefore, quite agrees with what might be expected if Pilate "marveled if he were already dead," and required to be satisfied on this point by the testimony of the Roman officer who was in command of the execution party. Those who have paid attention to the extraordinarily difficult question, What are the indisputable signs of death?—will be able to estimate the value of the opinion of a rough soldier on such a subject; even if his report to the procurator were in no wise affected by the fact that the friend of Jesus, who anxiously awaited his answer, was a man of influence and of wealth.

The inanimate body, wrapped in linen, was deposited in a spacious,* cool, rock chamber, the entrance of which was closed, not by a well-fitting door, but by a stone rolled against the opening, which would of course allow free passage of air. A little more than thirty-six hours afterward (Friday 6 P. M., to Sunday 6 A. M., or a little after) three women visit the tomb and find it empty. And they are told by a young man "arrayed in a white robe" that Jesus is gone to his native country of Galilee, and that the disciples and Peter will find him there.

Thus it stands, plainly recorded, in the oldest tradition that, for any evidence to the contrary, the sepulchre may have been vacated at any time during the Friday or Saturday nights. If it

* Spacious, because a young man could sit in it "on the right side" (xv, 5), and therefore with plenty of room to spare.

is said that no Jew would have violated the Sabbath by taking the former course, it is to be recollected that Joseph of Arimathæa might well be familiar with that wise and liberal interpretation of the fourth commandment, which permitted works of mercy to men—nay even the drawing of an ox or an ass out of a pit—on the Sabbath. At any rate, the Saturday night was free to the most scrupulous observers of the law.

These are the facts of the case as stated by the oldest extant narrative of them. I do not see why any one should have a word to say against the inherent probability of that narrative; and, for my part, I am quite ready to accept it as an historical fact, that so much and no more is positively known of the end of Jesus of Nazareth. On what grounds can a reasonable man be asked to believe any more? So far as the narrative in the first Gospel, on the one hand, and those in the third Gospel and the Acts, on the other go beyond what is stated in the second Gospel, they are hopelessly discrepant with one another. And this is the more significant because the pregnant phrase "some doubted," in the first Gospel, is ignored in the third.

But it is said that we have the witness Paul speaking to us directly in the Epistles. There is little doubt that we have, and a very singular witness he is. According to his own showing, Paul, in the vigor of his manhood, with every means of becoming acquainted, at first hand, with the evidence of eye-witnesses, not merely refused to credit them, but "persecuted the church of God and made havoc of it." The reasoning of Stephen fell dead upon the acute intellect of this zealot for the traditions of his fathers: his eyes were blind to the ecstatic illumination of the martyr's countenance "as it had been the face of an angel"; and when, at the words "Behold, I see the heavens opened and the Son of man standing on the right hand of God," the murderous mob rushed upon and stoned the rapt disciple of Jesus, Paul ostentatiously made himself their official accomplice.

Yet this strange man, because he has a vision one day, at once, and with equally headlong zeal, flies to the opposite pole of opinion. And he is most careful to tell us that he abstained from any re-examination of the facts.

> Immediately I conferred not with flesh and blood; neither went I up to Jerusalem to them which were apostles before me; but I went away into Arabia. (Galatians i, 16, 17.)

I do not presume to quarrel with Paul's procedure. If it satisfied him, that was his affair; and, if it satisfies any one else, I am not called upon to dispute the right of that person to be satisfied. But I certainly have the right to say that it would not satisfy me, in like case; that I should be very much ashamed to pretend that it could, or ought to, satisfy me; and that I can entertain but a

very low estimate of the value of the evidence of people who are to be satisfied in this fashion, when questions of objective fact, in which their faith is interested, are concerned. So that, when I am called upon to believe a great deal more than the oldest Gospel tells me about the final events of the history of Jesus on the authority of Paul (1 Corinthians xv, 5–8), I must pause. Did he think it, at any subsequent time, worth while "to confer with flesh and blood," or, in modern phrase, to re-examine the facts for himself? or was he ready to accept anything that fitted in with his preconceived ideas? Does he mean, when he speaks of all the appearances of Jesus after the crucifixion as if they were of the same kind, that they were all visions, like the manifestation to himself? And, finally, how is this account to be reconciled with those in the first and the third Gospels—which, as we have seen, disagree with one another?

Until these questions are satisfactorily answered, I am afraid that, so far as I am concerned, Paul's testimony can not be seriously regarded, except as it may afford evidence of the state of traditional opinion at the time at which he wrote, say between 55 and 60 A. D.; that is, more than twenty years after the event; a period much more than sufficient for the development of any amount of mythology about matters of which nothing was really known. A few years later, among the contemporaries and neighbors of the Jews, and, if the most probable interpretation of the Apocalypse can be trusted, among the followers of Jesus also, it was fully believed, in spite of all evidence to the contrary, that the Emperor Nero was not really dead, but that he was hidden away somewhere in the East, and would speedily come again at the head of a great army, to be revenged upon his enemies.

Thus, I conceive that I have shown cause for the opinion that Dr. Wace's challenge touching the Sermon on the Mount, the Lord's Prayer, and the Passion, was more valorous than discreet. After all this discussion, I am still at the agnostic point. Tell me, first, what Jesus can be proved to have been, said, and done, and I will tell you whether I believe him, or in him,* or not! As Dr. Wace admits that I have dissipated his lingering shade of unbelief about the bedevilment of the Gadarene pigs, he might have done something to help mine. Instead of that, he manifests a total want of conception of the nature of the obstacles which impede the conversion of his "infidels."

The truth I believe to be, that the difficulties in the way of

* I am very sorry for the interpolated "in," because citation ought to be accurate in small things as in great. But what difference it makes whether one "believes Jesus" or "believes in Jesus" much thought has not enabled me to discover. If you "believe him" you must believe him to be what he professed to be—that is, "believe in him"; and if you "believe in him" you must necessarily "believe him."

arriving at a sure conclusion as to these matters, from the Sermon on the Mount, the Lord's Prayer, or any other data offered by the synoptic Gospels (and *a fortiori* from the fourth Gospel) are insuperable. Every one of these records is colored by the prepossessions of those among whom the primitive traditions arose and of those by whom they were collected and edited; and the difficulty of making allowance for these prepossessions is enhanced by our ignorance of the exact dates at which the documents were first put together; of the extent to which they have been subsequently worked over and interpolated; and of the historical sense, or want of sense, and the dogmatic tendencies, of their compilers and editors. Let us see if there is any other road which will take us into something better than negation.

There is a wide-spread notion that the "primitive Church," while under the guidance of the apostles and their immediate successors, was a sort of dogmatic dove-cote, pervaded by the most loving unity and doctrinal harmony. Protestants, especially, are fond of attributing to themselves the merit of being nearer "the Church of the apostles" than their neighbors; and they are the less to be excused for their strange delusion because they are great readers of the documents which prove the exact contrary. The fact is that, in the course of the first three centuries of its existence, the Church rapidly underwent a process of evolution of the most remarkable character, the final stage of which is far more different from the first than Anglicanism is from Quakerism. The key to the comprehension of the problem of the origin of that which is now called "Christianity," and its relation to Jesus of Nazareth, lies here. Nor can we arrive at any sound conclusion as to what it is probable that Jesus actually said and did without being clear on this head. By far the most important and subsequently influential steps in the evolution of Christianity took place in the course of the century, more or less, which followed upon the crucifixion. It is almost the darkest period of Church history, but, most fortunately, the beginning and the end of the period are brightly illuminated by the contemporary evidence of two writers of whose historical existence there is no doubt,* and against the genuineness of whose most important works there is no widely admitted objection. These are Justin, the philosopher and martyr, and Paul, the Apostle to the Gentiles. I shall call upon these witnesses only to testify to the condition of opinion among those who called themselves disciples of Jesus in their time.

Justin, in his dialogue with Trypho the Jew, which was written somewhere about the middle of the second century, enumerates

* True for Justin; but there is a school of theological critics, who more or less question the historical reality of Paul and the genuineness of even the four cardinal epistles.

certain categories of persons who, in his opinion, will, or will not, be saved.* These are:

1. Orthodox Jews who refuse to believe that Jesus is the Christ. *Not saved.*

2. Jews who observe the law; believe Jesus to be the Christ; but who insist on the observance of the law by Gentile converts. *Not saved.*

3. Jews who observe the law; believe Jesus to be the Christ, and hold that Gentile converts need not observe the law. *Saved* (in Justin's opinion; but some of his fellow-Christians think the contrary).

4. Gentile converts to the belief in Jesus as the Christ, who observe the law. *Saved* (possibly).

5. Gentile believers in Jesus as the Christ, who do not observe the law themselves (except so far as the refusal of idol sacrifices), but do not consider those who do observe it heretics. *Saved* (this is Justin's own view).

6. Gentile believers who do not observe the law except in refusing idol sacrifices, and hold those who do observe it to be heretics. *Saved.*

7. Gentiles who believe Jesus to be the Christ and call themselves Christians. but who eat meats sacrificed to idols. *Not saved.*

8. Gentiles who disbelieve in Jesus as the Christ. *Not saved.*

Justin does not consider Christians who believe in the natural birth of Jesus, of whom he implies that there is a respectable minority, to be heretics, though he himself strongly holds the preternatural birth of Jesus and his pre-existence as the "Logos" or "Word." He conceives the Logos to be a second God, inferior to the first, unknowable, God, with respect to whom Justin, like Philo, is a complete agnostic. The Holy Spirit is not regarded by Justin as a separate personality, and is often mixed up with the "Logos." The doctrine of the natural immortality of the soul is, for Justin, a heresy; and he is as firm a believer in the resurrection of the body as in the speedy second coming and the establishment of the millennium.

This pillar of the Church in the middle of the second century—a much-traveled native of Samaria—was certainly well acquainted with Rome, probably with Alexandria, and it is likely that he knew the state of opinion throughout the length and breadth of the Christian world as well as any man of his time. If the various categories above enumerated are arranged in a series thus—

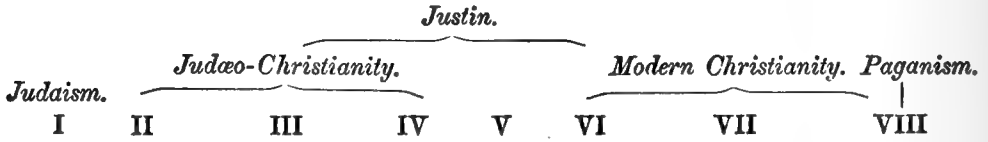
		Justin's Christianity.					
Orthodox Judaism.	*Judæo-Christianity.*					*Idolothytic Christianity.*	*Paganism.*
I	II	III	IV	V	VI	VII	VIII

* See "Dial. cum Tryphone," sections 47 and 35. It is to be understood that Justin does not arrange these categories in order as I have done.

it is obvious that they form a gradational series from orthodox Judaism, on the extreme left, to paganism, whether philosophic or popular, on the extreme right; and it will further be observed that, while Justin's conception of Christianity is very broad, he rigorously excludes two classes of persons who, in his time, called themselves Christians; namely, those who insist on circumcision and other observances of the law on the part of Gentile converts; that is to say, the strict Judæo-Christians (II), and, on the other hand, those who assert the lawfulness of eating meat offered to idols—whether they are gnostics or not (VII). These last I have called "idolothytic" Christians, because I can not devise a better name, not because it is strictly defensible etymologically.

At the present moment I do not suppose there is an English missionary in any heathen land who would trouble himself whether the materials of his dinner had been previously offered to idols or not. On the other hand, I suppose there is no Protestant sect within the pale of orthodoxy, to say nothing of the Roman and Greek Churches, which would hesitate to declare the practice of circumcision and the observance of the Jewish Sabbath and dietary rules, shockingly heretical.

Modern Christianity has, in fact, not only shifted far to the right of Justin's position, but it is of much narrower compass.



For, though it includes VII, and even, in saint and relic worship, cuts a "monstrous cantle" out of paganism, it excludes, not only all Judæo-Christians, but all who doubt that such are heretics. Ever since the thirteenth century, the Inquisition would have cheerfully burned, and in Spain did abundantly burn, all persons who came under the categories II, III, IV, V. And the wolf would play the same havoc now if it could only get its blood-stained jaws free from the muzzle imposed by the secular arm.

Further, there is not a Protestant body except the Unitarian, which would not declare Justin himself a heretic, on account of his doctrine of the inferior godship of the Logos; while I am very much afraid that, in strict logic, Dr. Wace would be under the necessity, so painful to him, of calling him an "infidel," on the same and on other grounds.

Now let us turn to our other authority. If there is any result of critical investigations of the sources of Christianity which is certain,* it is that Paul of Tarsus wrote the Epistle to the Gala-

* I guard myself against being supposed to affirm that even the four cardinal epistles of Paul may not have been seriously tampered with. See no e on page 176.

tians somewhere between the years 55 and 60 A. D., that is to say, roughly, twenty, or five-and-twenty, years after the crucifixion. If this is so, the Epistle to the Galatians is one of the oldest, if not the very oldest, of extant documentary evidences of the state of the primitive Church. And, be it observed, if it is Paul's writing, it unquestionably furnishes us with the evidence of a participator in the transactions narrated. With the exception of two or three of the other Pauline epistles, there is not one solitary book in the New Testament of the authorship and authority of which we have such good evidence.

And what is the state of things we find disclosed? A bitter quarrel, in his account of which Paul by no means minces matters or hesitates to hurl defiant sarcasms against those who were "reputed to be pillars": James, "the brother of the Lord," Peter, the rock on whom Jesus is said to have built his Church, and John, "the beloved disciple." And no deference toward "the rock" withholds Paul from charging Peter to his face with "dissimulation."

The subject of the hot dispute was simply this: Were Gentile converts bound to obey the law or not? Paul answered in the negative; and, acting upon his opinion, had created at Antioch (and elsewhere) a specifically "Christian" community, the sole qualifications for admission into which were the confession of the belief that Jesus was the Messiah, and baptism upon that confession. In the epistle in question, Paul puts this—his "gospel," as he calls it—in its most extreme form. Not only does he deny the necessity of conformity with the law, but he declares such conformity to have a negative value. "Behold, I, Paul, say unto you, that if ye receive circumcision, Christ will profit you nothing" (Galatians v, 2). He calls the legal observances "beggarly rudiments," and anathematizes every one who preaches to the Galatians any other gospel than his own—that is to say, by direct consequence, he anathematizes the Jerusalem Nazarenes whose zeal for the law is testified by James in a passage of the Acts cited further on. In the first Epistle to the Corinthians, dealing with the question of eating meat offered to idols, it is clear that Paul himself thinks it a matter of indifference; but he advises that it should not be done, for the sake of the weaker brethren. On the other hand, the Nazarenes of Jerusalem most strenuously opposed Paul's "gospel," insisting on every convert becoming a regular Jewish proselyte, and consequently on his observance of the whole law; and this party was led by James and Peter and John (Galatians ii, 9). Paul does not suggest that the question of principle was settled by the discussion referred to in Galatians. All he says is that it ended in the practical agreement that he and Barnabas should do as they had been doing in respect of the Gentiles;

while James and Peter and John should deal in their own fashion with Jewish converts. Afterward he complains bitterly of Peter, because, when on a visit to Antioch, he at first inclined to Paul's view, and ate with the Gentile converts; but when "certain came from James," "drew back, and separated himself, fearing them that were of the circumcision. And the rest of the Jews dissembled likewise with him; insomuch that even Barnabas was carried away with their dissimulation" (Galatians ii, 12, 13).

There is but one conclusion to be drawn from Paul's account of this famous dispute, the settlement of which determined the fortunes of the nascent religion. It is that the disciples at Jerusalem, headed by "James, the Lord's brother," and by the leading apostles, Peter and John, were strict Jews, who objected to admit any converts to their body, unless these, either by birth or by becoming proselytes, were also strict Jews. In fact, the sole difference between James and Peter and John, with the body of disciples whom they led, and the Jews by whom they were surrounded, and with whom they for many years shared the religious observances of the Temple, was that they believed that the Messiah, whom the leaders of the nation yet looked for, had already come in the person of Jesus of Nazareth.

The Acts of the Apostles is hardly a very trustworthy history; it is certainly of later date than the Pauline epistles, supposing them to be genuine. And the writer's version of the conference of which Paul gives so graphic a description, if that is correct, is unmistakably colored with all the art of a reconciler, anxious to cover up a scandal. But it is none the less instructive on this account. The judgment of the "council" delivered by James is that the Gentile converts shall merely "abstain from things sacrificed to idols, and from blood and from things strangled, and from fornication." But notwithstanding the accommodation in which the writer of the Acts would have us believe, the Jerusalem church held to its endeavor to retain the observance of the law. Long after the conference, some time after the writing of the Epistles to the Galatians and Corinthians, and immediately after the dispatch of that to the Romans, Paul makes his last visit to Jerusalem, and presents himself to James and all the elders. And this is what the Acts tells us of the interview:

> And they said unto him, Thou seest, brother, how many thousands (or myriads) there are among the Jews of them which have believed; and they are all zealous for the law: and they have been informed concerning thee, that thou teachest all the Jews which are among the Gentiles to forsake Moses, telling them not to circumcise their children, neither to walk after the customs (Acts xxi, 20, 21).

They therefore request that he should perform a certain public religious act in the Temple, in order that

all shall know that there is no truth in the things whereof they have been informed concerning thee; but that thou thyself walkest orderly, keeping the law (ibid., 24).

How far Paul could do what he is here requested to do, and which the writer of the Acts goes on to say he did, with a clear conscience, if he wrote the epistles to the Galatians and Corinthians, I may leave any candid reader of those epistles to decide. The point to which I wish to direct attention is the declaration that the Jerusalem church, led by the brother of Jesus and by his personal disciples and friends, twenty years and more after his death, consisted of strict and zealous Jews.

Tertullus, the orator, caring very little about the internal dissensions of the followers of Jesus, speaks of Paul as a "ringleader of the sect of the Nazarenes" (Acts xxiv, 5), which must have affected James much in the same way as it would have moved the Archbishop of Canterbury, in George Fox's day, to hear the latter called a "ringleader of the sect of Anglicans." In fact, "Nazarene" was, as is well known, the distinctive appellation applied to Jesus; his immediate followers were known as Nazarenes, while the congregation of the disciples, and, later, of converts at Jerusalem—the Jerusalem church—was emphatically the "sect of the Nazarenes," no more in itself to be regarded as anything outside Judaism than the sect of the Sadducees or of the Essenes.* In fact, the tenets of both the Sadducees and the Essenes diverged much more widely from the Pharisaic standard of orthodoxy than Nazarenism did.

Let us consider the position of affairs now (A. D. 50–60) in relation to that which obtained in Justin's time, a century later. It is plain that the Nazarenes—presided over by James "the brother of the Lord," and comprising within their body all the twelve apostles—belonged to Justin's second category of "Jews who observe the law, believe Jesus to be the Christ, but who insist on the observance of the law by Gentile converts," up till the time at which the controversy reported by Paul arose. They then, according to Paul, simply allowed him to form his congregation of non-legal Gentile converts at Antioch and elsewhere; and it would seem that it was to these converts, who would come under Justin's fifth category, that the title of "Christian" was first applied. If any of these Christians had acted upon the more than half-permission given by Paul, and had eaten meats offered to idols, they would have belonged to Justin's seventh category.

Hence, it appears that, if Justin's opinion, which was doubtless that of the church generally in the middle of the second century, was correct, James and Peter and John and their followers could

* All this was quite clearly pointed out by Ritschl nearly forty years ago. See "Die Entstehung der alt-katholischen Kirche" (1850), p. 108.

not be saved; neither could Paul, if he carried into practice his views as to the indifference of eating meats offered to idols. Or, to put the matter another way, the center of gravity of orthodoxy, which is at the extreme right of the series in the nineteenth century, was at the extreme left, just before the middle of the first century, when the "sect of the Nazarenes" constituted the whole church founded by Jesus and the apostles; while, in the time of Justin, it lay midway between the two. It is therefore a profound mistake to imagine that the Judæo-Christians (Nazarenes and Ebionites) of later times were heretical outgrowths from a primitive, universalist "Christianity." On the contrary, the universalist "Christianity" is an outgrowth from the primitive, purely Jewish, Nazarenism; which, gradually eliminating all the ceremonial and dietary parts of the Jewish law, has thrust aside its parent, and all the intermediate stages of its development, into the position of damnable heresies.

Such being the case, we are in a position to form a safe judgment of the limits within which the teaching of Jesus of Nazareth must have been confined. Ecclesiastical authority would have us believe that the words which are given at the end of the first Gospel, "Go ye, therefore, and make disciples of all the nations, baptizing them in the name of the Father and of the Son and of the Holy Ghost," are part of the last commands of Jesus, issued at the moment of his parting with the eleven. If so, Peter and John must have heard these words; they are too plain to be misunderstood; and the occasion is too solemn for them to be ever forgotten. Yet the "Acts" tells us that Peter needed a vision to enable him so much as to baptize Cornelius; and Paul, in the Galatians, knows nothing of words which would have completely borne him out as against those who, though they heard, must be supposed to have either forgotten or ignored them. On the other hand, Peter and John, who are supposed to have heard the "Sermon on the Mount," know nothing of the saying that Jesus had not come to destroy the law, but that every jot and tittle of the law must be fulfilled, which surely would have been pretty good evidence for their view of the question.

We are sometimes told that the personal friends and daily companions of Jesus remained zealous Jews and opposed Paul's innovations, because they were hard of heart and dull of comprehension. This hypothesis is hardly in accordance with the concomitant faith of those who adopt it, in the miraculous insight and superhuman sagacity of their Master; nor do I see any way of getting it to harmonize with the other orthodox postulate; namely, that Matthew was the author of the first Gospel and John of the fourth. If that is so, then, most assuredly, Matthew was no dullard; and as for the fourth Gospel—a theosophic romance of the

first order—it could have been written by none but a man of remarkable literary capacity, who had drunk deep of Alexandrian philosophy. Moreover, the doctrine of the writer of the fourth Gospel is more remote from that of the "sect of the Nazarenes" than is that of Paul himself. I am quite aware that orthodox critics have been capable of maintaining that John, the Nazarene, who was probably well past fifty years of age when he is supposed to have written the most thoroughly Judaizing book in the New Testament—the Apocalypse—in the roughest of Greek, underwent an astounding metamorphosis of both doctrine and style by the time he reached the ripe age of ninety or so, and provided the world with a history in which the acutest critic can not make out where the speeches of Jesus end and the text of the narrative begins; while that narrative is utterly irreconcilable in regard to matters of fact with that of his fellow-apostle, Matthew.

The end of the whole matter is this: The "sect of the Nazarenes," the brother and the immediate followers of Jesus, commissioned by him as apostles, and those who were taught by them up to the year 50 A. D., were not "Christians" in the sense in which that term has been understood ever since its asserted origin at Antioch, but Jews—strict orthodox Jews—whose belief in the Messiahship of Jesus never led to their exclusion from the Temple services, nor would have shut them out from the wide embrace of Judaism.* The open proclamation of their special view about the Messiah was doubtless offensive to the Pharisees, just as rampant Low Churchism is offensive to bigoted High Churchism in our own country; or as any kind of dissent is offensive to fervid religionists of all creeds. To the Sadducees, no doubt, the political danger of any Messianic movement was serious, and they would have been glad to put down Nazarenism, lest it should end in useless rebellion against their Roman masters, like that other Galilean movement headed by Judas, a generation earlier. Galilee was always a hot-bed of seditious enthusiasm against the rule of Rome; and high priest and procurator alike had need to keep a sharp eye upon natives of that district. On the whole, however, the Nazarenes were but little troubled for the first twenty years of their existence; and the undying hatred of the Jews against those later converts whom they regarded as apostates and fautors of a sham Judaism was awakened by Paul. From their point of view, he was a mere renegade Jew, opposed alike to orthodox Judaism and to orthodox Nazarenism, and whose teachings threatened Judaism

* "If every one was baptized as soon as he acknowledged Jesus to be the Messiah, the first Christians can have been aware of no other essential differences from the Jews."—Zeller, "Vorträge" (1865), p. 216.

with destruction. And, from their point of view, they were quite right. In the course of a century, Pauline influences had a large share in driving primitive Nazarenism from being the very heart of the new faith into the position of scouted error; and the spirit of Paul's doctrine continued its work of driving Christianity further and further away from Judaism, until "meats offered to idols" might be eaten without scruple, while the Nazarene methods of observing even the Sabbath or the Passover were branded with the mark of Judaizing heresy.

But if the primitive Nazarenes of whom the Acts speaks were orthodox Jews, what sort of probability can there be that Jesus was anything else? How can he have founded the universal religion which was not heard of till twenty years after his death?* That Jesus possessed in a rare degree the gift of attaching men to his person and to his fortunes; that he was the author of many a striking saying, and the advocate of equity, of love, and of humility; that he may have disregarded the subtleties of the bigots for legal observance, and appealed rather to those noble conceptions of religion which constituted the pith and kernel of the teaching of the great prophets of his nation seven hundred years earlier; and that, in the last scenes of his career, he may have embodied the ideal sufferer of Isaiah—may be, as I think it is, extremely probable. But all this involves not a step beyond the borders of orthodox Judaism. Again, who is to say whether Jesus proclaimed himself the veritable Messiah, expected by his nation since the appearance of the pseudo-prophetic work of Daniel, a century and a half before his time; or whether the enthusiasm of his followers gradually forced him to assume that position?

But one thing is quite certain: if that belief in the speedy second coming of the Messiah which was shared by all parties in the primitive church, whether Nazarene or Pauline; which Jesus is made to prophesy, over and over again, in the synoptic Gospels; and which dominated the life of Christians during the first century after the crucifixion—if he believed and taught that, then assuredly he was under an illusion, and he is responsible for that which the mere effluxion of time has demonstrated to be a prodigious error.

When I ventured to doubt "whether any Protestant theologian who has a reputation to lose will say that he believes the Gadarene story," it appears that I reckoned without Dr. Wace, who, referring to this passage in my paper, says:

* Dr. Harnack, in the lately published second edition of his "Dogmengeschichte," says (p. 39), "Jesus Christ brought forward no new doctrine"; and again (p. 65), "It is not difficult to set against every portion of the utterances of Jesus an observation which deprives him of originality." See also Zusatz 4, on the same page.

He will judge whether I fall under his description; but I repeat that I believe it, and that he has removed the only objection to my believing it.*

Far be it from me to set myself up as a judge of any such delicate question as that put before me; but I think I may venture to express the conviction that, in the matter of courage, Dr. Wace has raised for himself a monument *ære perennius*. For, really, in my poor judgment, a certain splendid intrepidity, such as one admires in the leader of a forlorn hope, is manifested by Dr. Wace when he solemnly affirms that he believes the Gadarene story on the evidence offered. I feel less complimented perhaps than I ought to do, when I am told that I have been an accomplice in extinguishing in Dr. Wace's mind the last glimmer of doubt which common sense may have suggested. In fact, I must disclaim all responsibility for the use to which the information I supplied has been put. I formally decline to admit that the expression of my ignorance whether devils, in the existence of which I do not believe, if they did exist, might or might not be made to go out of men into pigs, can, as a matter of logic, have been of any use whatever to a person who already believed in devils and in the historical accuracy of the Gospels.

Of the Gadarene story, Dr. Wace, with all solemnity and twice over, affirms that he "believes it." I am sorry to trouble him further, but what does he mean by "it"? Because there are two stories, one in "Mark" and "Luke," and the other in "Matthew." In the former, which I quoted in my previous paper, there is one possessed man; in the latter there are two. The story is told fully, with the vigorous, homely diction and the picturesque details of a piece of folk-lore, in the second Gospel. The immediately antecedent event is the storm on the Lake of Gennesareth. The immediately consequent events are the message from the ruler of the synagogue and the healing of the woman with an issue of blood. In the third Gospel, the order of events is exactly the same, and there is an extremely close general and verbal correspondence between the narratives of the miracle. Both agree in stating that there was only one possessed man, and that he was the residence of many devils, whose name was "Legion."

In the first Gospel, the event which immediately precedes the Gadarene affair is, as before, the storm; the message from the ruler and the healing of the issue are separated from it by the accounts of the healing of a paralytic, of the calling of Matthew, and of a discussion with some Pharisees. Again, while the second Gospel speaks of the country of the "Gerasenes" as the locality of the event, the third Gospel has "Gerasenes," "Gergesenes," and "Gadarenes" in different ancient MSS.; while the first has "Gadarenes."

* "Popular Science Monthly" for May, 1889, p. 76.

The really important points to be noticed, however, in the narrative of the first Gospel, are these—that there are two possessed men instead of one; and that while the story is abbreviated by omissions, what there is of it is often verbally identical with the corresponding passages in the other two Gospels. The most unabashed of reconcilers can not well say that one man is the same as two, or two as one; and, though the suggestion really has been made, that two different miracles, agreeing in all essential particulars, except the number of the possessed, were effected immediately after the storm on the lake, I should be sorry to accuse any one of seriously adopting it. Nor will it be pretended that the allegory refuge is accessible in this particular case.

So, when Dr. Wace says that he believes in the synoptic evangelists' account of the miraculous bedevilment of swine, I may fairly ask which of them does he believe? Does he hold by the one evangelist's story, or by that of the two evangelists? And having made his election, what reasons has he to give for his choice? If it is suggested that the witness of two is to be taken against that of one, not only is the testimony dealt with in that common-sense fashion against which theologians of his school protest so warmly; not only is all question of inspiration at an end, but the further inquiry arises, after all, is it the testimony of two against one? Are the authors of the versions in the second and the third Gospels really independent witnesses? In order to answer this question, it is only needful to place the English versions of the two side by side, and compare them carefully. It will then be seen that the coincidences between them, not merely in substance, but in arrangement, and in the use of identical words in the same order, are such, that only two alternatives are conceivable: either one evangelist freely copied from the other, or both based themselves upon a common source, which may either have been a written document, or a definite oral tradition learned by heart. Assuredly, these two testimonies are not those of independent witnesses. Further, when the narrative in the first Gospel is compared with that in the other two, the same fact comes out.

Supposing, then, that Dr. Wace is right in his assumption that Matthew, Mark, and Luke wrote the works which we find attributed to them by tradition, what is the value of their agreement, even that something more or less like this particular miracle occurred, since it is demonstrable, either that all depend on some antecedent statement, of the authorship of which nothing is known, or that two are dependent upon the third?

Dr. Wace says he believes the Gadarene story; whichever version of it he accepts, therefore, he believes that Jesus said what he is stated in all the versions to have said, and thereby virtually

declared that the theory of the nature of the spiritual world involved in the story is true. Now I hold that this theory is false, that it is a monstrous and mischievous fiction; and I unhesitatingly express my disbelief in any assertion that it is true, by whomsoever made. So that, if Dr. Wace is right in his belief, he is also quite right in classing me among the people he calls "infidels"; and although I can not fulfill the eccentric expectation of the Bishop of Peterborough, that I shall glory in a title which, from my point of view, it would be simply silly to adopt, I certainly shall rejoice not to be reckoned among the bishop's "us Christians" so long as the profession of belief in such stories as the Gadarene pig affair, on the strength of a tradition of unknown origin, of which two discrepant reports, also of unknown origin, alone remain, forms any part of the Christian faith. And, although I have, more than once, repudiated the gift of prophecy, yet I think I may venture to express the anticipation, that if "Christians" generally are going to follow the line taken by the Bishop of Peterborough and Dr. Wace, it will not be long before all men of common sense qualify for a place among the "infidels." —*Nineteenth Century.*

FUNGI.

I.—TOADSTOOLS AND MUSHROOMS.*

By T. H. McBRIDE,
PROFESSOR OF BOTANY IN THE UNIVERSITY OF IOWA.

THE fungi as a class may hardly be called popular. For various reasons they are, so to speak, under a cloud. They are little known, and so in lieu of better information the legend "poison" seems to run for all the finer and more showy species. If not held absolutely poisonous, most are at least considered useless and are nameless. Literature, the all-embracing, which concerns itself freely with other forms of animate nature, draws a line at the fungi; and Browning evinces great boldness when he ventures to touch with the wand of his poesy "the freaked, fawn-colored, flaky crew" that rises in November hours.

Worse than all this, thanks to the imperfect knowledge of days not long gone by, the very word *fungus* is uncanny, and to most minds of vague, uncertain application, suggestive of things unpleasant, not to say direful. For what, forsooth, is a fungus? A wily invader which, having by some unguarded entrance gained access, may do all sorts of mischief; may fill our cellar, for instance, and turn us out of house and home, as one is reputed to have filled the

* Illustrations from drawings by M. F. Linder and the author.

cellar of the wine merchant, barring the door from within and threatening summary eviction and what not! Is it not a fearful parasite which, having found lodging in the tissues of its unwilling host, swells to proportions vast, a hidden tumor, sending its human victim all too soon forth from his tenement of clay?

Even when not thus associated with the destruction of nobler forms, fungi are nevertheless held *suspect*. At best and largest they are odd, peculiar, hiding in out-of-the-way places, far from "the warm precincts of the cheerful day"; "off color," as men say, and owing little or no allegiance to our sovereign sun; pale, ghastly things whose homes are with the dead.

It remained for modern Science to dignify the world; nothing shall be stranger to her touch benign. Even the fungi come into prominence as they come into light. Odd as they may appear and mysterious too, they, like some odd and peculiar people, do greatly improve upon acquaintance. Certainly no one can look in upon a basket of *Boleti* fresh from August woods and not greatly admire their delicate tints, their yellows, purples, browns, and grays. Fungi, once for all, are plants, for the most part very simple ones too; in their larger forms more commonly useful than noxious, and positively sources of serious injury and detriment in those species only which to mankind at large are unseen, unknown, and unsuspected. To these reference will be made again; for the present let us consider such forms only as meet the eye of ordinary observation, the common denizens of forest and of field.

Assuming the vegetable nature of fungi, the most notable thing about them, as compared with all surrounding vegetation, is their color. Growing plants are green; Whitney says the words are synonymous. But whatever the colors fungi may take on, and they are often brilliantly tinted, they are never green, at any rate in the sense of possessing leaf-green. Without exception the fungi are chlorophyl-less. This, though a negative quality, is, nevertheless, a very convenient one, and withal expressive, for it defines exactly the place these plants must hold in the economy of nature. Chlorophyl, as is well known, gives to ordinary plants their special and peculiar ability, namely, the power to elaborate the most important organic products—starch, sugar, and the like. This power, accordingly, the chlorophyl-less fungi have not. They are strictly non-productive plants; all that they have they receive. Likewise bringing to the feast of life naught save appetite, they must needs lay under contribution, living or dead, the whole organic world, and are *parasites* or *saprophytes* according to their dietary habits. Such as derive their nourishment from dead organic matter are saprophytes, while those which assail living organisms, and derive food-supply direct from the living tissues of living hosts, are properly enough called parasites.

Somehow or other, through sympathy perhaps, we are more willing to pardon saprophytism than parasitism pure and simple, and Nature apparently takes the same view of the case, for the saprophytes include all the largest and finest specimens of the fungus kind. Mushrooms, toadstools, earth-stars, puff-balls, stink-horns, truffles, bracket-fungi, are nearly without exception saprophytes. Such fungi, too, as we see, have won attention and enjoy something of a popular classification. This classification science largely confirms—not wholly; and it is interesting to notice that it is just where the popular classification is weak that science fails to discover difference. Many a country wight and many an epicure as well would deem it rare fortune could he learn to distinguish invariably toadstools from mushrooms. Suppose we say that toadstools are poisonous while mushrooms are not. A toadstool, accordingly, is a poisonous mushroom, and a mushroom is an edible toadstool. The only possible means, therefore, by which the two may be distinguished is a test direct, as in the old rule which bids the inquirer eat with the assurance that, if he survive, he has eaten a mushroom; if he die, a toadstool. But some species poisonous to one person are by no means so to another; so that even the rule just quoted is unsatisfactory on the score of being inconclusive, as well as inconvenient of application. Even *Agaricus muscarius*, esteemed so very poisonous to ordinary mortals, is said to produce in the Kamtchatkan simply an increase of that pleasing stupidity which the Chinaman seeks in his opium-bowl or the American in his beer. Furthermore, Science runs her lines not as between toadstools and mushrooms, but as between specific forms. Poisonous and not poisonous, edible and inedible, are side by side in any enumeration of species. Let it be once known which are edible species, and these may thereafter be readily recognized by any one competent to discern a species—no easy matter, by the way, even to the practiced student.

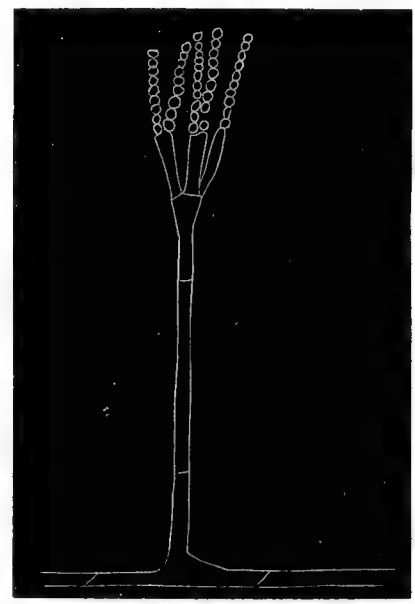


Fig. 1.—Fruit of Green Mold (*Penicillium glaucum*).

So much for popular estimate and classification. Let us now briefly consider fungi from the standpoint of structure, the true basis of classification or distinction. A bit of mold placed on the stage of our microscope will enable us to make a beginning (Fig. 1). Here we have cells, of course, tubular in shape and disposed to form thread-like branches in different directions. These threads are known as *hyphæ*, and fungi generally are masses of

hyphæ modified here and there to the accomplishment of various functions. Fungi, like other organisms, have two principal things to do—viz., to accumulate energy and to expend it; to grow and to produce fruit. The hyphæ of a fungus are, therefore, in ordinary cases of two sorts—nutrient hyphæ forming the mycelium, and fruiting hyphæ which make up the fructification. In what we term puff-ball, mushroom, we have simply the fructification—the fruiting hyphæ—all compacted together, while the mycelium lies hidden beneath the surface. When, however, we pluck the mushroom from its place, the mycelium may perhaps seldom be discovered. There are for this two reasons: first, the mycelial threads are generally tenuous and delicate in the extreme, and unless crowded together escape observation; and, secondly, once the fructification or colony of mushrooms is formed, the energy of the mycelium having passed above the surface, the threads vanish. Only in special cases, or where the fructification is unusually large, and the number of hyphæ converging at a single point in consequence very great, do we find root-like structures that are at once obvious and persistent. Fugacious as the mycelium thus appears, it is really in many—perhaps most—cases much longer-lived than the fructification it creates. Months—possibly in some instances years—elapse while the subterranean hyphal threads ramifying and spreading through myriad diminutive tunnels are ingathering to some single center those resources of nutriment and energy which shall at length break forth with a suddenness and volume utterly astounding. In my neighbor's yard, not long ago, appeared a succession of giant puff-balls one after another, sometimes two or three at a time, over an area of perhaps thirty by forty feet. In size the plants ranged from the dimensions of a goose-egg to that of a half-bushel, and the amount of matter raised above the surface was little less than one hundred pounds. The largest fruit seemed simply sessile, hardly attached to the substratum, while others, smaller, showed something like a tap-root, white, cord-like, extending a few inches downward—not a root, certainly, rather the undeveloped base of the ball itself. Whence had all this wealth of organic matter come, and what was the meaning of it all? The previous existence of a wood-yard on the locality affords probable explanation of the phenomenon. Through and through the accumulated detritus of the old wood-yard the mycelium of the puff-ball had literally threaded its way, developing perchance for years over an area of not less than twelve hundred square feet, restoring again for the moment to the kingdom of life and light organic matter which seemed fallen into ruin irretrievable.

Turning our attention now to the fructification, we shall find our mushroom to consist of the following parts: A short stalk,

or stem, crowned with a cap, the *pileus*. This cap consists of an expanded disk, bearing on its lower surface hundreds of radiating plates, the gills or *lamellæ*, with sharp edges and delicately tinted, velvety sides. Cut a section perpendicular to the course of these plates or gills, and we have a comb-like structure which under a good lens presents the appearance portrayed in Fig. 2. Under still better lenses we may discover on each gill-section a marginal row of rather large cylindric cells, each bearing at its summit a pair of smaller cells manifestly formed by abstriction from diverging branches of the larger cell (see Fig. 3). The small cells are the spores, and the supporting cell but the terminus of an extended and much-branched hypha, which has blended with a myriad like itself to form stalk and cap and gill of our completed mushroom. That is the whole structure, and yet from such simple machinery behold what wealth and variety of form and style come forth! Other modes of spore-production there are to be hereafter seen, but that described is characteristic of the vast majority of those greater fungi which occupy the shadows of our world. To begin with, there are hundreds of species of agarics, fungi like the mushroom, differing from each other in matters of form and color chiefly, the attachment of stipe and gills, the stability and instability of the entire structure. Some, as the "inkcaps" (*Coprinus*), spring in the night and vanish in inky dissolution ere the sun ascends to midday; others, as the little woolly fungus with cleft gills (*Schizophyllum*), so common on fallen branches everywhere, survive the storms of many seasons and outlast the substratum on which they grow. Fig. 3 shows the elegant curvature of the cleft gill-plates, and the order in which they appear. New ones are constantly intercalated between those already formed.

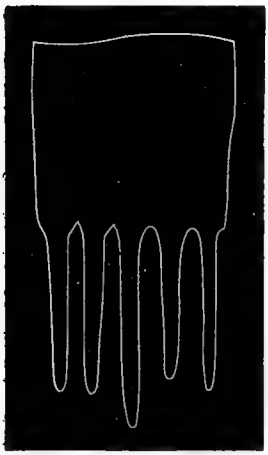


FIG. 2.—SECTION OF THE LAMELLÆ OF COMMON MUSHROOM.

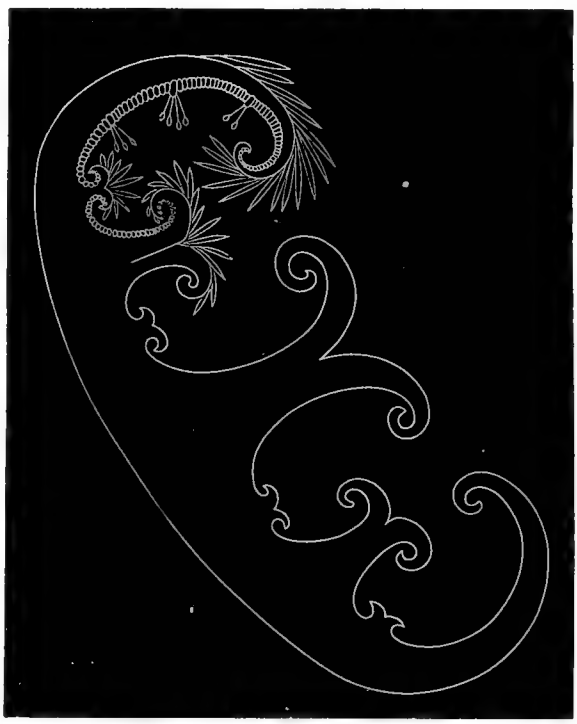


FIG. 3.—SCHIZOPHYLLUM COMMUNE, cross-section.

In all these the lamellæ run out in rays and remain quite gen-

erally distinct from one another; but here follows a series in which these plates all intersect, or wander in many a winding line and labyrinthine pattern (*Dœdalea, Trametes*, etc.), until the intersections become so numerous as to form a perfect honeycomb whose cells are minute pores. The gummy, golden *Boleti* of the woodlands, and the common bracket-fungi (*Polyporus*) of every stump and log in all the forest, are examples.

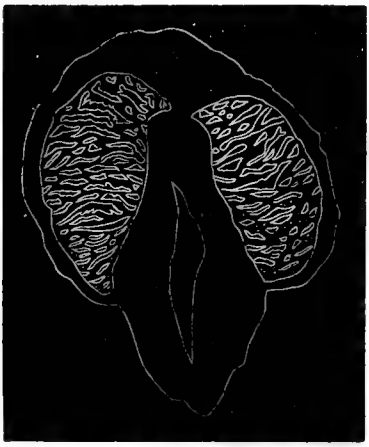


FIG. 4.—SECOLIUM WARNEI, vertical section.

Even the puff-ball family—another section of the greater fungi—form their fruit in agaric fashion, and the connection between our mushroom and the giant "puffer," though at first sight remote, is yet not far to seek. It must be remembered that mushrooms when first emerging from the ground are quite contracted and closed, often like a closed umbrella—one of the old-fashioned sort, puckered around the margin with a string. Split such a mushroom at this stage, and all the lamellæ will be found with their edges close pressed against the sides of the stipes, the edge of the pileus close drawn round the bottom. Now, in autumn we may find a fungus looking exactly like an unopened toadstool; but you watch its opening in vain—it never opens. The puckering string never relaxes, the lamellæ never leave the stipe, but are indeed grown fast against it, and with maturity become wrinkled in myriad folds, finally to break down entirely, leaving a mass of dusty brown spores which escape only with the final rupture of the fragile, unexpanded pileus (Fig. 4). From such a fungus the puff-ball differs chiefly in degree; the spores are borne upon threads and fill up definite cavities, one or more, and are discharged, as in the case just described, by the rupture of the inclosing tissues. These latter here constitute a definite wall—the *peridium*. This may break open irregularly, or it may break regularly, throwing back from the top its pointed lobes

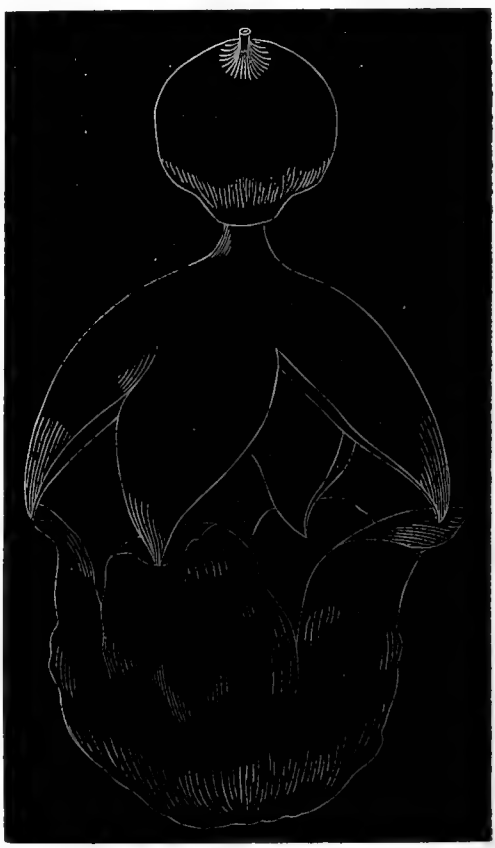


FIG. 5.—GEASTER FORNICATUS (after Morgan).

in roseate and star-like forms—earth-stars, beautiful as they are curious, and offering a singularly perfect mechanism for the dispersal of the spores. Here is an earth-star (Fig. 5) whose peridium consists of three coats—two outer, strong and leathery, and one inner, delicate, silk-like. The whole structure is developed as a smooth white ball beneath the soil. But, once the spores are ripe, the outermost peridium splits open at the top, its lobes spring backward and outward, giving room for the second covering to burst in similar fashion. The lobes of the second, however, by recurving, hoist the entire inner structure out of the ground and up into the air, where the inner peridium, enthroned thus upon springing arches, groined by no human hand, opens at tip a purse-like mouth, and suffers the spores slowly to escape, to sail on unknown journeys with the passing breeze.

We have space left but sufficient to mention the fruiting of the morel. Here we have on the outer upper side of the structure a layer of rather large elongate cells, quite similar to those on the mushroom gills; but, instead of abstricted spores on the outside of the supporting cells, we find each of the latter a fruit-case in which are lodged eight elliptical sporules arranged in a row, formed freely—that is, each entirely independent of the other and of the cell-wall that incloses all. But this method of fruiting brings us in sight of the microscopic and parasitic world of fungi, subject of our next chapter. Here, then, we well might rest; and yet, ere toadstools, mushrooms, and puffers vanish entirely from our thought, it were well to note, if but for a moment, the various titles these organisms wear. The names by which natural objects are known contain often in primary significance something of historic epitome; so, in the present case, we may discover the manner in which the object named first attracted human attention: the word itself is the record. Thus it appears that the word *fungus*, although coming to us from the Latin, is nevertheless of Greek origin, and is the same word as that we have anglicized in *sponge;* so that, according to the earliest record we have, the sponges of the sea and the fungi (puff-balls?) of the land were considered kin. Our Teutonic ancestors seem to have arrived at the same conclusion; and to this day, for a German, *Schwamm* is either a sponge or a fungus, as you like it. Nor less interesting is the etymology of our other common names for such plants. Toadstool is sufficiently plain, prosaic, and suggestive; mushroom would seem to be the English adaptation of a French word, *mousseron* (something growing in or among moss), evidently pronounced by Englishmen long before spelled, and evincing the fact that the quick French wit was first to discover the edible qualities of this as of so many other delicacies.

FABULOUS ASTRONOMY.*

By Prof. J. C. HOUZEAU.

THE darkness of the night exercised a sort of terror upon the minds of our ancestors. Just as material existence was supposed to succeed to nothing, and to be followed by it, day succeeds night, and this, they said, is the origin of time, as the winter is of the year. The Ostiaks of the Yenisei count their years by the snows, as also, or by winters, did the Iroquois of North America. The Numidians, Cæsar's Gauls, and the Germans of Tacitus, estimated daily periods by the nights. The night had a considerable importance in the North; and the Scandinavians had the most coherent and most poetical ideas of it. Day was the son of Night. The latter went first, a passage in the Edda says, mounted on her horse Rinfax, of the icy mane. Every morning, at the conclusion of his race, the courser watered the earth with the foam that fell from his bridle; this was the dew. Day followed, mounted on Sinfax, of the glowing mane, which lightened up the air and the earth. These people also believed that the longest night, that of the winter solstice, begat all the others, and that the world was created on such a night. Therefore night was called mother. Midwinter-night, or Yule, was the great annual festival, and marked the beginning of the new year. The Chaldeans said that the world began at the autumnal equinox, when the night became longer than the day. The French courts in the seventeenth century still ordered clients to appear within fourteen nights. The English *fortnight* is a contraction of this term.

The ancient Peruvians said that the moon was dead during the three days that it is invisible. The Khasias, of northeastern India, thought that the sun burned it up. Some savage tribes believe that the lunation is a quarrel between the sun and moon as husband and wife, identically repeated in every month. The increasing moon represents its gaining the ascendency, the decrease its yielding, till at last the sun swallows it and spits its head out in the sky. The ancient Slavs imagined that the moon was condemned to wander, for infidelity with the morning star. The Dakota Indians fancied that the declining moon was eaten by mice; the Polynesians, by spirits of the dead. The Hottentots said that, suffering from headache, it covered its face with its hand; the Eskimos, that, becoming tired and hungry, it retired to rest and eat, after which it recuperated very fast.

There is probably no country where some kind of a picture has not been made out of the visible spots on the moon. Two types

* From the "Bibliographie générale de l'Astronomie," by MM. Houzeau and Lancaster.

of figures, distributed according to a geographical rule, have predominated in these fancies. In Eastern Asia, it is a hare or rabbit. The Chinese and Japanese make it a hare. sitting on its hind-quarters, pounding rice in a mortar. The Hindus see a hare or roe; the Siamese, a hare, or, some of them, a man and woman cultivating their field. The North American and Mexican Indians symbolize the moon by a hare or rabbit; and some of the Central American monuments represent it by a jar or spiral shell with a rabbit coming out from under it. In South America, a human figure took the place of the hare. The Incas related that a light young woman, walking in the moonlight, was charmed by the beauty of the star, and sprang forward to embrace it. The moon took her up, and has kept her ever since. Some tribes, in both North and South America, make of the spots a woman bent with age. In Samoa, they see a woman and her child; on the Book Islands, men; in Timor, an old woman spinning. The Scandinavian Edda relates that Mane, who regulates the course of the moon in its quarters, placed there two children whom he saw carrying a jug of water hung between them from a pole. The Eskimos say that Anninga, the moon, brother of the beautiful Malnia, the sun, was pursuing his sister and about to overtake her, when she turned round and smutted his face and clothes with her fingers, which she had blackened with the soot of a lamp. The Khasias say that the spots are the cinders resulting from the monthly burning up of the moon by the sun.

French peasants variously believe that they see in the moon the traitor Judas, hanging from an elder-branch; turnip-Jack wheeling a barrow of stolen turnips; Cain leaning on his spade and looking at the murdered Abel; a peasant who has been caught by the moon stealing wood in his lord's domain; a peasant compelled to freeze in the moon with his bundle of sticks for making fence on Sunday; a hunter and his dog; or a she-goat and her keeper by a bush.

Eclipses of the moon attract more attention than those of the sun, because total ones are more frequently seen than those of the sun, and the darkness is of longer duration. The Peruvians supposed that they were an illness of the moon, and if total were a sign of its death, when it would fall to the earth and put an end to the world. When one occurred, they would beat upon everything that would make a noise, and chastise their dogs, in the faith that the star, witnessing the sufferings of the creatures it loved, would revive itself to save them. All would call upon the heavenly powers not to allow the star to die; and, when the light returned, praise was given to the great god Pache-camac, supporter of the universe, for having restored the moon, and thereby prevented the winding up of human existence.

The Caribs, and the Hurons as well, made a great din, upon drums and kettles, and by rattling loose pebbles in gourds, to frighten away the terrible demon Maboya, the author of frightful apparitions, pestilence, thunder, and storms, who was trying to eat up the moon. The French author Dutestre describes the Caribs, young and old, women and men, as dancing all night long, with their feet close together, one hand on their heads and the other on their hips, not singing but shouting lugubriously. Once beginning to dance, every one had to keep it up till daylight, without stopping for anything whatever. At the same time a girl would be shaking a gourd rattle and trying to keep her voice in tune with the din. While Eskimos were applying somewhat similar remedies, their women bored the ears of the dogs in the faith that, if the animals cried out, the end of the world was not yet at hand; for these animals are supposed to have existed before men, and to have a better presentiment of the future. The practice of those tribes which shoot arrows at the jaguar or shark, or whatever animal they may suppose to be eating the moon, is matched by the example of Alfonso VI, of Portugal, in 1664, who, learning that a comet was in sight, went out to look at it, scolded it, and fired pistol-shots at it.

While the story of the dragon which causes eclipses by devouring the sun or the moon is still current among the populace in Siam and China, the educated classes in those countries have mastered enough of the science of the phenomena to be able to calculate them. But in China the court and imperial authorities throughout keep up in form the primitive traditions. Under these traditions an eclipse of the sun was a warning to the emperor to look into his faults and amend them. The coming phenomenon having been pre-announced by the official astronomer,* notice of it was given throughout the country and the court made preparation for it by fasting and retreat. The appointed day was one of anxious waiting. The instant the star was touched, or when it began, according to the Chinese expression, to be eaten, the emperor himself gave the alarm by beating the prodigy-roll on the thunder-drum. The mandarins, who had come with their bows and arrows to succor the suffering star, shot into the air uninterruptedly. The Chinese *illuminati* know that these are only forms, but superstition still rules among the people, who throw themselves upon their knees at the beginning of the eclipse, and make a great noise with drums and gongs, to deliver the star from the devouring dragon. The Greek and Latin authors relate that a great noise was made during eclipses. The early Christians

* The astronomers He and Hi were condemned to death for having failed to predict, according to the requirements of the law, the eclipse of the sun that occurred in the reign of Tchong Kang, 2155 B. C.

rang bells during storms * and eclipses to counteract the action of bad spirits, to repel, with the priest's blessing, the darkness caused by phantoms—a survival, according to P. Lafitan, of the dark genii that devoured the moon.

The earliest observers of the stars had no suspicion of their true nature, or of the considerable distances that separate them from us. If they did not think them within reach of their hands, they supposed that they were, at least, almost in a literal sense, accessible to the voice. Homer says that the highest pines of Mount Ida passed beyond the limits of the atmosphere and penetrated into the ethereal region through which the clangor of the arms of his heroes reached to the sky. This sky was a solid hemisphere, a bell resting upon the earth, or, according to Euripides, a cover set over the work of the sublime artisan. The Hebrew psalmist, of the eleventh century before our era, said to the Lord, "Thou stretchest out the heavens as a pavilion." The stars of Anaximenes were fixed in this vault like nails. The celestial bell covered a flat earth which was surrounded by water on every side. Every people imagined itself in the center of it, and China is still "The Middle Empire." The Incas exhibited this center in their sanctuary of Cuzco, the name of which signified *navel*, as the Greeks also saw it in the Temple of Apollo at Delphi, which was also called the navel (ὀμφαλός) of the world, and was celebrated by Pindar under that name. The Chinese located the navel of the earth in the city of Khotân. The conception of the earth as flat and like a cake prevailed in European civilization till the Crusades, and the *lazzaroni* of Naples have it still.

The Hawaiians, Maoris, and Eskimos supposed that the whole sky was supported by a pillar, as the ancients fancied it upheld by Atlas. The Iroquois thought it was fluid.

The Polynesians explained the revolutions of the sun by supposing that the great god Meni held it by a cord.

The shepherd of Sapta Sindhon regarded the stars as fires kindled by Agni (the elementary fire), or by Varuna (the celestial vault). A hymn which he addressed to the gods mentions the moon with icy rays to signalize its powerlessness against the divine fires of heaven. (It is to be remarked that the moon is often spoken of as a frozen place—probably in reference to the difference in temperature between day and night.)

The milky way, which was Winter's path to the Scandinavians, was the road of souls for some of the American nations; the souls entered the world by the door situated where it intersects the zodiac in Gemini, and quit it to return to the gods by the door of Sagittarius. French peasants still call it St. James's road; mythology attributed it to the milk that dropped from Juno's breast

* This practice was kept up till the last century.

while she was suckling Hercules. It was the celestial river of the Chinese, a shark-infested creek to the Tahitians; to another tribe, the field where their ancestors hunted ostriches; star-dust to the Peruvians. The Pleiades were regarded by the Iroquois and some of the ancients as a group of dancers, and are still figured in some parts of Europe as a hen and chickens. A tribe called the Chokitapia are said to have regulated their festivals by the appearance and disappearance of this group. When they disappeared, in the autumn in that country, was the time for beginning farm-work, the feast of the men; and the feast of the women was celebrated on their reappearance. The former festival referred to the burial or combustion of the seed; the latter to the return of the absent. The day before the reappearance of these stars the women rejoiced and danced around a pole. In the autumn, the dance of the dead was held. Women swore by the Pleiades, and men by the sun. In all religious festivals the calumet was presented toward the Pleiades, and prayers for happiness were addressed to them. These Indians believed that the Pleiades were seven young persons who guarded the holy seed during the night and executed a sacred dance over it. Epizors, the morning star, charmed with their grace, took them to the sky, where the stars were cheered by their gambols. The sand-dance of Malay warriors may convey some idea of this celestial dance. The bath of purification, prescribed by some of the medicine-men, comprised a triangular hole in which seven hot stones were dropped and covered over with cold water. In their invocations, the medicine-men prayed the Pleiades to help them heal bodily diseases. For talismans, they had seven bones, seven balls, or seven buttons.

The period of fifty-two years formed a complete era for the Aztecs, and they questioned whether at the end of that period the great heavenly clock, having performed its revolution, might not stop forever. This era menaced a considerable number of the population once in their lives, and some of them perhaps twice. The night on which the fifty-second year would expire was a solemn moment to them, and was signalized by extinguishing the sacred fires in the temples and those on private hearth-stones, and by breaking all vessels that had contained provisions; and the evening was passed in darkness, with trembling and fear. The day was in November, when the Pleiades would culminate at midnight, and this moment was the termination of the century. As the hour appeared, the human victim was sacrificed, and the sticks were rubbed over his still quick body for striking the fire for his funeral pile and the inauguration of the new era. Men were waiting with torches ready to be lighted, with which the new fire was to be distributed to all the provinces. The moment of midnight was hailed with shouts of joy. The world had not

come to an end, and men could hope that it would last at least through another era. Those who could not attend the public ceremonies watched kneeling on the roofs of their houses. The secular festival was suppressed by the Spaniards, the last human victim having been sacrificed on the pyramid of Tlaloc in 1507. —*Translated for the Popular Science Monthly from a review, by M. L. Barré, in the Revue Scientifique.*

THE PRODUCTION OF BEET-SUGAR.

By A. H. ALMY.

IN the May number of this magazine a sketch was presented of the rise and progress of the beet-sugar industry. In this article it is proposed to outline the method of growing the plant, and the processes employed in extracting the sugar. The sugar-beet, like other plants, contains a definite number of chemical elements which are indispensable to its growth, and which must be present in suitable proportions in order to insure its highest development. Yet it is not long since the proportions of these constituents were looked upon as merely incidental, and without any direct bearing on the processes of growth. Plants are nourished by air, water, and the substances contained in the soil; but they differ in the kinds and quantities of nourishment required. Some need to have their roots constantly in water, others are best suited to dry soils, and others again prosper only on the best and most richly manured land. There are some elements common to all plants, and some peculiar to each kind. Like animals, plants are endowed with taste or choice regarding their food—they do not absorb indiscriminately nor in the same proportions all the substances presented to them. From this it follows that the fertilization of the soil should be adapted to the character of the plant that is to be cultivated. Wheat, rye, barley, and other cereals push up long stalks having few and slender leaves, which absorb little nourishment from the air. These plants consequently take most of their food through the roots, and are, therefore, great exhausters of the soil. Plants, on the contrary, having large, fleshy, green leaves, like the beet, take greater quantities of carbonic acid and water from the air, and hence withdraw less material from the ground. In the process of growth plants exhaust that portion of the soil which comes in contact with their roots; hence, after the surface layers have been drawn upon by short, creeping roots like those of the cereals, a long tap-root, like that of the beet, may be able to extract an abundance of nourishment from the deeper layers.

The mechanical condition of the soil is another important factor in the cultivation of the sugar-beet. From the closeness of its texture, a stiff clay retains water, and does not readily admit heat or air among its particles; it also opposes much resistance to the fibrous roots making their way through it. By preventing the free growth of the roots downward, clay is especially unfavorable to the sugar-beet crop; for the beet, instead of producing the long, slim root which is necessary for the proper secretion of saccharine material in the sugar-cells, grows round, turnip-like roots, which are of no value for sugar-making. Sand is the opposite of clay, and, from the looseness of its texture, admits heat too freely, and is not capable of retaining a sufficient amount of moisture for the needs of vegetation. In sand, also, the particles of plant food are washed down by the rains below the reach of the roots, or are vaporized by heat and escape into the air. Plants grow best in loam, which is a mixture of these soils of opposite character, in such proportion that the faults of both are corrected. The depth of the soil and the nature of the underlying stratum are also important; for if the richest soil is only seven or eight inches deep, and lies on a cold, wet clay or on rock, it will not be as fruitful as a leaner soil that lies on gravel, for instance, which is perhaps the best subsoil. The best soil for the cultivation of the sugar-beet root is a mellow, sandy loam, with a free and permeable subsoil, such as would be called by the German agriculturist a first-class barley soil. It should be ten to sixteen inches deep—the deeper the better—rich in well-decomposed organic matter and minerals.

Ordinary land can not be planted with the same crop year after year without a gradual diminution of product. This is owing to the fact that the specific food of the particular plant is exhausted from the soil by the constant drafts upon it. But if the land is planted one or more years with a vegetable which takes a different kind of nourishment from the soil, time is allowed for the chemical changes constantly going on in the ground to produce a supply of the food required by the first kind of crop. In the cultivation of the beet-root for sugar-producing, it must follow the cereals, such as wheat, rye, and barley, but, to be profitable, not oftener than every third year.

The advantages of correct fertilization in the cultivation of the beet-root are shown by the experiments of Lawes and Gilbert. On one acre of ground, cultivated without manure, 302 bushels of beets were grown. On another acre adjoining and possessing the same characteristics of soil, enriched with 550 pounds of nitrate of soda or Chilian saltpeter, 886 bushels of roots were obtained. The beets grown without manure contained 2,115½ pounds of sugar per acre; the beets grown with the mineral nitrogen con-

tained 5,145 pounds per acre. In other words, with the use of a fertilizer, an increase of 3,030 pounds of sugar was obtained.

The application of highly nitrogenous fertilizers, or the incorporation of partly decayed organic substances—like stable manure—in the soil in the autumn or in the spring, directly preceding the cultivation of the sugar-beet, is known to act injuriously on the composition of the roots. Such manuring increases the foreign substances in the juice, prevents a desirable development of the sugar, besides placing the latter under unfavorable circumstances for separation. Thus no fertilization must be used during the year of the beet crop.

After the plowing and harrowing of the soil, much the same as required for a potato crop, leaving the ground as smooth as a garden, the sowing of the seed commences early in the month of May, when the *beet-planter*, represented in Fig. 1, is brought into requisi-

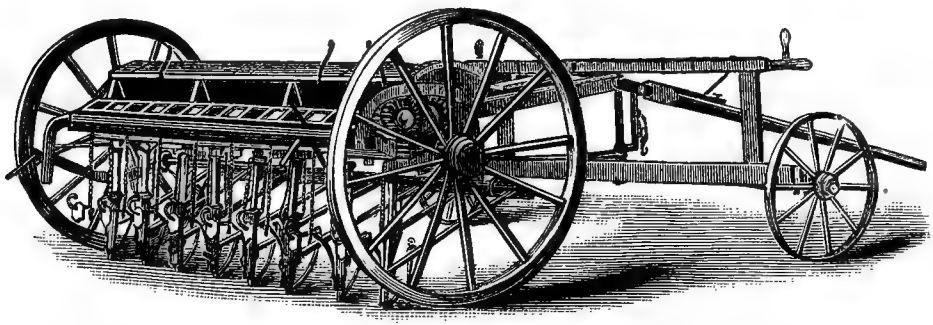


FIG. 1.—THE GERMANIA BEET-PLANTER.

tion. Like the mower, reaper, binder, and other agricultural wonders, it saves the labor of many workmen. It is drawn by two horses, and plants eight rows, eighteen inches apart, at each passage. The seed is placed in hoppers extending along the top of the machine; thence it descends through chutes or apertures, which can be enlarged or contracted at pleasure, into the body of the machine. A shaft, furnished with small spoons, runs through the body of the machine, and is made to revolve with greater or less rapidity by an arrangement of cog-wheels connecting the shaft with one of the driving-wheels. At each revolution each little spoon brings up a seed and deposits it in a small hopper, from which it descends through a series of funnel-shaped tubes, which telescope into each other, into the seed-box of the drill. Another series of cog-wheels is set in motion by the other driving-wheel, and these cause another shaft to revolve, faster or slower, according to the arrangement of the wheels. This shaft is furnished with eight wheels, with cams or projections on the circumference, which operate the valve-rods that open and shut the seed-boxes in the drills, and thus this gearing regulates the distance at which seeds are dropped, just as the other regulates

the quantity of seed deposited in the seed-boxes. The seed-drills are furnished with little plows, which open furrows for the seed, deeper or shallower in proportion as they are laden with weights provided for the purpose, and, being hung on pivots, they readily adapt themselves to any inequalities on the surface of the land. In returning across the field, the inner wheel follows in the track made by the outer one in going, and thus the last row of a twenty-acre field is parallel to the first, and the spaces between the rows are uniform. With land thoroughly prepared, and with men and horses practiced in their work, the machine could plant twenty-five to thirty acres per day.

The *beet-cultivator*, Fig. 2, is also drawn by two horses, and cultivates five rows at each passage. It consists mainly of five

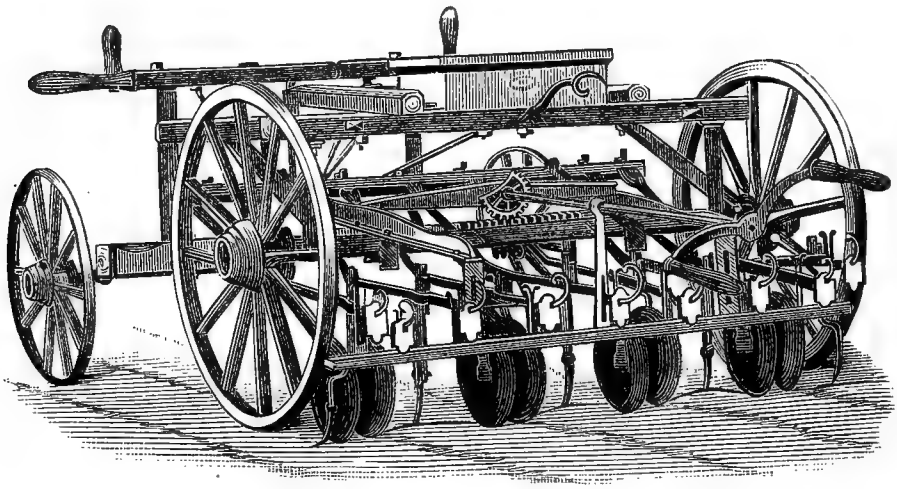


FIG. 2.—THE BEET-CULTIVATOR, WITH ATTACHMENT FOR PROTECTING THE YOUNG PLANTS.

sets of scuffles or hoes, set in a framework, suspended between the hind-wheels of the machine. By means of a lever, terminating in a cog-wheel and playing on a cogged semicircle, this frame can be moved from side to side, or elevated to pass over obstructions, or for convenience in going to and returning from the field. Each set of hoes comprises three different forms of implements adapted to the cultivation of the crop at different stages of its growth. The first set consists of a broad, single scuffle, almost as wide as the distance between the rows; this is intended to be used about as soon as the rows can be traced, and it is provided with a contrivance which bestrides the rows, and protects the young plants from being covered with earth. The second set of implements consists of two narrow scuffles, which penetrate and stir the soil to a greater depth, and are used after the plants have been thinned out and have grown stronger, and there is no longer any danger of covering them with earth. The third set, connected with the beet-cultivator, is a kind of double mold-board plow, and is used for the last hoeing or hilling, Fig. 3. The shape and use

of these implements will be seen by reference to the diagrams, which illustrate the cultivator rigged for use at different stages of the growth of the crop.

Every seed-vessel of the beet, containing from two to three germs, will produce as many plants, of which the strongest is left,

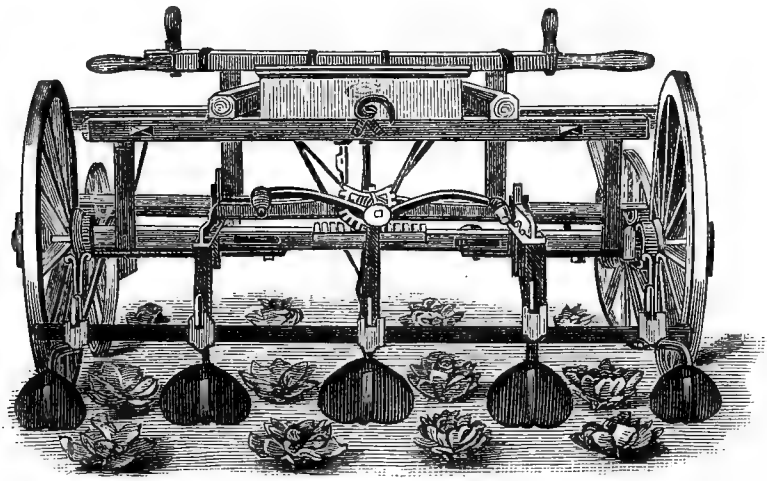


FIG. 3.—THE BEET-CULTIVATOR, WITH ATTACHMENT FOR COVERING THE ROOTS AT THE LAST HOEING.

while the rest are pulled up or otherwise destroyed. The process of thinning out the plants, not unlike the same operation in the cultivation of corn, takes place after the first passage of the cultivator, as soon as the roots have reached the length of from four to five inches. The remaining plants are six to eight inches apart. The soil around the young plant is frequently loosened by the beet-cultivator, as shown in Fig. 2, every two or three weeks, until the leaves have acquired their proper development early in June. This treatment, by destroying the weeds and increasing the general absorbing properties of the soil, favors an undisturbed and early development of the leaves, which have a controlling influence in the formation of sugar.

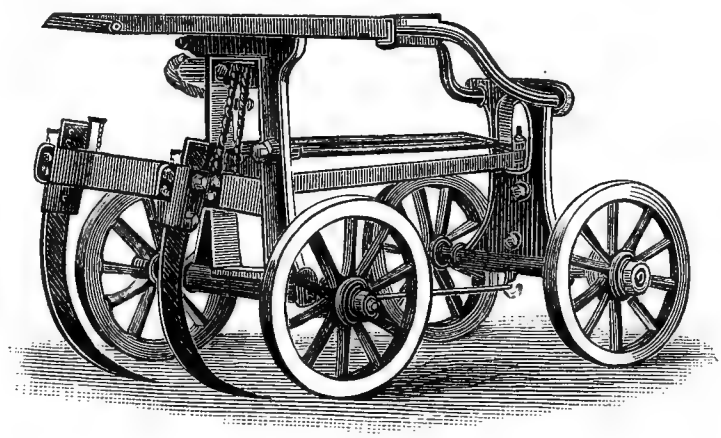


FIG. 4.—THE BEET-DIGGER.

The *beet-digger,* Fig. 4, is a powerful machine, also drawn by two horses. It consists of two long knives or coulters, fixed in a heavy framework, and so arranged that they may be set to run to a greater or less depth, as may be desired. These knives run under and lift two rows of beets at each passage. As the machine

passes along, only a slight rippling or undulating motion is observed in the rows of beet-tops, but the roots are loosened and cleared of dirt more perfectly than could be done by hand, and, as no roots are broken or left in the ground, a considerable increase in the crop is obtained. Like the beet-cultivator, the digger is steered by a lever at the hind end of the machine, and can be lifted to pass over obstructions and for convenience of travel to and from the field. The beets being raised out of the soil, and the leaves cut off with sword-like knives about one half to an inch above the root, the harvesting is completed by the removal of the roots to the pits or factory.

These machines are constructed to work with mathematical exactness, and are used in Germany with great success, and accomplish a very important saving of labor. They have also been experimented with at the Massachusetts Agricultural College with the same results. It is obvious that the smoother and more level the land, the better for cultivation; but the beet machinery will do good work on rolling and uneven land. The beet-planter, or any part of it, may pass over stones or mounds without interfering with its operation, ample provision being made to enable each part to adapt itself to the inequalities of the land. Finally, the crop must be kept free from weeds until harvested, otherwise the root-lifter, which on clean land is a model of simplicity and effectiveness, will be clogged and will not work at all. In short, it requires and abundantly rewards careful preparation of the land, punctual performance of the various operations of tillage, and perseverance in destroying weeds. We may say, this machinery is well adapted to the culture of other crops, particularly corn.

The estimated cost of the cultivation of the sugar-beet per acre, without machinery, on the farm in New England, is about the same as for a crop of onions, corn, or potatoes, and, exclusive of fertilizers, may be estimated as follows:

Fall plowing	$2.00
Spring plowing	4.00
Harrowing	2.00
Marking and planting	1.00
First weeding and thinning	3.00
Cultivator with horse, three times	4.50
Total	$16.50

It would be impossible, within the limits of this article, to describe in minute detail all the approved methods for the manufacture of beet-sugar; but an attempt will be made to give a general idea of the different processes, with a description of some of the ingenious mechanical contrivances introduced during the past

decade, which have been important agencies in making it possible to manufacture beet-sugar at a profit. The method of extracting the sugar from the beet-root is entirely unlike the one usually employed in manufacturing sugar from the cane-plant, but the principle of the former is equally applicable to the latter, and will probably be generally adopted when the cane-sugar manufacturer can afford to replace his old mechanical system with rotary diffusion batteries.

The beet-roots are dumped, by the farmers, into large bins about nine hundred feet long, capable of holding five thousand tons of beets, from which they are dropped by adjustable traps into a concrete ditch or canal, underneath the beet-house. This canal is provided with descents of brickwork or metal gutters, through which the roots are borne by the rushing water into the wash-house, which constitutes the first stage of the factory. In the wash-house is a large screw or raising wheel arrangement, by which the beets are emptied into a hopper on the second floor,

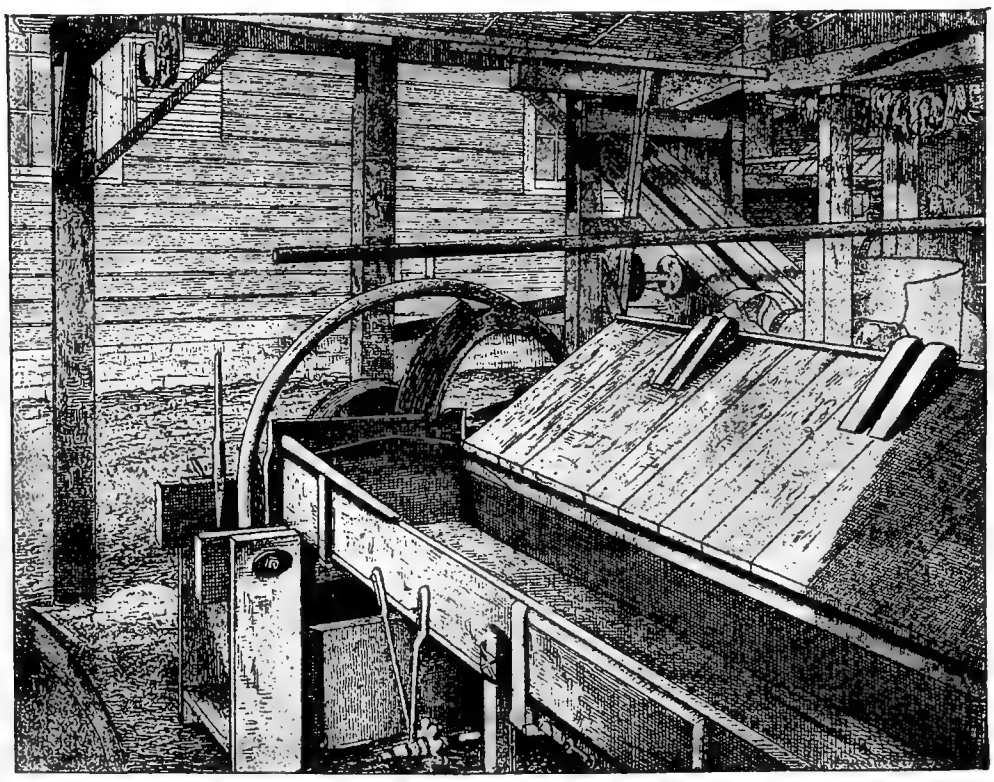


FIG. 5.—THE BEET-CUTTER.

from which they pass into a large, drum-shaped iron cylinder, called the *wash-barrel*, where the roots are thoroughly cleaned. The washing of the beet is a very important operation in the manufacture of the sugar, for the roots are thus freed from mold, small stones, and other kinds of dirt attaching to them, which not only saves the machinery employed in the actual preparation of the beets from injury, but keeps the sugar ultimately obtained free

from impurity. With the mere washing of the beets the sugar manufacturer is not content; they are therefore freed from those parts which are poor in saccharine, damaged or otherwise undesirable, by a machine called a *carousal*.

When cleaned, the beets are thrown from the wash-barrel into a hopper, from which they pass into an endless elevator which carries them to the top floor, where they are discharged into a large hopper. They then pass into a *cage* which will hold one thousand pounds of beets, and, when this weight is indicated, the cage empties its load into the *cutter* or slicer, Fig. 5. The cage and the indicator enable the factory people to closely estimate the amount of raw material used each day. It is also a check on every department. It will show any error that may arise in the receiving or shipping departments. The slicer is a round iron shaft, rotating horizontally, and fitted with steel knives capable of slicing four hundred tons of beets in twenty-four hours. The rotating knives, which descend upon the beets, cut them into thin slices, thus exposing the sugar-cells, which is an important factor in the diffusion system. The lower end of the cutter opens into a wooden trough about two feet square, on the bottom of which is an endless belt. As the sliced beets fall from the cutter, the belt carries them along to the diffusion tanks.

In alluding to the operation of the *diffusion battery* in the article on "Growth of the Beet-Sugar Industry," it was said that "though simple in its conception, it nevertheless illustrates well-known laws of chemical science in the transfusion of liquids, and successfully opens the membranous walls of the sugar-cells of the plant, giving a higher grade of juice, with less gummy, nitrogenous, and fibrous impurities, at less cost than by the old methods of mechanical pressure." By membranous diffusion is understood the process of exchange between two fluids of unequal density, contained in two vessels separated only by a membrane. Supposing the sugar-cells to be brought in contact with pure water, then, theoretically, if the cells contain twelve per cent of sugar, transfusion will go on till an equal weight of water contains six per cent of sugar, while by the passage of water into the cells the juice there is reduced to the same degree. Taking the six-per-cent watery solution and treating with it fresh roots containing twelve per cent of sugar, a nine-per-cent solution will be obtained, which, on being brought a third time in contact with fresh roots, would be raised to a density of 10·5 per cent. Thus, seven eighths of the whole sugar would be obtained at the third operation, and it is on this theory that the diffusion process is based.

A *diffusion battery*, Fig. 6, consists of a range of twelve large, close, upright cylinders called diffusers, provided with man-holes above and perforated false bottoms, with a like number of heaters,

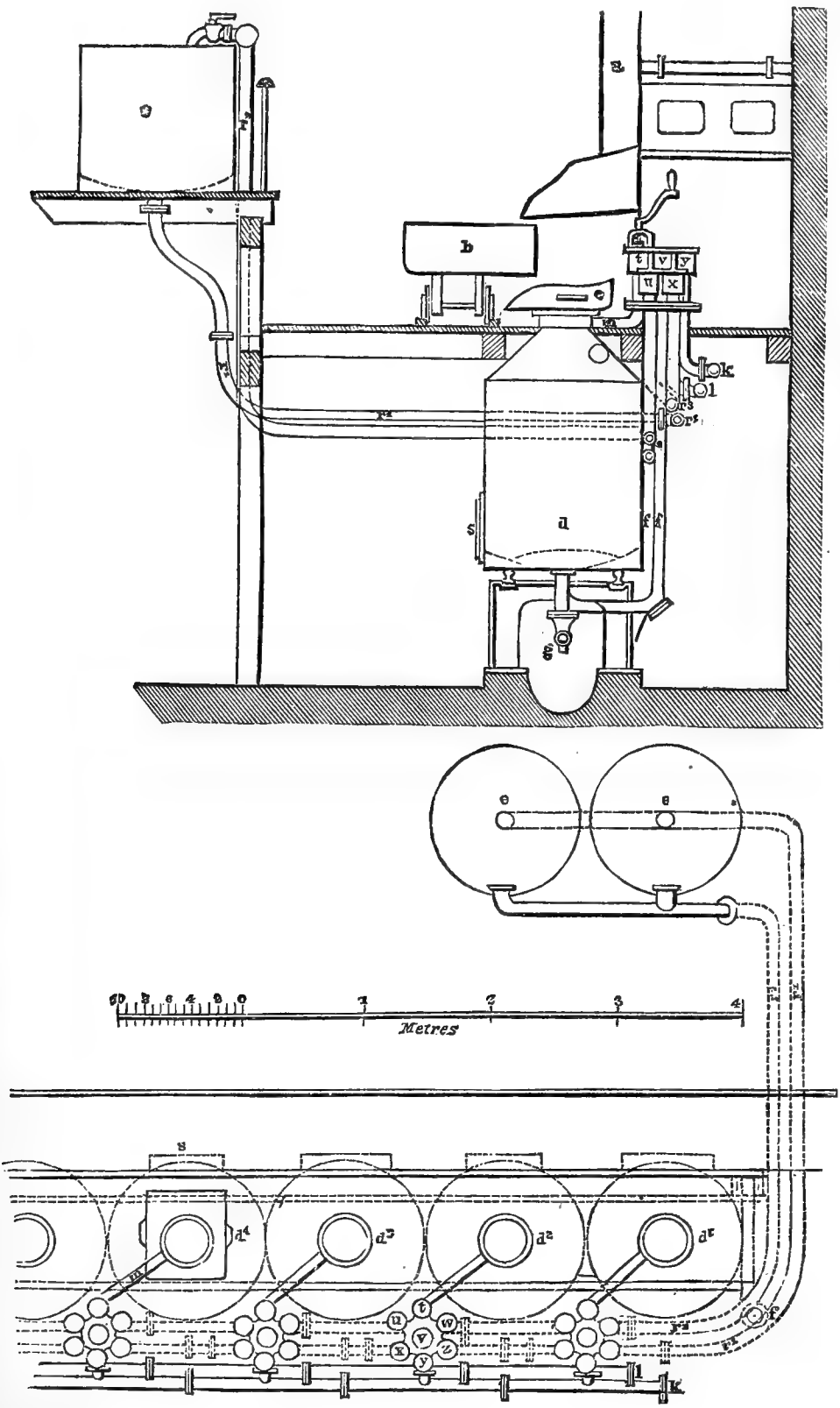


FIG. 6.—VERTICAL AND HORIZONTAL SECTIONS OF ROBERT'S DIFFUSION BATTERY (Stammer).

a, root-cutter; b, charging-car with weighing attachment; c, movable hopper; d, d^1, d^2, d^3, etc., diffusers; e, reheating-reservoir; f, communicating-tubes between diffusers; g, discharge-tube; k, conducting-tube for displaced water or juice; l, safety-tube connecting with all the diffusers, and serving to disconnect a defective one; t, u, v, x, y, z, valves corresponding to the various tubes; m, tube joining valves with diffusers; r^1 and r^2, etc., conduits between reheaters and diffusers; w and u, valves corresponding with same; r^3, conduit of juice to defecators; s, manhole for exit of exhausted slices.

arranged in alternation with the diffusers, revolving on a center. As the pure water from an elevated tank percolates through the mass of the two or three tons of sliced beets, under a pressure of eighty pounds, the fluid contents of any one cylinder can be forced into another through the communicating pipes, and thus—under

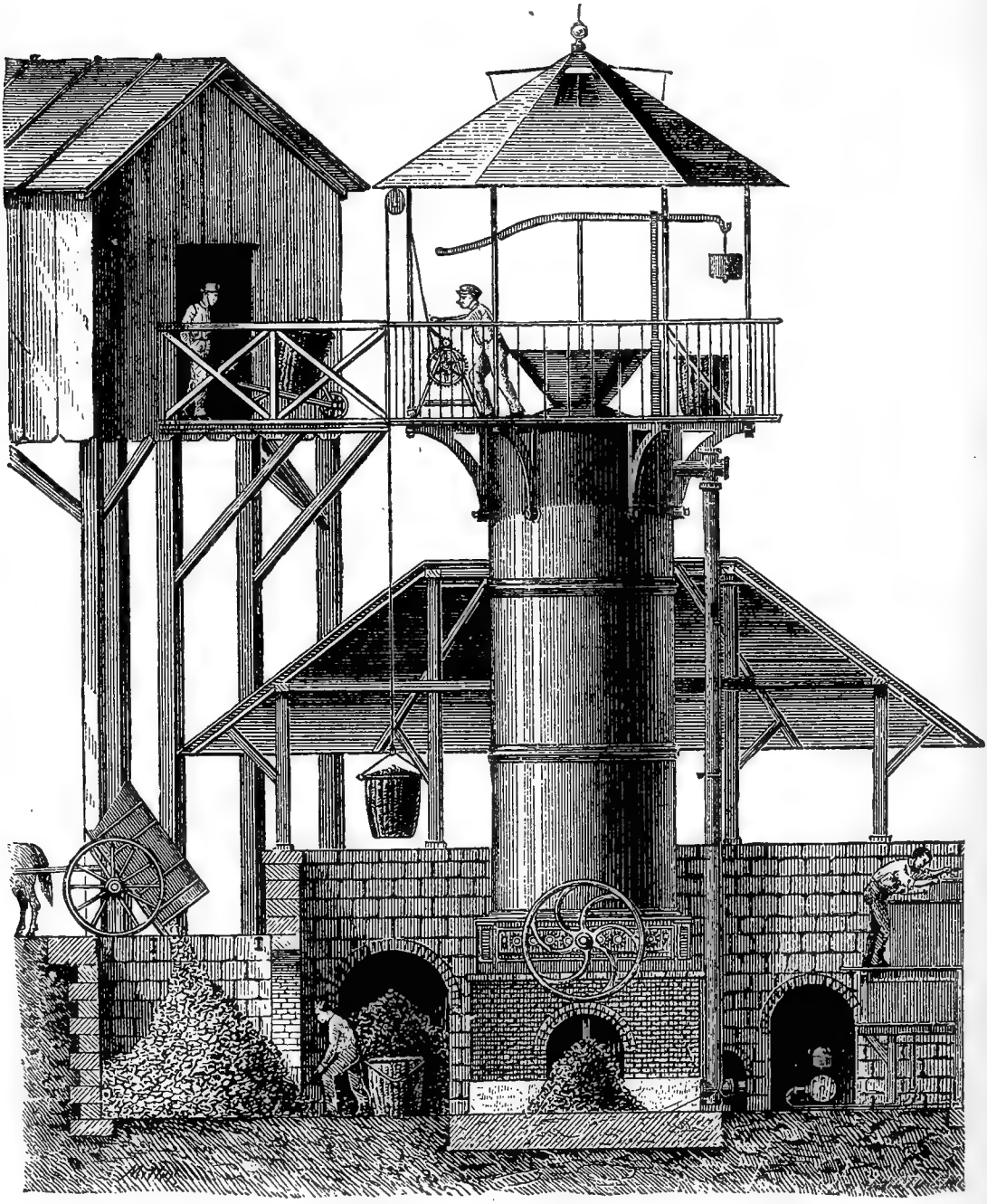


FIG. 7.—FURNACE FOR SUPPLY OF LIME AND CARBONIC-ACID GAS TO FACTORY ("Journal des Fabricants de Sucre").

the combined influence of heat and pressure—the whole solution becomes richly charged with sugar. From cylinder No. 1, which contains the slices almost exhausted of their soluble contents, the fluid passes into No. 2, where it acts on slices somewhat richer in juice. So it goes on through the series, meeting in each cylinder

slices increasingly rich in juice, and acquiring density in its progress. Before entering the last cylinder the solution is heated, and the richly charged fluid is sent forward to the carbonation tanks. This process of saturation consists in the treatment of the diffusion juices with lime and carbonic acid, whereby the non-saccharine substances are precipitated and partly decomposed,

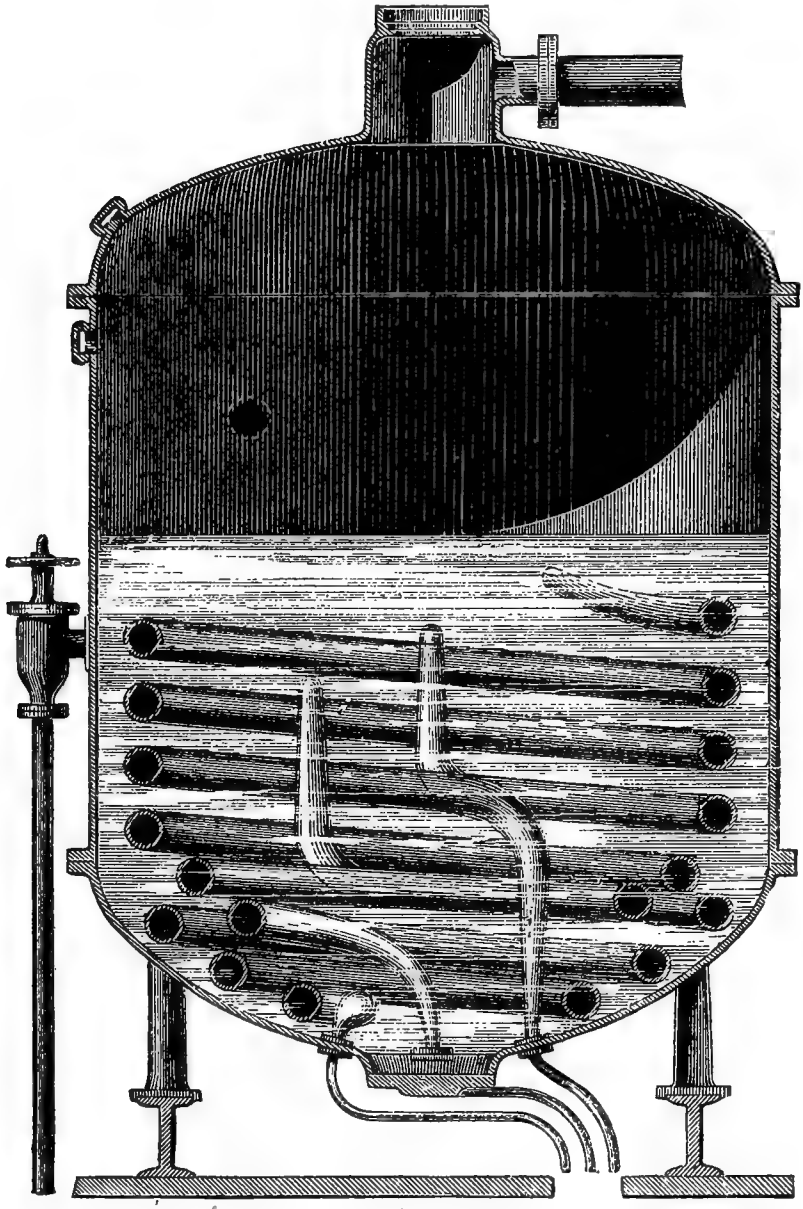


FIG. 8.—VACUUM STRIKE-PAN, VERTICAL SECTION (Maumené).

the sugar remaining unaltered in solution. These foreign or non-saccharine substances, which are present in the juice in considerable proportions, would interfere with the crystallization of the sugar.

The carbonic-acid gas is generated in a lime-kiln, Fig. 7, which consists of a hollow circular chamber of incombustible material provided with furnaces and delivery apertures, and is generally placed in the open air in the factory yard. The lime and carbonic-

acid gas are obtained by the decomposition of marble chips by a fire of coke and a bath of sulphuric acid. The process of saturation being complete, the juice is drawn through sand-catchers by means of a lye-pump, which conveys it under pressure into the filter-presses of the first saturation, where the precipitated substances are received. The presses consist of a number of four-cornered plates or frames, over which cloths are stretched. The

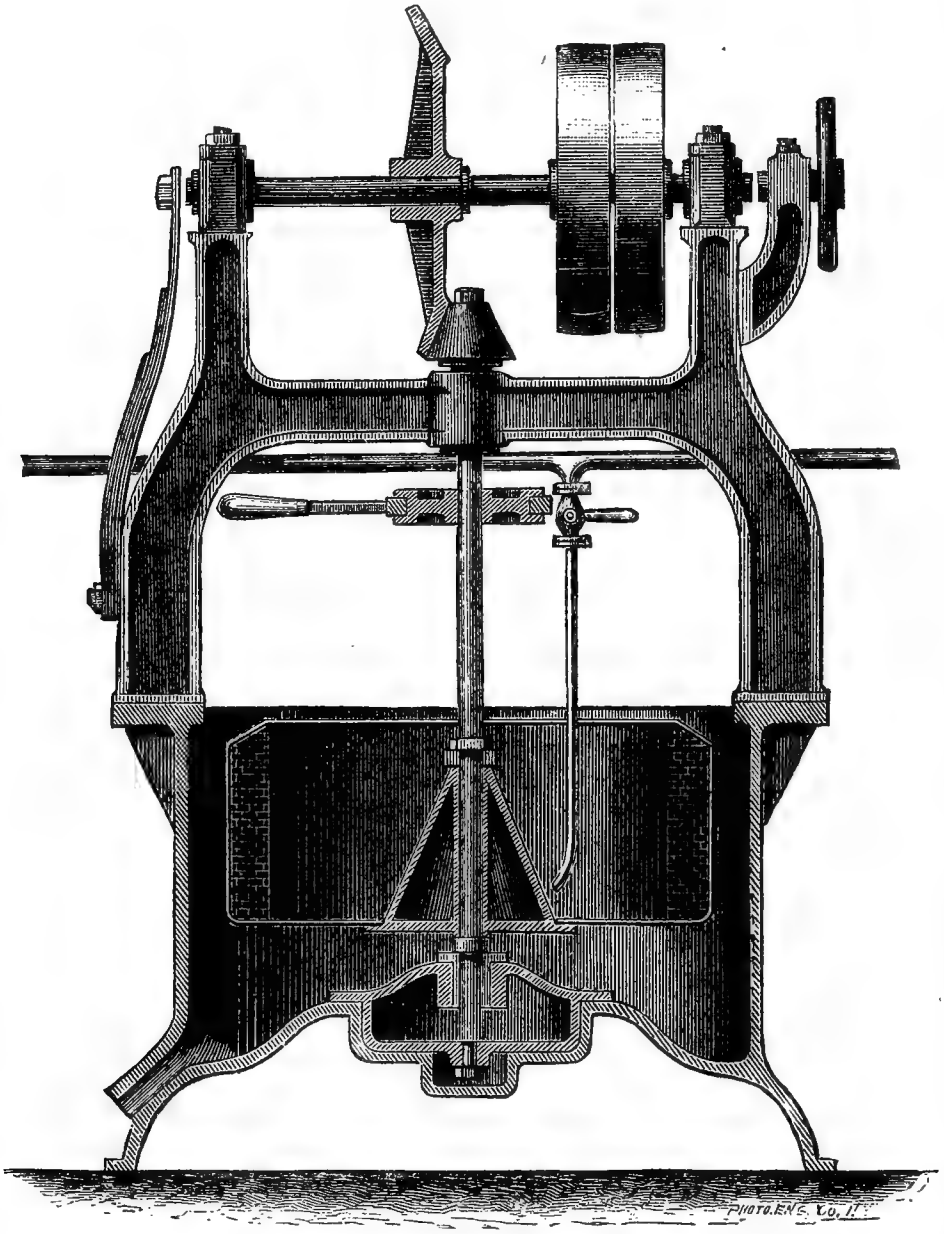


FIG. 9.—CENTRIFUGAL FILTER (Maumené).

residuum is deposited between the plates or in the frames, as the case may be, while the fluid passes through the cloths before leaving the press, and is thus filtered.

From the presses the liquid mass passes to the *evaporator*. This consists of one or more cylindrical vessels, either in a vertical or a horizontal position, according as its effect is single,

double, triple, or quadruple, and provided with a system of heating pipes. The steam which proceeds from the boiling juice of the first vessel serves to heat the second vessel, and so on through the entire series. The evacuation of the heating system on the evaporator is effected by means of small tubes leading from one vessel to the other and connected with a condenser.

When the sirup has attained to a certain degree of concentration, it is drawn off by means of pneumatic suction direct into the *vacuum boiler*. The vacuum boiler, Fig. 8, consists of a vertical, cylindrical, or ball-shaped vessel, with a conical base, containing heating worm tubes. The mass obtained from the vacuum boiler is first of all placed in a refrigerator, which consists of a trough provided with a stirrer and a refrigerator jacket. The mass of sugar crystals must now be separated from the sirup, so that raw sugar may be obtained, and hence it is sent forward from the refrigerator to the centrifugal machines.

A centrifugal machine, Fig. 9, consists of a cylindrical drum, over which is a finely perforated sieve, and which rotates with great rapidity on its own axis. The mass placed in the drum is pressed against the sieve by the action of centrifugal force, and the fluid escapes through the small apertures. The sirup having been disposed of, the yellow sugar obtained is called the first product, and this, having been emptied from the drum, is transferred to another sieve, where it is freed from the lumps which it may contain, and the raw sugar is finally emptied into sacks on the lower floor, when it is ready for the refinery. The process of refining raw sugar into the block sugar of commerce is an independent industry.

MISCHIEF-MAKERS IN MILK.

By ALICE B. TWEEDY.

VERY recently it was announced by Proust that the bicarbonate of soda used as a preservative of milk formed a compound particularly injurious to children—i. e., the lactate of soda.

There appears to be great danger, in the newly aroused fear of fermentative changes in food and of the baneful products of the busy bacilli, that any vaunted preservative or germicide may be greedily seized upon at once, without thought as to the innocence of its chemical activity. This easy credence in antiseptics seems to be characteristic of the minds that shrink with most unreasoning fear from every advance in bacteriological research. Not long since, a novelist, more imaginative than scientific, arraigned Science because "the idea of the comma bacillus is more dreadful than that of the cholera." This, as an outburst of ignorance, would be

excusable, preferring the known horror to the immeasurable unknown. But, to one acquainted with the fact that infinitesimal life swarms about and within us, why should it be terrible to learn that some forms are coincident with disease? If we thrive upon palpitant air, drink water* populated with bacteria, and shelter millions of microbes in our bodies, why should we tremble to find a few unfriendly species that we can not safely entertain? We talk glibly of "pure air" and "pure water"; but, to be exact, we have only a laboratory knowledge of either, and might as well try to rid ourselves of our surplus population as to provide ourselves with these elements in a sterilized state.

"Dead" and "undesirable" may be equivalent terms in regard to air and water, but we do not yet know whether they can be applied to food. All of the bacilli that visit our articles of diet seem to herald some fermentative or putrefactive change. Sometimes these are agreeable to us, and we aid them in their work of creating yeast, wine, and kumyss. Even then we watch closely and fix a limit to their activity. Generally, we are squeamish about their advent in meat, milk, cheese, or eggs, having dire experience of the alkaloids that they manufacture. And, it must be noted, it is not the bacilli themselves that give us trouble; for all we know they may be as digestible as the cholera bacillus was to M. Roche Fontaine. It is the physiological result of their sojourn in the food that constitutes the danger—the unfortunate remainder, or ptomaine, that may be fatal to us. This ptomaine is an alkaloid formed from the medium in which the organism exists, and includes whatever substance may be left of the bacterium itself. Just as man changes the atmosphere about him by exhaling carbonic-acid gas and various solid particles of matter, so the bacillus decomposes the tissues and fluids of the body in which it resides.

Nothing more wonderful than this work of disintegration is revealed to us in the economy of Nature. The picture of species after species accomplishing, by a brief life, one step toward the final resolution of organic matter into the elementary products, is not surpassed by a study of the glacial chiseling of the rocks, nor of the marvelous influence of the earth-worm in fructifying the soil.

Obviously, we can not wait for the manufacture of any poison, but must make it an impossibility, if we can, without rivaling any of the toxic effects by our remedies. Acquaintance is occasionally made with the ptomaine before the guilty micrococcus is known; in such cases even more care must be exercised.

Following the investigations of Lister and Hueppe, the ordi-

* A cubic centimetre of wholesome water may contain from 53,000 to 770,000 colonies of bacteria.

nary fermentation of milk is traced to the growth of a micro-organism known as *Bacterium lactis,* which converts the milk-sugar into lactic acid. The work of decomposition is then taken up by another bacillus, named *subtilis,* through which butyric acid is produced. Recent experiments made in the cultivation of milk bacteria by Baginski * indicate that the *Bacterium lactis* is incorrectly named, and, being responsible for an acetic-acid formation, is better termed *aceti.*

There is also a peculiar fermentator, *Bacterium coli,* that refuses to meddle with milk-sugar alone, but upon the addition of white of egg shows extraordinary activity, furnishing lactic, formic, and acetic acid. These three—*Bacterium aceti, Bacillus subtilis,* and *Bacterium coli*—are the normal visitants † of milk, and the changes dependent upon their presence are well understood. The micro-organisms that breed disease and death appear under exceptional circumstances, against which, so far as they are known, we may carefully guard.

The bacilli of phthisis, typhoid, and scarlet fever have been detected in milk supposed to be wholesome. Thorough inspection of cattle and dairies may reduce the frequency of infection; but, until such supervision is the rule, all danger can be avoided by boiling the milk. In the late Congress at Paris on the study of tuberculosis, Dr. Nocard advised this to be done in every case where there existed any tendency to consumption.

A peculiar sickness,‡ which in its malignant form is similar to anthrax, has been traced to a germ occurring in milk. The conditions required for its development are known, and have been artificially produced by feeding cattle with fodder exposed to the dew-fall. The poison is found in sweet milk, butter, cream, and cheese, but not in buttermilk. It is either formed in small quantity, or has the property attributed to it of self-attraction. Neither the ptomaine nor the bacillus producing it has been determined, and they offer a new field for experiment.

The chief mischief-maker is yet unknown, unless it may possibly be identical with the micrococcus # found by Dr. Sternberg in cheese. Its ptomaine,‖ however, was isolated by Prof. Vaughan, of the University of Michigan, in 1885, and was called, from the substance in which it was discovered, *tyrotoxicon*—cheese-poison.

The history of this discovery is interesting. Three hundred cases of cheese-poisoning were recorded in Michigan by the Board

* "Report of the Physiological Society of Berlin," January 18, 1889.

† Twenty-three varieties of bacteria were found in intestines of milk-fed infants suffering with summer complaints (Dr. Booker, Baltimore).

‡ "Science," New York, 1886, vol. viii, p. 482.

\# "Report of the Board of Health of Michigan," 1884–'85, vol. xiii, p. 218.

‖ "Ptomaines and Leucomaines," Vaughan and Novy, p. 56.

of Health during 1883 and 1884. Although none of these were fatal, the illness was in some instances alarming, and the evil effects were confined to twelve different cheeses. Samples of these were sent to Prof. Vaughan for analysis. The cheese exhibited no unusual taste or odor, but a dog, with keener instinct than the human, selected a piece of untainted cheese in preference. The detection of the poison proved to be a difficult task. The ptomaine was volatile and unstable, and a method had to be invented for its isolation. An alcoholic extract of the cheese fixed the poison in a fatty acid. An aqueous extract was made and evaporated, when the poison also disappeared. Two years of patient study perfected the process, and Prof. Vaughan succeeded in separating the ptomaine in crystalline shape. During the same year he obtained tyrotoxicon from milk kept in stoppered bottles in the laboratory.

In 1886 there occurred some cases of mysterious poisoning at Long Branch. Twenty-four persons became suddenly ill at one hotel, nineteen at another, and in the following week thirty more complained of similar symptoms. The investigations conducted by the chemists, Newton and Wallace, established the fact that tyrotoxicon was the cause of the sickness. The conditions in which the poison was generated are given in the report as follows: "The noon's milking—which alone was followed by illness—was placed while hot in the cans, and then, without any attempt at cooling, carted eight miles during the warmest part of the day in a very hot month"! Milk-poisoning in Iowa and Michigan was subsequently traced to the formation of tyrotoxicon; and, in India,* an English surgeon, Firth, discovered the same ptomaine in milk that occasioned sickness.

It might be supposed that so favorable a *nidus* as custard would not be overlooked by the mischievous bacillus. After Vaughan's method of isolating the ptomaine was made known, many analyses of poisonous ice-cream and cream-puffs testified to its industry. Wherever this toxic agent was identified, the circumstances attending its growth were carefully studied, and the care of the milk, cream, or custard was found to be faulty. In some instances cleanliness had been strictly observed, but other conditions inducing fermentation had been overlooked. In the milk-poisoning at Long Branch proper airing and cooling of the milk were neglected. In Milan, Mich., three fatal cases occurred in the tidy home of a farmer's family. Examination showed that the buttery where the milk was kept had a new floor laid over decaying boards, and some of the dirt accumulations between these, taken to the laboratory, generated tyrotoxicon in fresh milk. In Lawton, Mich., the custards prepared for freezing stood for some hours in

* "Indian Medical Journal," Calcutta, 1887, vol. vi, p. 1.

an unventilated building formerly used as a meat-market. The ice-cream made from them poisoned eighteen persons.

According to Prof. Vaughan, tyrotoxicon does not develop below 60° Fahr., and is anaërobic—grows when air is excluded. Some very simple measures, then, are preventive:

1. Scrupulous cleanliness.* A little dry milk on the rim of a can or vessel may breed the germ which will find a culture-ground in fresh milk.
2. A low temperature—below 60° Fahr.
3. Ventilation in an untainted atmosphere.

It is but just to say that these precautions are generally observed by careful dairymen and cream manufacturers. There is grave reason to fear, however, that they are not generally observed after the milk reaches the consumer's hands. Also, the slightest carelessness may affect seriously that class of the community which does not speak for itself—the very youngest.

The symptoms of cholera infantum † and poisoning by tyrotoxicon have been proved experimentally to be very much alike, if not identical. Even the *post-mortem* condition of children dying with this complaint is shown by Prof. Vaughan to agree exactly with that caused by tyrotoxicon-poisoning in animals. The enormous per cent of deaths from the disease occurs between the ages of six months and two years, proving conclusively that heat and atmospheric conditions can not be the potent causes. There is only one differing factor in the life of those under six months and older children—the food. The younger class, then, must escape, because a greater majority of them are naturally nourished. Statistics ‡ prove with increasing testimony that *all* artificial feeding is not only unnatural but hazardous, and to be successful requires the most intelligent attention. However, if all mothers and nurses could learn that milk exposed to foul or warm air for any length of time may not only sour, but become the vehicle of a virulent poison, perhaps the summer months would bear a better health record.#

One word of warning may not be amiss.‖ Whenever a young child is fed upon cow's milk, and this causes symptoms of disagreement, the diet should be changed at once either to meat or rice; for, if the chief mischief-maker be at work, the best milk will only furnish it with the medium in which it flourishes, and, deprived of this, it will inevitably perish.

* "Philadelphia Medical News," vol. l, p. 676.

† Prof. Vaughan's address before the New York Academy of Medicine, May, 1888. "Philadelphia Medical News," June, 1888.

‡ "Of 591 cases in Liverpool only 28 had natural nourishment; of 341 in Leicester, only two per cent" ("Philadelphia Medical News," June, 1887).

"Nine tenths of the mortality under one year of age is from preventable causes" (Dr. Wood's address before the American Medical Association).

‖ "Sanitarian," vol. xvii, pp. 308–311.

IS CHRISTIAN SCIENCE A "CRAZE"?

By JOSHUA F. BAILEY.

THE impression is quite general that Christian Science is merely a captivating theory; that its text-book, "Science and Health," is a collection of ingenious opinions—relating mainly to the cure of physical disease by imaginative means—that appeal especially "to persons of a highly religious and highly emotional nature." It is also confounded with "faith-cure" and "mind-cure," and alleged abuses and malpractice occurring under these and other irregular forms of mental healing are heralded as "another Christian Science case." It is credited with contemning observation and induction, and, by consequence, natural science; with making man "a part of God," and with various fanciful pretensions about sickness and death, and the unreality of matter.

A writer in the April "Popular Science Monthly" succeeded in committing all these errors and offenses against exactness of statement—besides others that space forbids the enumeration of—in less than four pages of the "Monthly." After having in this small compass misstated the doctrines and pretensions of the true school of Mind-healing, demolished his own misstatements, and all the false systems as well, this writer, with a strange disregard of sequence, devotes six pages to argument and instance in favor of mental healing, and—most surprising of all—administers what Christian scientists consider a well-merited rebuke to the M. D.s for not giving the public the benefits of this "pleasant and inexpensive medicine that cures in some cases where drugs fail," "shortens the term of sickness and lightens its pains in many other cases," and, "furthermore, has no injurious incidental effects."

There is really no excuse for such misrepresentation of Christian Science; for it has a text-book, "Science and Health," universally recognized as the exponent of its doctrines and methods. When called in question, it is entitled to be judged on authorized statements, and not on those of speculators in public credulity, on newspaper gossip and public rumor. This text-book says: "Systems of so-called 'mind-cure' are as truly material as the prevailing systems of medicine. They have no relationship with Christian Science"; and of "faith-cure," "Faith is belief, and not understanding. Belief is virtually blindness when it admits truth without understanding it. If truth is admitted, but not understood, it may be lost, and error may enter through this same channel of ignorant belief."

So far from not trusting observation and induction, "Science and Health" is a record of experiments in Mind that satisfy the

most exacting rules for the use of these guides in investigation, and that extend over many years. Its statements are absolute and demonstrable in the same sense and by the same methods as the propositions of geometry. Every line of this book was written from demonstration, by which is meant experiment in the sense the word carries in natural science. The author first worked out the principles of healing in Christian Science on herself, after she had been condemned by medical science. Then, through nine years more, she worked out the rule of the operation of truth in the constant, public practice of healing "all manner of diseases," physical and moral.

This practice covered thousands of cases. Her history through these years, and the almost twenty that have succeeded them, has been one of silent endurance, in reliance on God, of mockery and persecution, often—in the earlier times—of hunger and cold. Suffering worse than martyrdom, daily repeated, has set its seal upon her work.

Here is her own declaration as to the method pursued in working out her discovery:

"The point to be determined is, Shall Science explain all cause and effect, or shall these be left open to mere speculative thought? . . . In Christian Science mere opinion is valueless. Proof is essential to a due estimate of the subject. . . . I have set forth Christian Science, and its application to the treatment of disease, only as I have discovered them. I have demonstrated the effects of Truth on the health, longevity, and morals of men through Mind. . . . I have healed hopeless disease, and raised the dying to life and health, through the understanding of God as the only life. . . . The sick, the halt, and the blind look up to me with blessings."

To the truthfulness of *the most surprising of her declarations* many certificates are published in "Science and Health" from persons of unquestioned character, and have stood fourteen years unchallenged. Hundreds of others have been published during the seven years past, and the publication continues monthly in the "Christian Science Journal," with the names and addresses of writers, and thousands more are at the free disposition of any inquirer for truth.

The laws or formulæ of Christian Science are given in "Science and Health" so plainly that any person of average intelligence can repeat the results obtained by the author. These results have been and are being repeated by multitudes of persons, who testify publicly to the fact that they have proved them to be invariable.

Prima facie, then, the pretensions of Christian Science are not absurd. They are entitled to fair and candid examination, conducted as it would be in the case of any other alleged science,

under its own canons of procedure, subject to the laws of observation and induction that govern all investigation. The validity of its conclusions must be allowed to rest on the proofs of conformity to these scientific tests.

The charge that Christian Science contemns natural science is as unfounded as that it disregards observation and induction. It is said in "Science and Health":

Learning is useful if it is of the right sort. History, observation, invention, philosophic research, and original thought, are essential to the growth of mortal mind out of itself, error. The tangled barbarism of learning we deplore—the mere dogma, the speculative theory, the nauseous fiction.

If natural science says one thing more clearly than another, it is this: that law is everywhere, and that there can be no exception to it. Natural science denies miracles, if by a miracle is meant any variation from the regular order of divine cause and effect.

Herein Christian Science is in a line with natural science. Christian Science devoutly believes the wonderful works performed by Jesus, but affirms that his so-called miracles were in accord with the highest law; that they proceeded from the divine Principle of him, which is the Christ or anointed imperial humanity. Miracles are impossible in Science. The highest manifestation of Life or Truth is divine—not supernatural or preternatural, since Science is nature explicated.

The rational claims of natural science against the authority and mere belief of dogmatic theology have all been anticipated and formulated in "Science and Health." The comparison of "The Devil-Theory," in the editor's table of the April "Monthly," with the following passage from the chapter "Imposition and Demonstration," will illustrate this identity of attitude:

God, or good, has not created a mind susceptible of creating evil, for evil is the opposing error, and not the truth of creation.

As I understand it, the only evil, or devil, in the universe is made up of such erroneous beliefs as these: that man is a compound of both mind and matter; that a wicked mind can exist in a material form, and both form and mind can be created by the Divine Mind; that God is the author of sin, sickness, and death; and that Mind can be an entity within the cranium, with power to sin *ad libitum*. In other words, Satan is not a person but an illusion. A lie is the only Satan there is, as results prove. All the discords of earth are lies, and falsehood can not proceed from Truth. In and of itself discord is a falsity. It does not represent the fact relative to God or man.

To give the merest outline of the Principle and rule of Christian Science, as laid down in "Science and Health," would require a volume. Some of the phenomena and workings of human consciousness, and conclusions from the standpoint of Christian Science, can only be briefly referred to in the space at command.

Man may be defined as a state of consciousness, and the condition of consciousness constitutes the individuality. Consciousness is related to two distinct classes of phenomena. One of these

classes embraces the impressions derived from or received through the five personal senses, and constitutes what is called material or physical life. These are all summarized in the word *matter*. In the technology of Christian Science they are termed "beliefs" of matter, and are treated as inhering in a supposed subject termed "mortal man" or "mortal mind," and are said to be cognized through material sense. This is the consciousness of life in matter, or life in the material body, and in Christian Science is termed the "false consciousness."

Besides this consciousness or sense of material life, or life in the body, there is another sense or consciousness of Truth, Love, beauty, expressed in the word God, or Spirit. The impressions of Spirit not only do not come to us through the personal senses, can not be cognized by material sense, but they are contrary to this sense, are the opposites of the phenomena of material sense. They are distinct or obscure, just as the individual is immersed in or withdrawn from the objects of material sense, and the impressions derived from them.

Because these two states of consciousness are opposites, they are destructive of one another: as one is increased, the other is diminished; they are precisely represented in the action of light and darkness—as one advances, the other recedes. Every human individuality is the battle-ground of these opposing forces; the scale is at every instant inclined more strongly to the one or the other, and the true history of the individual and of the race—the only history—is the record of this struggle.

In the uninstructed consciousness, and on this mortal plane of existence, the beliefs and fears that are the inseparable concomitants of material sense, or the belief of life in matter, predominate; beliefs of good or ill are connected with all the elemental and other conditions that make up the material environment; with every act of the material man; with every article of food, drink, or apparel; with the function and operation of every organ of the body; with sleep and wakefulness, and every condition that can be named. In their train is the countless array of disease, envy, jealousy, malice, hatred, covetousness; every condition of thought that lust, appetite, and the nameless brood that develop and are propagated as earthly life advances—these are the shadowy attendants that haunt the consciousness of material man—the penalty attached to the false sense of life in matter.

Does progress in wisdom, gained from personal sense, emancipate man from this terrible thralldom? To the contrary, the more knowledge he gains, relative to these conditions and influences, the more laws he finds himself subject to—a subjection that the savage, untutored man is free from. In the words of "Science and Health," "Man hath sought out many inventions, but he

hath not yet found that knowledge can save him from the dire effects of knowledge."

The character of this personal or material sense or so-called consciousness, and the doctrine of Science concerning it, are stated in these graphic words from the text-book of Science:

Personal sense defrauds, lies, cheats, will break all the commands of the Mosaic Decalogue, to meet its own demands. How, then, can this sense be the channel of blessings or of understanding to man? How can man, reflecting God, be dependent on such material senses for knowing, hearing, seeing? Who dare say that the senses of man can be at one time the medium for serving sin, and, at another, for communion with God?

An affirmative reply would contradict the Scripture, for "the same fountain sendeth not forth sweet and bitter waters."

The so-called senses of matter are the only source of evil or error. Science shows them to be false; since matter has no sensation, and no organic construction can give it hearing and sight, or make it the medium of Mind.

Outside of the material sense of things, all is harmony. A wrong sense—of God, man, and creation—is *nonsense*, or want of sense. Belief would have the material senses sometimes good and sometimes bad.

Science sustains with immortal proof the impossibility of any material sense, and defines these so-called senses as human beliefs, whose testimony can not be true of man or his Maker—of whose reality, or immortality, the senses can take no cognizance. Nerves have no more sensation, apart from what belief bestows upon them, than the fibers of a plant. Mind alone feels, sees, tastes, smells, and hears; therefore these faculties continue when organization is destroyed. Otherwise the very worms could unfashion man. If it were possible for the real senses of man to be injured, Soul could reproduce them in all their perfection; but they can not be disturbed, since they exist in Soul.

"Science and Health" gives plain, practical rules by which the origin and classification of all the objects or images appearing in consciousness can, first, be instantly recognized; and, second, can be dealt with understandingly and on their merits. It thus simply affirms that states and conditions of consciousness can be gradually and progressively controlled and changed from fear and suffering to happiness and serene confidence. It teaches how to eliminate from consciousness, how to destroy all objects that are opposed to harmony, through the cultivated understanding of Truth. The operation of this understanding results in gradual elimination of material sense, and beliefs of matter that are its concomitant, from the individual, and thus from the race, consciousness. The improved state of consciousness thus resulting is what constitutes "Christian Science Mind-healing."

Hundreds of thousands of persons, found in every city, town, and village, are living this Science. They have destroyed, individually, and in the measure of their several understandings of Science, the beliefs and fears of matter, and have come into a state of measurable, relative health and harmony. That all who

enter the Science can not demonstrate on themselves and others with the same or with uniform success, is no more an argument against its Principle and Rule, than is the fact that few can follow the calculations of Leverrier an argument against the existence of the planet Neptune, or the truth of mathematics that pointed it out. Because every school-boy or college graduate does not work his way into the calculus, or reach the demonstration of the highest problem of geometry, shall we deny the exactness and value of mathematics, and throw away our Euclid and the arithmetics? To the contrary of such reasoning, would not the pretension that the results of Christian Science could be brought out arbitrarily, and in disregard of established facts and laws of consciousness, be a demonstration of its unscientific character?

Now, as to the question of reality or unreality of matter and its beliefs, especially of sickness and sin: evidently, if the objects opposed to harmony can be destroyed or kept out of any individual consciousness, such objects will—to this individual—have ceased to exist. If he can keep out any one or a number of such objects, just in so far approach is made to the state of absolute harmony, that is wholeness or health.

Christian Science admits the reality of the phenomena of matter—as defined above—*to material sense,* and it teaches the destruction of this sense, through the operation of Truth understood; but it demonstrates, by such destruction, that it is a false sense, and that it is unreal in this—that it has neither Principle nor permanence.

The exercise of the healing power in Christian Science is no mystery. It is explained in "Science and Health" as follows:

"A mental state of self-condemnation and guilt, or a faltering and doubting trust in Truth, are unsuitable conditions for healing the sick; if lost yourself in the belief and fear of disease, and ignorant of the mental remedy, you fail to use the energies of Mind in your own behalf, you can exercise little or no power for others' help."

"To succeed in healing you must conquer your own beliefs and fears as well as those of your patients, and you must rise daily into higher and holier being; by the spirit of Truth and Love you manifest, you will heal the sick. . . . Science makes no concessions to persons or opinions. One must abide strictly by its rules, or he can not demonstrate its Principle. . . . We approach to God or Life in the ratio of our spirituality and fidelity to Truth; and in that ratio we are able to discern the thoughts of the sick and the sinful that it may heal them."

The power of healing goes up and down with the moral condition of the healer, and this so completely that the Scientist knows

his position and power in Mind, from day to day, with the same certainty and precision that the mariner knows the position of his ship on the ocean.

"Science and Health" describes the operation of Christian healing in these words:

The body improves under the same truth that improves the mind. Christian Science is sunlight to the body. It invigorates and purifies. It acts as an alterative, neutralizing error with Truth. It changes the secretions, expels humors, dissolves tumors, relaxes rigid muscles, and restores carious bones to soundness. The effects of this Science are to stir the human mind to a change of base whereby it may yield to the Divine Mind.

As when an acid and an alkali meet and ferment, bringing out a third property, so mental and moral fermentation change the material base of man, giving more spirituality to mortal sense, and causing it to depend less on material evidence. The changes that go on in mortal mind serve to reconstruct the body.

Hence the doctrine "Truth is the universal medicine of sin *and* sickness"; both have their origin in error, in ignorance; the antidote to error is Truth, to ignorance is understanding; and the question of reality or unreality is summed up in the words "Sin and sickness have just as much reality as you give them—*and no more.*"

The nature and scope of healing in Christian Science are further set forth in these words:

No man is healed in sin, or by it, any more than he is morally saved in or by sin. To be every whit whole, he must be better spiritually as well as physically. Lust, hatred, and dishonesty make a man sick; and neither medicine nor mind can physically help him unless they make him better morally, and so deliver him from the destroyer. Body and mind are one. The heat of hatred, inflaming brutal propensities, the indulgence of evil motives and aims, will make any man (who is above the very lowest type of manhood) a hopeless sufferer. They consume the body with the fires of hell!

It will be seen that Christian Science is the Science of Life; its text-book says: "Its anatomy is mental self-knowledge, and consists in the art of dissecting thoughts, in order to discover their quality, quantity, and origin; it teaches when and how to probe the self-inflicted wounds of malice, envy, and hate; how to secure the hallowed influences of unselfishness, philanthropy, spiritual love, and the government of the body, both in health and sickness; its ontology is the nature and essence of all being—Mind, and its essential qualities; and on these primary elements my system of mental healing is based; its pharmacy is moral, and its medicine is intellectual and spiritual for physical healing."

The proposition "all is Mind, there is no matter," is fundamental in Christian Science, but, as above intimated, it is not, as superficial critics allege, a bald denial of the phenomena of material sense. In its methods the truth of this proposition is

demonstrated or proved by the annihilation of the alleged unreality. The affirmation of the absolute supremacy of Mind is not stated as a theory, but is accompanied by plain rules, comprehensible to any fair intelligence, by which this supremacy can be verified in an endless progression. This authority over the supposed conditions of matter was first completely demonstrated by Jesus. It is the Science of the life of Jesus, in its supremacy over matter and its beliefs of sin and sickness, that is set forth in "Science and Health."

No one knows, or can learn, any more of this Science than he has demonstrated—that is, lived. The students of natural science will not find unreasonable the declaration of an humble beginner in this Science, that no one is entitled to sit as a judge on it who has not either gone through with the demonstrations as set forth by its Founder, according to her directions, or until he can show by experience that when the rules of the Science are followed the results are not invariable.

This position was forcibly stated in a review of it that appeared the year following the publication of "Science and Health," as follows: "Why do you assail her for individual opinions and beliefs? That is not the ground she occupies. She declares that what she states is not her own. It is Science left subject to proof, based upon Principle, governed by given rules, the demonstration whereof she leaves for you. It is for you to decide whether it is Science or not: now who can answer that question who doesn't understand Science?"

Enough has been said to show that healing in Christian Science is very different from the fanciful representation given of it by the writer in the April "Monthly." Physical healing is a necessary and useful incident, not a factor, in the scheme of Christian Science. The operation of the healing power is as clearly defined and as tangible in consciousness, just as amenable to law—vastly more so to one reasonably well instructed—as are the phenomena involved in the operation of natural law on the plane of visible effects.

The writer in the April "Monthly" could not tell its readers what Christian Science is, precisely because it *is* Science, and can not be learned or picked up by curiously turning over the leaves of "Science and Health," from odd paragraphs in the daily papers, or from the loose gossip that circulates in the lower atmosphere of human thought.

For the ungenerous and unworthy statements reflecting on the personal character and motives of the founder of Christian Science, these words of hers from the great text-book of Science shall make the only answer:

"In founding this system of ethics and medicine I have labored

for principle, not for personality. Others can not take my place, even if willing to do so. I therefore remain at my post, working for the generations to come, never looking for a present reward."

"I have clung to Truth most closely in the hour of its trial. The weapons of mortal selfishness, envy, ambition, and hatred that have opposed, have often pierced the human heart, but 'none of these things have moved me.' . . . Twenty-two years I have planted and watered 'in labor and travail, working day and night.'"

"Hoping all things, enduring all things—in the spirit of Christ's charity—ready to bless them that curse me, glad to bear consolation to the sorrowing and healing to the sick, I commit these pages to honest seekers for Truth in this age and to posterity."

As to the reflections of the same character on the tens of thousands of devoted students who are laboring to spread the glad tidings she has brought, to alleviate and, finally, to destroy the supposed ills of humanity—real to sense, but not to Truth—they are left to the judgment of those who have followed these few words, so unworthy of their great theme.

It is proper to refer to the declaration of the signs of "decadence" of Christian Science. Its founder began in 1867 with a single student. Since that time she has taught nearly four thousand, the number increasing every year—not to speak of the pressure for admission to her classes of hundreds she is obliged every year to refuse. "Science and Health" had an insignificant sale during the years following its publication in 1875. But this, too, has steadily increased yearly, until it has reached a sale of forty thousand copies. A large proportion of the students from the classes of its author have become healers and teachers, so that, while for obvious reasons no exact statistics of their number can be given, it is certain that some hundreds of thousands are to-day "in" Science—that is, living, according to their several understandings, the "Life that is Spirit." Among those who receive "Science and Health" as a revelation of divine Truth are many of the most gifted and honored men and women not only in this country but in England.

Christian Science is no "craze." The readers of "The Popular Science Monthly" will judge for themselves whether the words of its founder are words of soberness or of delusion. She says: "I have never supposed this century would present the full fruits of Christian Science, or that sin, sickness, and death would not continue for centuries to come; but this I do aver, that, as a result of my teaching, old age and decrepitude will not come so soon—that already health is restored and longevity increased by

it. If such are the present fruits, what may not the harvest be when justice shall be done to this Science?"

Christian Science claims to be the Science of sciences; it takes up without hesitation the challenge, "The true science of mind-cure must explain all the phenomena of mental healing," and voluntarily lays itself under the further obligation to account for all mental and all supposed material phenomena whatever. It is this, and all of this, or it is nothing. *Aut omnis, aut nullus,* is the motto on its shield, is its word to humanity. Though the brow of divine Science is star-encircled, its feet are upon the earth, and health, harmony, and holiness are the gifts it brings to men.

"COWARDLY AGNOSTICISM."*

A WORD WITH PROF. HUXLEY.

By W. H. MALLOCK.

I WELCOME the discussion which, in this review and elsewhere, has been lately revived in earnest as to the issue between positive science and theology. I especially welcome Prof. Huxley's recent contribution to it, to which presently I propose to refer in detail. In that contribution—an article with the title "Agnosticism," which appeared a month or two since in "The Nineteenth Century"—I shall point out things which will probably startle the public, the author himself included, in case he cares to attend to them.

Before going further, however, let me ask and answer this question. If Prof. Huxley should tell us that he does not believe in God, why should we think the statement, as coming from him, worthy of an attention which we certainly should not give it if made by a person less distinguished than himself? The answer to this question is as follows: We should think Prof. Huxley's statement worth considering for two reasons: Firstly, he speaks as a man pre-eminently well acquainted with certain classes of facts. Secondly, he speaks as a man eminent, if not pre-eminent, for the vigor and honesty with which he has faced these facts, and drawn certain conclusions from them. Accordingly, when he sums up for us the main conclusions of science, he speaks not in his own name, but in the name of the physical universe, as modern science has thus far apprehended it; and similarly, when from these conclusions he reasons about religion, the bulk of the argu-

* "The Bishop of Peterborough departed so far from his customary courtesy and self-respect as to speak of 'cowardly agnosticism.'"—Prof. Huxley, "Nineteenth Century," February, 1889, p. 170, and "Popular Science Monthly," April, 1889, p. 751.

ments which he advances against theology are in no way peculiar to himself, or gain any of their strength from his reputation; they are virtually the arguments of the whole non-Christian world. He may possibly have, on some points, views peculiar to himself. He may also have certain peculiar ways of stating them. But it requires no great critical acuteness, it requires only ordinary fairness, to separate those of his utterances which represent facts generally accepted, and arguments generally influential, from those which represent only some peculiarity of his own. Now, all this is true not of Prof. Huxley only. With various qualifications, it is equally true of writers with whom Prof. Huxley is apparently in constant antagonism, and who also exhibit constant antagonism among themselves. I am at this moment thinking of two especially—Mr. Frederic Harrison and Mr. Herbert Spencer. Mr. Harrison, in his capacity of religious teacher, is constantly attacking both Mr. Spencer and Prof. Huxley. Prof. Huxley repays Mr. Harrison's blows with interest; and there are certain questions of a religious and practical character as to which he and Mr. Spencer would be hardly on better terms. But, underneath the several questions they quarrel about, there is a solid substructure of conclusions, methods, and arguments, as to which they all agree—agree in the most absolute way. What this agreement consists in, and what practical bearing, if taken by itself, it must have on our views of life, I shall now try to explain in a brief and unquestionable summary; and in that summary, what the reader will have before him is not the private opinion of these eminent men, but ascertained facts with regard to man and the universe; and the conclusions which, if we have nothing else to assist us, are necessarily drawn from those facts by the necessary operations of the mind. The mention of names, however, has this signal convenience—it will keep the reader convinced that I am not speaking at random, and will supply him with standards by which he can easily test the accuracy and the sufficiency of my assertions.

The case, then, of science, or modern thought, against theological religion or theism, and the Christian religion in particular, substantially is as follows:

In the first place, it is now an established fact that the physical universe, whether it ever had a beginning or no, is, at all events, of an antiquity beyond what the imagination can realize; and also that, whether or no it is limited, its extent is so vast as to be equally unimaginable. Science may not pronounce it absolutely to be either eternal or infinite, but science does say this, that so far as our faculties can carry us they reveal to us no hint of either limit, end, or beginning.

It is further established that the stuff out of which the universe

is made is the same everywhere and follows the same laws—whether at Clapham Common or in the farthest system of stars—and that this has always been so to the remotest of the penetrable abysses of time. It is established yet further that the universe in its present condition has evolved itself out of simpler conditions, solely in virtue of the qualities which still inhere in its elements, and make to-day what it is, just as they have made all yesterdays.

Lastly, in this physical universe science has included man—not alone his body, but his life and his mind also. Every operation of thought, every fact of consciousness, it has shown to be associated in a constant and definite way with the presence and with certain conditions of certain particles of matter, which are shown, in their turn, to be in their last analysis absolutely similar to the matter of gases, plants, or minerals. The demonstration has every appearance of being morally complete. The interval between mud and mind, seemingly so impassable, has been traversed by a series of closely consecutive steps. Mind, which was once thought to have descended into matter, is shown forming itself, and slowly emerging out of it. From forms of life so low that naturalists can hardly decide whether it is right to class them as plants or animals, up to the life that is manifested in saints, heroes, or philosophers, there is no break to be detected in the long process of development. There is no step in the process where science finds any excuse for postulating or even suspecting the presence of any new factor.

And the same holds good of the lowest forms of life, and what Prof. Huxley calls "the common matter of the universe." It is true that experimentalists have been thus far unable to observe the generation of the former out of the latter, but this failure may be accounted for in many ways, and does nothing to weaken the overwhelming evidence of analogy that such generation really does take place or has taken place at some earlier period. "Carbonic acid, water, and ammonia," says Prof. Huxley, "certainly possess no properties but those of ordinary matter. . . . But when they are brought together under certain conditions they give rise to protoplasm; and this protoplasm exhibits the phenomenon of life. I see no breach in this series of steps in molecular complication, and I am unable to understand why the language which is applicable to any one form of the series may not be used to any of the others." *

So much, then, for what modern science teaches us as to the universe and the evolution of man. We will presently consider the ways, sufficiently obvious as they are, in which this seems to conflict with the ideas of all theism and theology. But first for a

* "Lay Sermons, Addresses, and Reviews," pp. 114, 117.

moment let us turn to what it teaches us also with regard to the history and the special claims of Christianity. Approaching Christianity on the side of its alleged history, it establishes the three following points: It shows us first that this alleged history, with the substantial truth of which Christianity stands or falls, contains a number of statements which are demonstrably at variance with fact; secondly, that it contains others which, though very probably true, are entirely misinterpreted through the ignorance of the writers who recorded them; and, thirdly, that though the rest may not be demonstrably false, yet those among them most essential to the Christian doctrine are so monstrously improbable and so utterly unsupported by evidence that we have no more ground for believing in them than we have in the wolf of Romulus.

Such, briefly stated, are the main conclusions of science in so far as they bear on theology and the theologic conception of humanity. Let us now consider exactly what their bearing is. Prof. Huxley distinctly tells us that the knowledge we have reached as to the nature of things in general does not enable us to deduce from it any absolute denial either of the existence of a personal God or of an immortal soul in man, or even of the possibility and the actual occurrence of miracles. On the contrary, he would believe to-morrow in the miraculous history of Christianity if only there were any evidence sufficiently cogent in its favor; and on the authority of Christianity he would believe in God and in man's immortality. Christianity, however, is the only religion in the world whose claims to a miraculous authority are worthy of serious consideration, and science, as we have seen, considers these claims to be unfounded. What follows is this—whether there be a God or no, and whether he has given us immortal souls or no, science declares bluntly that he has never informed us of either fact; and if there is anything to warrant any belief in either, it can be found only in the study of the natural universe. Accordingly, to the natural universe science goes, and we have just seen what it finds there. Part of what it finds bears specially on the theologic conception of God, and part bears specially on the theologic conception of man. With regard to God, to an intelligent creator and ruler, it finds him on every ground to be a baseless and a superfluous hypothesis. In former conditions of knowledge it admits that this was otherwise—that the hypothesis then was not only natural but necessary; for there were many seeming mysteries which could not be explained without it. But now the case has been altogether reversed. One after another these mysteries have been analyzed, not entirely, but to this extent at all events, that the hypothesis of an intelligent creator is not only nowhere necessary, but it generally introduces far more difficulties

than it solves. Thus, though we can not demonstrate that a creator does not exist, we have no grounds whatever for supposing that he does. With regard to man, what science finds is analogous. According to theology, he is a being specially related to God, and his conduct and his destinies have an importance which dwarfs the sum of material things into insignificance. But science exhibits him in a very different light; it shows that in none of the qualities once thought peculiar to him does he differ essentially from other phenomena of the universe. It shows that just as there are no grounds for supposing the existence of a creator, so there are none for supposing the existence of an immortal human soul; while as for man's importance relative to the rest of the universe, it shows that, not only as an individual, but also as a race, he is less than a bubble of foam is when compared with the whole sea. The few thousand years over which history takes us are as nothing when compared with the ages for which the human race has existed. The whole existence of the human race is as nothing when compared with the existence of the earth; and the earth's history is but a second and the earth but a grain of dust in the vast duration and vast magnitude of the All. Nor is this true of the past only, it is true of the future also. As the individual dies, so also will the race die; nor would a million of additional years add anything to its comparative importance. Just as it emerged out of lifeless matter yesterday, so will it sink again into lifeless matter to-morrow. Or, to put the case more briefly still, it is merely one fugitive manifestation of the same matter and force which, always obedient to the same unchanging laws, manifest themselves equally in a dung-heap, in a pig, and in a planet—matter and force which, so far as our faculties can carry us, have existed and will exist everywhere and forever, and which nowhere, so far as our faculties avail to read them, show any sign, as a whole, of meaning, of design, or of intelligence.

It is possible that Prof. Huxley, or some other scientific authority, may be able to find fault with some of my sentences or my expressions, and to show that they are not professionally or professorially accurate. If they care for such trifling criticism they are welcome to the enjoyment of it; but I defy any one to show, putting expression aside and paying attention only to the general meaning of what I have stated, that the foregoing account of what science claims to have established is not substantially true, and is not admitted to be so by any contemporary thinker who opposes science to theism, from Mr. Frederic Harrison to Prof. Huxley himself.

And now let us pass on to something which in itself is merely a matter of words, but which will bring what I have said thus far into the circle of contemporary discussion. The men who are

mainly responsible for having forced the above views on the world, who have unfolded to us the verities of nature and human history, and have felt constrained by these to abandon their old religious convictions—these men and their followers have by common consent agreed, in this country, to call themselves by the name of agnostics. Now there has been much quarreling of late among these agnostics as to what agnosticism—the thing which unites them—is. It must be obvious, however, to every impartial observer, that the differences between them are little more than verbal, and arise from bad writing rather than from different reasoning. Substantially the meaning of one and all of them is the same. Let us take, for instance, the two who are most ostentatiously opposed to each other, and have lately been exhibiting themselves, in this and other reviews, like two terriers each at the other's throat. I need hardly say that I mean Prof. Huxley and Mr. Harrison.

Some writers, Prof. Huxley says, Mr. Harrison among them, have been speaking of agnosticism as if it was a creed or a faith or a philosophy. Prof. Huxley proclaims himself to be "dazed" and "bewildered" by the statements. Agnosticism, he says, is not any one of these things. It is simply—I will give his definition in his own words—

> a method, the essence of which lies in the vigorous application of a single principle. . . . Positively, the principle may be expressed: In matters of the intellect, follow your reason as far as it will take you, without regard to any other consideration. And negatively: In matters of the intellect, do not pretend that conclusions are certain which are not demonstrated or demonstrable. That I take to be the agnostic faith, which if a man keep whole and undefiled, he shall not be ashamed to look the universe in the face, whatever the future may have in store for him.

Now anything worse expressed than this for the purpose of the discussion he is engaged in, or, indeed, for the purpose of conveying his own general meaning, it is hardly possible to imagine. Agnosticism, as generally understood, may, from one point of view, be no doubt rightly described as "a method." But is it a method with no results, or with results that are of no interest? If so, there would be hardly a human being idiot enough to waste a thought upon it. The interest resides in its results, and its results solely, and specially in those results that affect our ideas about religion. Accordingly, when the word agnosticism is now used in discussion, the meaning uppermost in the minds of those who use it is not a method, but the results of a method, in their religious bearings; and the method is of interest only in so far as it leads to these. Agnosticism means, therefore, precisely what Prof. Huxley says it does not mean. It means a creed, it means a faith, it means a religious or irreligious philosophy. And this

is the meaning attributed to it not only by the world at large, but in reality by Prof. Huxley also quite as much as by anybody. I will not lay too much stress on the fact that, in the passage just quoted, having first fiercely declared agnosticism to be nothing but a method, in the very next sentence he himself speaks of it as a "faith." I will pass on to a passage that is far more unambiguous. It is taken from the same essay. It is as follows:

"'Agnosticism [says Mr. Harrison] is a stage in the evolution of religion, an entirely negative stage, the point reached by physicists, a purely mental conclusion, with no relation to things social at all.' I am [says Prof. Huxley] quite dazed by this declaration. Are there then any 'conclusions' that are not 'purely mental'? Is there no relation to things social in 'mental conclusions' which affect men's whole conception of life? . . . 'Agnosticism is a stage in the evolution of religion.' If . . . Mr. Harrison, like most people, means by 'religion' theology, then, in my judgment, agnosticism can be said to be a stage in its evolution only as death may be said to be the final stage in the evolution of life."

Let us consider what this means. It means precisely what every one else has all along been saying, that agnosticism is to all intents and purposes a doctrine, a creed, a faith, or a philosophy, the essence of which is the negation of theologic religion. Now the fundamental propositions of theologic religion are these: There is a personal God, who watches over the lives of men; and there is an immortal soul in man, distinct from the flux of matter. Agnosticism, then, expressed in the briefest terms, amounts to two articles—not of belief, but of disbelief. *I do not believe in any God, personal, intelligent, or with a purpose; or, at least, with any purpose that has any concern with man. I do not believe in any immortal soul, or in any personality or consciousness surviving the dissolution of the body.*

Here I anticipate from many quarters a rebuke which men of science are very fond of administering. I shall be told that agnostics never say "there is no God," and never say "there is no immortal soul." Prof. Huxley is often particularly vehement on this point. He would have us believe that a dogmatic atheist is, in his view, as foolish as a dogmatic theist; and that an agnostic, true to the etymology of his name, is not a man who denies God, but who has no opinion about him. But this—even if true in some dim and remote sense—is for practical purposes a mere piece of solemn quibbling, and is utterly belied by the very men who use it whenever they raise their voices to speak to the world at large. The agnostics, if they shrink from saying that there is no God, at least tell us that there is nothing to suggest that there is one, and much to suggest that there is not. Surely, if they never spoke more strongly than this, for practical purposes this is an absolute denial. Prof. Huxley, for instance, is utterly unable to demonstrate that an evening edition of the "Times" is not printed in

Sirius; but if any action depended on our believing this to be true, he would certainly not hesitate to declare that it was a foolish and fantastic falsehood. Who would think the better of him—who would not think the worse—if in this matter he gravely declared himself to be an agnostic? And precisely the same may be said of him with regard to the existence of God. For all practical purposes he is not in doubt about it. He denies it. I need not, however, content myself with my own reasoning. I find Prof. Huxley himself indorsing every word that I have just uttered. He declares that such questions as are treated of in volumes of divinity "are essentially questions of lunar politics, . . . not worth the attention of men who have work to do in the world": and he cites Hume's advice with regard to such volumes as being "most wise"—"Commit them to the flames, for they can contain nothing but sophistry and illusion."* Quotations of a similar import might be indefinitely multiplied; but it will be enough to add to this the statements quoted already, that agnosticism is to theologic religion what death is to life; and that physiology does but deepen and complete the gloom of the gloomiest motto of paganism—"*Debemur morti.*" If then agnosticism is not an absolute and dogmatic denial of the fundamental propositions of theology, it differs from an absolute and dogmatic denial in a degree that is so trivial as to be, in the words of Prof. Huxley himself, "not worth the attention of men who have work to do in the world." For all practical purposes and according to the real opinion of Prof. Huxley and Mr. Harrison equally, agnosticism is not doubt, is not suspension of judgment; but it is a denial of what "most people mean by religion"—that is to say, the fundamental propositions of theology, so absolute that Prof. Huxley compares it to their death.

And now let us pass on to the next point in our argument, which I will introduce by quoting Prof. Huxley again. This denial of the fundamental propositions of theology "affects," he says, "men's whole conception of life." Let us consider how. By the Christian world, life was thought to be important owing to its connection with some unseen universe, full of interests and issues which were too great for the mind to grasp at present, but in which, for good or evil, we should each of us one day share, taking our place among the awful things of eternity. But at the touch of the agnostic doctrine this unseen universe bursts like a bubble, melts like an empty dream; and all the meaning which it once imparted to life vanishes from its surface like mists from a field at morning. In every sense but one, which is exclusively physical, man is remorselessly cut adrift from the eternal; and whatever importance or interest anything has for any of us, must

* "Lay Sermons, Addresses, and Reviews," p. 125.

be derived altogether from the shifting pains or pleasures which go to make up our momentary span of life, or the life of our race, which in the illimitable history of the All is an incident just as momentary.

Now supposing the importance and interest which life has thus lost can not be replaced in any other way, will life really have suffered any practical change and degradation? To this question our agnostics with one consent say Yes. Prof. Huxley says that if theologic denial leads us to nothing but materialism, "the beauty of a life may be destroyed," and "its energies paralyzed"; * and that no one, not historically blind, "is likely to underrate the importance of the Christian faith as a factor in human history, or to doubt that some substitute genuine enough and worthy enough to replace it will arise." † Mr. Spencer says the same thing with even greater clearness: while, as for Mr. Harrison, it is needless to quote from him; for half of what he has written is an amplification of these statements.

It is admitted, then, that life, in some very practical sense, will be ruined if science, having destroyed theologic religion, can not put, or allow to be put, some other religion in place of it. But we must not content ourselves with this general language. Life will be ruined, we say. Let us consider to what extent and how. There is a good deal in life which obviously will not be touched at all—that is to say, a portion of which is called the moral code. Theft, murder, some forms of lying and dishonesty, and some forms of sexual license, are inconsistent with the welfare of any society; and society, in self-defense, would still condemn and prohibit them, even supposing it had no more religion than a tribe of gibbering monkeys. But the moral code thus retained would consist of prohibitions only, and of such prohibitions only as could be enforced by external sanctions. Since, then, this much would survive the loss of religion, let us consider what would be lost along with it. Mr. Spencer, in general terms, has told us plainly enough. What would be lost, he says, is, in the first place, "our ideas of goodness, rectitude, or duty," or, to use a single word, "morality." This is no contradiction of what has just been said, for morality is not obedience, enforced or even instinctive, to laws which have an external sanction, but an active co-operation with the spirit of such laws, under pressure of a sanction that resides in our own wills. But not only would morality be lost, or this desire to work actively for the social good; there would be lost also every higher conception of what the social good or of what our own good is; and men would, as Mr. Spencer says, "become chiefly absorbed in

* "Lay Sermons, Addresses, and Reviews," p. 127.

† "Agnosticism," "Nineteenth Century," February, 1889, p. 191, and "Popular Science Monthly," April, 1889, p. 773.

the immediate and the relative." * Prof. Huxley admits in effect precisely the same thing when he says that the tendency of systematic materialism is to "paralyze the energies of life," and "to destroy its beauty."

Let us try to put the matter a little more concisely. It is admitted by our agnostics that the most valuable element in our life is our sense of duty, coupled with obedience to its dictates; and this sense of duty derives both its existence and its power over us from religion, and from religion alone. How it derived them from the Christian religion is obvious. The Christian religion prescribed it to us as the voice of God to the soul, appealing as it were to all our most powerful passions—to our fear, to our hope, and to our love. Hope gave it a meaning to us, and love and fear gave it a sanction. The agnostics have got rid of God and the soul together, with the loves, and fears, and hopes by which the two were connected. The problem before them is to discover some other considerations—that is, some other religion—which shall invest duty with the solemn meaning and authority derivable no longer from these. Our agnostics, as we know, declare themselves fully able to solve it. Mr. Spencer and Mr. Harrison, though the solution of each is different, declare not only that some new religion is ready for us, but that it is a religion higher and more efficacious than the old; while Prof. Huxley, though less prophetic and sanguine, rebukes those "who are alarmed lest man's moral nature be debased," and declares that a wise man like Hume would merely "smile at their perplexities." †

Let us now consider what this new religion is—or rather these new religions, for we are offered more than one. So far as form goes, indeed, we are offered several. They can, however, all of them be resolved into two, resting on two entirely different bases, though sometimes, if not usually, offered to our acceptance in combination. One of these, which is called by some of its literary adherents Positivism or the Religion of Humanity, is based on two propositions with regard to the human race. The first proposition is that it is constantly though slowly improving, and will one day reach a condition thoroughly satisfactory to itself. The second proposition is that this remote consummation can be made so interesting to the present and to all intervening generations that they will strain every nerve to bring it about and hasten it. Thus, though humanity is admitted to be absolutely a fleeting phenomenon in the universe, it is presented relatively as of the utmost moment to the individual; and duty is supplied with a constant

* "Since the beginning, religion has had the all-essential office of preventing men from being chiefly absorbed in the relative or the immediate, and of awaking them to a consciousness of something beyond it."—"First Principles," p. 100.

† "Lay Sermons," pp. 123, 124.

meaning by hope, and with a constant motive by sympathy. The basis of the other religion is not only different from this, but opposed to it. Just as this demands that we turn away from the universe, and concentrate our attention upon humanity, so the other demands that we turn away from humanity and concentrate our attention on the universe. Mr. Herbert Spencer calls this the Religion of the Unknowable; and though many agnostics consider the name fantastic, they one and all of them, if they resign the religion of humanity, consider and appeal to this as the only possible alternative.

Now I have already in this review, not many months since, endeavored to show how completely absurd and childish the first of these two religions, the Religion of Humanity, is. I do not propose, therefore, to discuss it further here, but will beg the reader to consider that for the purpose of the present argument it is brushed aside like rubbish, unworthy of a second examination. Perhaps this request will sound somewhat arbitrary and arrogant, but I have something to add which will show that it is neither. The particular views which I now aim at discussing are the views represented by Prof. Huxley; and Prof. Huxley rejects the Religion of Humanity as completely as I do, and with a great deal less ceremony, as the following passage will demonstrate:

> Out of the darkness of prehistoric ages man emerges with the marks of his lowly origin strong upon him. He is a brute, only more intelligent than the other brutes; a blind prey to impulses which, as often as not, lead him to destruction; a victim to endless illusions which, as often as not, make his mental existence a terror and a burden, and fill his physical life with barren toil and battle. He attains a certain degree of physical comfort, and develops a more or less workable theory of life, in such favorable situations as the plains of Mesopotamia or Egypt, and, then, for thousands and thousands of years, struggles with varying fortunes, attended by infinite wickedness, bloodshed, and misery, to maintain himself at this point against the greed and the ambition of his fellow-men. He makes a point of killing or otherwise persecuting all those who try to get him to move on; and when he has moved on a step, foolishly confers post-mortem deification on his victims. He exactly repeats the process with all who want to move a step yet further. And the best men of the best epoch are simply those who make the fewest blunders and commit the fewest sins. . . . I know of no study so unutterably saddening as that of the evolution of humanity as it is set forth in the annals of history; . . . [and] when the positivists order men to worship humanity—that is to say, to adore the generalized conception of men, as they ever have been, and probably ever will be—I must reply that I could just as soon bow down and worship the generalized conception of a "wilderness of apes."*

Let us here pause for a moment and look about us, so as to see where we stand. Up to a certain point the agnostics have all gone together with absolute unanimity, and I conceive myself to have

* "Agnosticism," "Nineteenth Century," February, 1889, pp. 191, 192, and "Popular Science Monthly," April, 1889, pp. 772, 773.

gone with them. They have all been unanimous in their rejection of theology, and in regarding man and the race of men as a fugitive manifestation of the all-enduring something, which always, everywhere, and in an equal degree, is behind all other phenomena of the universe. They are unanimous also in affirming that, in spite of its fugitive character, life can afford us certain considerations and interests, which will still make duty binding on us, will still give it a meaning. At this point, however, they divide into two bands. Some of them assert that the motive and the meaning of duty is to be found in the history of humanity, regarded as a single drama, with a prolonged and glorious conclusion, complete in itself, satisfying in itself, and imparting, by the sacrament of sympathy, its own meaning and grandeur to the individual life, which would else be petty and contemptible. This is what some assert, and this is what others deny. With those who assert it we have now parted company, and are standing alone with those others who deny it—Prof. Huxley among them, as one of their chief spokesmen.

And now addressing myself to Prof. Huxley in this character, let me explain what I shall try to prove to him. If he could believe in God and in the divine authority of Christ, he admits he could account for duty and vindicate a meaning for life; but he refuses to believe, even though for some reasons he might wish to do so, because he holds that the beliefs in question have no evidence to support them. He complains that an English bishop has called this refusal "cowardly"—"has so far departed from his customary courtesy and self-respect as to speak of 'cowardly agnosticism.'" I agree with Prof. Huxley that, on the grounds advanced by the bishop, this epithet "cowardly" is entirely undeserved; but I propose to show him that, if not deserved on them, it is deserved on others, entirely unsuspected by himself. I propose to show that his agnosticism is really cowardly, but cowardly not because it refuses to believe enough, but because, tried by its own standards, it refuses to deny enough. I propose to show that the same method and principle, which is fatal to our faith in the God and the future life of theology, is equally fatal to anything which can give existence a meaning, or which can—to have recourse to Prof. Huxley's own phrases—"prevent our 'energies' from being 'paralyzed,' and 'life's beauty' from being destroyed." I propose, in other words, to show that his agnosticism is cowardly, not because it does not dare to affirm the authority of Christ, but because it does not dare to deny the meaning and the reality of duty. I propose to show that the miserable rags of argument with which he attempts to cover the life which he professes to have stripped naked of superstition, are part and parcel of that very superstition itself—that, though they are not the

chasuble and the embroidered robe of theology, they are its hair-shirt, and its hair-shirt in tatters—utterly useless for the purpose to which it is despairingly applied, and serving only to make the forlorn wearer ridiculous. I propose to show that in retaining this dishonored garment, agnosticism is playing the part of an intellectual Ananias and Sapphira; and that in professing to give up all that it can not demonstrate, it is keeping back part, and the larger part of the price—not, however, from dishonesty, but from a dogged and obstinate cowardice, from a terror of facing the ruin which its own principles have made.

Some, no doubt, will think that this is a rash undertaking, or else that I am merely indulging in the luxury of a little rhetoric. I hope to convince the reader that the undertaking is not rash, and that I mean my expressions to be taken in a frigid and literal sense. Let me begin then by repeating one thing, which I have said before. When I say that agnosticism is fatal to our conception of duty, I do not mean that it is fatal to those broad rules and obligations which are obviously necessary to any civilized society, which are distinctly defensible on obvious utilitarian grounds, and which, speaking generally, can be enforced by external sanctions. These rules and obligations have existed from the earliest ages of social life, and are sure to exist as long as social life exists. But so far are they from giving life a meaning, that on Prof. Huxley's own showing they have barely made life tolerable. A general obedience to them for thousands and thousands of years has left "the evolution of man, as set forth in the annals of history," the "most unutterably saddening study" that Prof. Huxley knows. From the earliest ages to the present—Prof. Huxley admits this—the nature of man has been such that, despite their laws and their knowledge, most men have made themselves miserable by yielding to "greed" and to "ambition," and by practicing "infinite wickedness." They have proscribed their wisest when alive, and accorded them a "foolish" hero-worship when dead. Infinite wickedness, blindness, and idiotic emotion have, then, according to Prof. Huxley's deliberate estimate, marked and marred men from the earliest ages to the present; and he deliberately says also, that "as men ever have been, they probably ever will be."

To do our duty, then, evidently implies a struggle. The impulses usually uppermost in us have to be checked, or chastened, by others, and these other impulses have to be generated, by fixing our attention on considerations which lie somehow beneath the surface. If this were not so, men would always have done their duty; and their history would not have been "unutterably saddening," as Prof. Huxley says it has been. What sort of considerations, then, must those we require be? Before answering

this question let us pause for a moment, and, with Prof. Huxley's help, let us make ourselves quite clear what duty is. I have already shown that it differs from a passive obedience to external laws, in being a voluntary and active obedience to a law that is internal; but its logical aim is analogous—that is to say, the good of the community, ourselves included. Prof. Huxley describes it thus—"to devote one's self to the service of humanity, including intellectual and moral self-culture under that name"; "to pity and help all men to the best of one's ability"; "to be strong and patient," "to be ethically pure and noble"; and to push our devotion to others "to the extremity of self-sacrifice." All these phrases are Prof. Huxley's own. They are plain enough in themselves; but, to make what he means yet plainer, he tells us that the best examples of the duty he has been describing are to be found among Christian martyrs and saints, such as Catherine of Sienna, and above all in the ideal Christ—"the noblest ideal of humanity," he calls it, "which mankind has yet worshiped." Finally, he says that "religion, properly understood, is simply the reverence and love for [this] ethical ideal, and the desire to realize that ideal in life which every man ought to feel." That man "ought" to feel this desire, and "ought" to act on it, "is," he says, "surely indisputable," and "agnosticism has no more to do with it than it has with music or painting."

Here, then, we come to something at last which Prof. Huxley, despite all his doubts, declares to be certain—to a conclusion which agnosticism itself, according to his view, admits to be "indisputable." Agnosticism, however, as he has told us already, lays it down as a "fundamental axiom" that no conclusions are indisputable but such as are "demonstrated or demonstrable." The conclusion, therefore, that we ought to do our duty, and that we ought to experience what Prof. Huxley calls "religion," is evidently a conclusion which, in his opinion, is demonstrated or demonstrable with the utmost clearness and cogency. Before, however, inquiring how far this is the case, we must state the conclusion in somewhat different terms, but still in terms which we have Prof. Huxley's explicit warrant for using. Duty is a thing which men in general, "as they always have been, and probably ever will be," have lamentably failed to do, and to do which is very difficult, going as it does against some of the strongest and most victorious instincts of our nature. Prof. Huxley's conclusion, then, must be expressed thus: "We ought to do something which most of us do not do, and which we can not do without a severe and painful struggle, often involving the extremity of self-sacrifice."

And now, such being the case, let us proceed to this crucial question—What is the meaning of the all-important word "*ought*"?

It does not mean merely that on utilitarian grounds the conduct in question can be defended as tending to certain beneficent results. This conclusion would be indeed barren and useless. It would merely amount to saying that some people would be happier if other people would for their sake consent to be miserable; or that men would be happier as a race if their instincts and impulses were different from "what they always have been and probably ever will be." When we say that certain conduct ought to be followed, we do not mean that its ultimate results can be shown to be beneficial to other people, but that they can be exhibited as desirable to the people to whom the conduct is recommended—and not only as desirable, but as desirable in a pre-eminent degree—desirable beyond all other results that are immediately beneficial to themselves. Now the positivists, or any other believers in the destinies of humanity, absurd as their beliefs may be, still have in their beliefs a means by which, theoretically, duty could be thus recommended. According to them, our sympathy with others is so keen, and the future in store for our descendants is so satisfying, that we have only to think of this future and we shall burn with a desire to work for it. But Prof. Huxley, and those who agree with him, utterly reject both of these suppositions. They say, and very rightly, that our sympathies are limited; and that the blissful future, which it is supposed will appeal to them, is moonshine. The utmost, then, in the way of objective results, that any of us can accomplish by following the path of duty, is not only little in itself, but there is no reason for supposing that it will contribute to anything great. On the contrary, it will only contribute to something which, as a whole, is "unutterably saddening."

Let us suppose, then, an individual with two ways of life open to him—the way of ordinary self-indulgence, and the way of pain, effort, and self-sacrifice. The first seems to him obviously the most advantageous; but he has heard so much fine talk in favor of the second, that he thinks it at least worth considering. He goes, we will suppose, to Prof. Huxley, and asks to have it demonstrated that this way of pain is preferable. Now what answer to that could Prof. Huxley make—he, or any other agnostic who agrees with him? He has made several answers. I am going to take them one by one; and while doing to each of them, as I hope, complete justice, to show that they are not only absolutely and ridiculously impotent to prove what is demanded of them, but they do not even succeed in touching the question at issue.

One of the answers hardly needs considering, except to show to what straits the thinker must be put who uses it. A man, says Prof. Huxley, ought to choose the way of pain and duty, because it conduces in some small degree to the good of others; and to do

good to others ought to be his predominant desire, or, in other words, his religion. But the very fact in human nature that makes the question at issue worth arguing, is the fact that men naturally do not desire the good of others, or, at least, desire it in a very lukewarm way; and every consideration which the positivist school advance to make the good of others attractive and interesting to ourselves Prof. Huxley dismisses with what we may call an uproarious contempt. If, then, we are not likely to be nerved to our duty by a belief that duty done tends to produce and hasten a change that shall really make the whole human lot beautiful, we are not likely to be nerved to it by the belief that its utmost possible result will be some partial and momentary benefit to a portion of "a wilderness of apes." The positivist says to the men of the present day: "Work hard at the foundation of things social; for on these foundations one day will arise a glorious edifice." Prof. Huxley tells them to work equally hard, only he adds that the foundation will never support anything better than pig-sties. His attempt, then, on social grounds, to make duty binding, and give force to the moral imperative, is merely a fragment of Mr. Harrison's system, divorced from anything that gave it a theoretical meaning. Prof. Huxley has shattered that system against the hard rock of reality, and this is one of the pieces which he has picked up out of the mire.

The social argument, then, we may therefore put aside, as good perhaps for showing what duty is, but utterly useless for creating any desire to do it. Indeed, to render Prof. Huxley justice, it is not the argument on which he mainly relies. The argument, or rather the arguments, on which he mainly relies have no direct connection with things social at all. They seek to create a religion, or to give a meaning to duty, by dwelling on man's connection, not with his fellow-men, but with the universe, and thus developing in the individual a certain ethical self-reverence, or rather, perhaps, preserving his existing self-reverence from destruction. How any human being who pretends to accurate thinking can conceive that these arguments would have the effect desired —that they would either tend in any way to develop self-reverence of any kind, or that this self-reverence, if developed, could connect itself with practical duty—passes my comprehension. Influential and eminent men, however, declare that such is their opinion; and for that reason the arguments are worth analyzing. Mr. Herbert Spencer is here in almost exact accord with Prof. Huxley; we will therefore begin by referring to his way of stating the matter.

"We are obliged," he says, "to regard every phenomenon as a manifestation of some power by which we are acted on; though omnipresence is unthinkable, yet, as experience discloses no bounds

to the diffusion of phenomena, we are unable to think of limits to the presence of this power; while the criticisms of science teach us that this power is incomprehensible. And this consciousness of an incomprehensible power, called omnipresent from inability to assign its limits, is just that consciousness on which religion dwells." * Now Prof. Huxley, it will be remembered, gives an account of religion quite different. He says it is a desire to realize a certain ideal in life. His terminology therefore differs from that of Mr. Spencer; but of the present matter, as the following quotation will show, his view is substantially the same.

"Let us suppose," he says, "that knowledge is absolute, and not relative, and therefore that our conception of matter represents that which really is. Let us suppose further that we do know more of cause and effect than a certain succession; and I for my part do not see what escape there is from utter materialism and necessarianism." And this materialism, were it really what science forces on us, he admits would amply justify the darkest fears that are entertained of it. It would "drown man's soul," "impede his freedom," "paralyze his energies," "debase his moral nature," and "destroy the beauty of his life." † But, Prof. Huxley assures us, these dark fears are groundless. There is indeed only one avenue of escape from them; but that avenue truth open to us.

"For," he says, "after all, what do we know of this terrible 'matter,' except as a name for the unknown and hypothetical cause of states of our own consciousness? And what do we know of that 'spirit' over whose extinction by matter a great lamentation is arising, . . . except that it also is a name for an unknown and hypothetical cause or condition of states of consciousness? . . . And what is the dire necessity and iron law under which men groan? Truly, most gratuitously invented bugbears. I suppose if there be an 'iron' law it is that of gravitation; and if there be a physical necessity it is that a stone unsupported must fall to the ground. But what is all we really know and can know about the latter phenomena? Simply that in all human experience stones have fallen to the ground under these conditions; that we have not the smallest reason for believing that any stone so circumstanced will not fall to the ground; and that we have, on the contrary, every reason to believe that it will so fall. . . . But when, as commonly happens, we change *will* into *must*, we introduce an idea of necessity which . . . has no warranty that I can discover anywhere. . . . Force I know, and Law I know; but who is this Necessity, save an empty shadow of my own mind's throwing?"

Let us now compare the statements of these two writers. Each states that the reality of the universe is unknowable; that just as surely as matter is always one aspect of mind, so mind is equally one aspect of matter; and that if it is true to say that the thoughts of man are material, it is equally true to say that the earth from

* "First Principles," p. 99.

† "Lay Sermons," pp. 122, 123, 127.

which man is taken is spiritual. Further, from these statements each writer deduces a similar moral. The only difference between them is, that Mr. Spencer puts it positively, and Prof. Huxley negatively. Mr. Spencer says that a consciousness of the unknowable nature of the universe fills the mind with religious emotion. Prof. Huxley says that the same consciousness will preserve from destruction the emotion that already exists in it. We will examine the positive and negative propositions in order, and see what bearing, if any, they have on practical life.

Mr. Spencer connects his religion with practical life thus: The mystery and the immensity of the All, and our own inseparable connection with it, deepen and solemnize our own conception of ourselves. They make us regard ourselves as "elements in that great evolution of which the beginning and the end are beyond our knowledge or conception"; and in especial they make us so regard our "own innermost convictions."

"It is not for nothing," says Mr. Spencer, "that a man has in him these sympathies with some principles, and repugnance to others. . . . He is a descendant of the past; he is a parent of the future; and his thoughts are as children born to him, which he may not carelessly let die. He, like every other man, may properly consider himself as one of the myriad agencies through whom works the Unknown Cause: and when the Unknown Cause produces in him a certain belief, he is thereby authorized to profess and act with this belief."*

In all the annals of intellectual self-deception it would be hard to find anything to outdo or even to approach this. What a man does or thinks, what he professes or acts out, can have no effect whatever, conceivable to ourselves, beyond such effects as it produces within the limits of this planet; and hardly any effect, worth our consideration, beyond such as it produces on himself and a few of his fellow-men. Now, how can any of these effects be connected with the evolution of the universe in such a way as to enable a consciousness of the universe to inform us that one set of effects should be aimed at by us rather than another? The positivists say that our aim should be the progress of man; and that, as I have said, forms a standard of duty, though it may not supply a motive. But what has the universe to do with the progress of man? Does it know anything about, it or care anything about it? Judging from the language of Mr. Spencer and Prof. Huxley, one would certainly suppose that it did. Surely, in that case, here is anthropomorphism with a vengeance. "It is not for nothing," says Mr. Spencer, "that the Unknowable has implanted in a man certain impulses." What is this but the old theologic doctrine of design? Can anything be more inconsistent with the entire theory of the evolutionist? Mr. Spencer's argu-

* "First Principles," p. 123.

ment means, if it means anything, that the Unknowable has implanted in us one set of sympathies in a sense in which it has not implanted others: else the impulse to deny one's belief, and not to act on it, which many people experience, would be authorized by the Unknowable as much as the impulse to profess it, and to act on it. And according to Mr. Spencer's entire theory, according to Prof. Huxley's entire theory, according to the entire theory of modern science, it is precisely this that is the case. If it is the fact that the Unknowable works through any of our actions, it works through all alike, bad, good, and indifferent, through our lies as well as through our truth-telling, through our injuries to our race as well as through our benefits to it. The attempt to connect the well-being of humanity with any general tendency observable in the universe, is in fact, on agnostic principles, as hopeless as an attempt to get, in a balloon, to Jupiter. It is utterly unfit for serious men to talk about; and its proper place, if anywhere, would be in one of Jules Verne's story-books. The destinies of mankind, so far as we have any means of knowing, have as little to do with the course of the Unknowable as a whole, as the destinies of an ant-hill in South Australia have to do with the question of home rule for Ireland.

Or even supposing the Unknowable to have any feeling in the matter, how do we know that its feeling would be in our favor, and that it would not be gratified by the calamities of humanity, rather than by its improvement? Or here is a question which is more important still. Supposing the Unknowable did desire our improvement, but we, as Prof. Huxley says of us, were obstinately bent against being improved, what could the Unknowable do to us for thus thwarting its wishes?

And this leads us to another aspect of the matter. If consciousness of the Unknowable does not directly influence action, it may yet be said that the contemplation of the universe as the wonderful garment of this unspeakable mystery, is calculated to put the mind into a serious and devout condition, which would make it susceptible to the solemn voice of duty. How any devotion so produced could have any connection with duty I confess I am at a loss to see. But I need not dwell on that point, for what I wish to show is this, that contemplation of the Unknowable, from the agnostic's point of view, is not calculated to produce any sense of devoutness at all. Devoutness is made up of three things, fear, love, and wonder; but were the agnostic's thoughts really controlled by his own principles (which they are not) not one of these emotions could the Unknowable possibly excite in him. It need hardly be said that he has no excuse for loving it, for his own first principles forbid him to say that it is lovable, or that it possesses any character, least of all any anthropomorphic character. But

perhaps it is calculated to excite fear or awe in him. This idea is more plausible than the other. The universe as compared with man is a revelation of forces that are infinite, and it may be said that surely these have something awful and impressive in them. There is, however, another side to the question. This universe represents not only infinite forces, but it represents also infinite impotence. So long as we conform ourselves to certain ordinary rules we may behave as we like for anything it can do to us. We may look at it with eyes of adoration, or make faces at it, and blaspheme it, but for all its power it can not move a finger to touch us. Why, then, should a man be in awe of this lubberly All, whose blindness and impotence are at least as remarkable as its power, and from which man is as absolutely safe as a mouse in a hole is from a lion? But there still remains the emotion of wonder to be considered. Is not the universe calculated to excite our wonder? From the agnostic point of view we must certainly say No. The further science reveals to us the constitution of things the feeling borne in on us more and more strongly is this, that it is not wonderful that things happen as they do, but that it would be wonderful if they happened otherwise: while as for the Unknown Cause that is behind what science reveals to us, we can not wonder at that, for we know nothing at all about it, and, if there is any wonder involved in the matter at all, it is nothing but wonder at our own ignorance.

So much, then, for our mere emotions toward the Unknowable. There still remains, however, one way more in which it is alleged that our consciousness of it can be definitely connected with duty; and this is the way which our agnostic philosophers most commonly have in view, and to which they allude most frequently. I allude to the search after scientific truth and the proclamation of it, regardless of consequences. Whenever the agnostics are pressed as to the consequences of their principles, it is on this conception of duty that they invariably fall back. Mr. Herbert Spencer, on his own behalf, expresses the position thus:

> The highest truth he sees will the wise man fearlessly utter, knowing that, let what may come of it, he is thus playing his right part in the world, knowing that if he can effect the change [in belief] he aims at, well; if not, well also; though not *so* well.*

After what has been said already it will not be necessary to dwell long on this astonishing proposition. A short examination will suffice to show its emptiness. That a certain amount of truth in social intercourse is necessary for the continuance of society, and that a large number of scientific truths are useful in enabling us to add to our material comforts is, as Prof. Huxley would say,

* "First Principles," p. 123.

"surely indisputable." And truth thus understood it is "surely indisputable" that we should cultivate. The reason is obvious. Such truth has certain social consequences, certain things that we all desire come of it; but the highest truth which Mr. Spencer speaks of stands, according to him, on a wholly different basis, and we are to cultivate it, not because of its consequences, but in defiance of them. And what are its consequences, so far as we can see? Prof. Huxley's answer is this: "I have had, and have, the firmest conviction that . . . the *verace via*, the straight road, has led nowhere else but into the dark depths of a wild and tangled forest." Now if this be the case, what possible justification can there be for following this *verace via?* In what sense is the man who follows it playing "his right part in the world"? And when Mr. Spencer says, with regard to his conduct, "it is well," with whom is it well, or in what sense is it well? We can use such language with any warrant or with any meaning only on the supposition that the universe, or the Unknowable as manifested through the universe, is concerned with human happiness in some special way, in which it is not concerned with human misery, and that thus our knowledge of it must somehow make men happier, even though it leads them into a wild and tangled forest. It is certain that our devotion to truth will not benefit the universe; the only question is, will knowledge of the universe, beyond a certain point, benefit us? But the supposition just mentioned is merely theism in disguise. It imputes to the Unknowable design, purpose, and affection. In every way it is contrary to the first principles of agnosticism. Could we admit it, then devotion to truth might have all the meaning that Mr. Spencer claims for it: but if this supposition is denied, as all agnostics deny it, this devotion to truth, seemingly so noble and so unassailable, sinks to a superstition more abject, more meaningless, and more ridiculous than that of any African savage, groveling and mumbling before his fetich.

We have now passed under review the main positive arguments by which our agnostics, while dismissing the existence of God as a question of lunar politics, endeavor to exhibit the reality of religion, and of duty, as a thing that is "surely indisputable." We will now pass on to their negative arguments. While by positive arguments they endeavor to prove that duty and religion are realities, by their negative arguments they endeavor to prove that duty and religion are not impossibilities. We have seen how absolutely worthless to their cause are the former; but if the former are worthless, the latter are positively fatal.

What they are the reader has already seen. I have taken the statement of them from Prof. Huxley, but Mr. Spencer uses language almost precisely similar. These arguments start with two

admissions. Were all our actions linked one to another by mechanical necessity, it is admitted that responsibility and duty would be no longer conceivable. Our "energies," as Prof. Huxley admits, would be "paralyzed" by "utter necessarianism." Further, did our conception of matter represent a reality, were matter low and gross, as we are accustomed to think of it, then man, as the product of matter, would be low and gross also, and heroism and duty would be really successfully degraded, by being reduced to questions of carbon and ammonia. But from all of these difficulties Prof. Huxley professes to extricate us. Let us look back at the arguments by which he considers that he has done so.

We will begin with his method of liberating us from the "iron" law of necessity, and thus giving us back our freedom and moral character. He performs this feat, or rather, he thinks he has performed it, by drawing a distinction between what *will* happen and what *must* happen. On this distinction his entire position is based. Now in every argument used by any sensible man there is probably some meaning. Let us try fairly to see what is the meaning in this. I take it that the idea at the bottom of Prof. Huxley's mind is as follows: Though all our scientific reasoning presupposes the uniformity of the universe, we are unable to assert of the reality behind the universe, that it might not manifest itself in ways by which all present science would be baffled. But what has an idea like this to do with any practical question? So far as man, and man's will, is concerned, we have to do only with the universe as we know it; and the only knowledge we have of it, worth calling knowledge, involves, as Prof. Huxley is constantly telling us, "the great act of faith," which leads us to take what has been as a certain index of what will be. Now, with regard to this universe, Prof. Huxley tells us that the progress of science has always meant, and "means now more than ever," "the extension of the province of . . . causation, and . . . the banishment of spontaneity."* And this applies, as he expressly says, to human thought and action as much as to the flowering of a plant. Just as there can be no voluntary action without volition, so there can be no volition without some preceding cause. Accordingly, if a man's condition at any given moment were completely known, his actions could be predicted with as much or with as little certainty as the fall of a stone could be predicted if released from the hand that held it. Now Prof. Huxley tells us that, with regard to certainty, we are justified in saying that the stone will fall; and we should, therefore, be justified in saying similarly of the man, that he will act in such and such a manner. Whether theoretically we are absolutely certain is no matter. We are absolutely certain for all practical purposes,

* "Lay Sermons," p. 123.

and the question of human freedom is nothing if not practical. What then is gained—is anything gained—is the case in any way altered—by telling ourselves that, though there is certainty in the case, there is no necessity? Suppose I held a loaded pistol to Prof. Huxley's ear, and offered to pull the trigger, should I reconcile him to the operation by telling him that, though it certainly would kill him, there was not the least necessity that it should do so? And with regard to volition and action, as the result of preceding causes, is not the case precisely similar? Let Prof. Huxley turn to all the past actions of humanity. Can he point to any smallest movement of any single human being, which has not been the product of causes, which in their turn have been the product of other causes? Or can he point to any causes which, under given conditions, could have produced any effects other than those they have produced, unless he uses the word *could* in the foolish and fantastic sense which would enable him to say that unsupported stones could possibly fly upward? For all practical purposes the distinction between *must* and *will* is neither more nor less than a feeble and childish sophism. Theoretically no doubt it will bear this meaning—that the Unknowable might have so made man, that at any given moment he could be a different being: but it does nothing to break the force of what all science teaches us—that man, formed as he is, can not act otherwise than as he does. The universe may have no necessity at the back of *it;* but its presence and its past alike are a necessity at the back of *us;* and it is not necessity, but it is doubt of necessity, that is really "the shadow of our own mind's throwing."

And now let us face Prof. Huxley's other argument, which is to save life from degradation by taking away the reproach from matter. If it is true, he tells us, to say that everything, mind included, is matter, it is equally true to say that everything, matter included, is mind; and thus, he argues, the dignity we all attribute to mind, at once is seen to diffuse itself throughout the entire universe. Mr. Herbert Spencer puts the same view thus:

> Such an attitude of mind [contempt for matter and dread of materialism] is significant not so much of a reverence for the Unknown Cause, as of an irreverence for those familiar forms in which the Unknown Cause is manifested to us.* . . . But whoever remembers that the forms of existence of which the uncultivated speak with so much scorn . . . are found to be the more marvelous the more they are investigated, and are also to be found to be in their natures absolutely incomprehensible . . . will see that the course proposed [a reduction of all things to terms of matter] does not imply a degradation of the so-called higher, but an elevation of the so-called lower.

The answer to this argument, so far as it touches any ethical or religious question, is at once obvious and conclusive. The one

* "First Principles," p. 556.

duty of ethics and of religion is to draw a distinction between two states of emotion and two courses of action—to elevate the one and to degrade the other. But the argument we are now considering, though undoubtedly true in itself, has no bearing on this distinction whatever. It is invoked to show that religion and duty remain spiritual in spite of all materialism; but it ends, with unfortunate impartiality, in showing the same thing of vice and of cynical worldliness. If the life of Christ is elevated by being seen in this light, so also is the life of Casanova; and it is as impossible in this way to make the one higher than the other as it is to make one man higher than another by taking them both up in a balloon.

I have now gone through the whole case for duty and for religion, as stated by the agnostic school, and have shown that, as thus stated, there is no case at all. I have shown their arguments to be so shallow, so irrelevant, and so contradictory, that they never could have imposed themselves on the men who condescend to use them, if these men, upon utterly alien grounds, had not pledged themselves to the conclusion which they invoke the arguments to support. Something else, however, still remains to be done. Having seen how agnosticism fails to give a basis to either religion or duty, I will point out to the reader how it actively and mercilessly destroys them. Religion and duty, as has been constantly made evident in the course of the foregoing discussion, are, in the opinion of the agnostics, inseparably connected. Duty is a course of conduct which is more than conformity to human law; religion consists of the emotional reasons for pursuing that conduct. Now these reasons, on the showing of the agnostics themselves, are reasons that do not lie on the surface of the mind. They have to be sought out in moods of devoutness and abstraction, and the more we dwell on them, the stronger they are supposed to become. They lie above and beyond the ordinary things of life; but after communing with them, it is supposed that we shall descend to these things with our purposes sharpened and intensified. It is easy to see, however, if we divest ourselves of all prejudice, and really conceive ourselves to be convinced of nothing which is not demonstrable by the methods of agnostic science, that the more we dwell on the agnostic doctrine of the universe, the less and not the more shall duty seem to be binding on us.

I have said that agnosticism can supply us with no religion. Perhaps I was wrong in saying so, but if we will but invert the supposed tendency of religion, it can and it will supply us with a religion indeed. It will supply us with a religion which, if we describe it in theological language, we may with literal accuracy describe as the religion of the devil—of the devil, the spirit which denies. Instead of telling us of duty, that it has a meaning which

does not lie on the surface, such meaning as may lie on the surface it will utterly take away. It will indeed tell us that the soul which sins shall die; but it will tell us in the same breath that the soul which does not sin shall die the same death. Instead of telling us that we are responsible for our actions, it will tell us that if anything is responsible for them it is the blind and unfathomable universe; and if we are asked to repent of any shameful sins we have committed, it will tell us we might as well be repentant about the structure of the solar system. These meditations, these communings with scientific truth, will be the exact inverse of the religious meditations of the Christian. Every man, no doubt, has two voices—the voice of self-indulgence or indifference, and the voice of effort and duty; but whereas the religion of the Christian enabled him to silence the one, the religion of the agnostic will forever silence the other. I say forever, but I probably ought to correct myself. Could the voice be silenced forever, then there might be peace in the sense in which Roman conquerors gave the name of peace to solitude. But it is more likely that the voice will still continue, together with the longing expressed by it, only to feel the pains of being again and again silenced, or sent back to the soul saying bitterly, I am a lie.

Such, then, is really the result of agnosticism on life, and the result is so obvious to any one who knows how to reason, that it could be hidden from nobody, except by one thing, and that is the cowardice characteristic of all our contemporary agnostics. They dare not face what they have done. They dare not look fixedly at the body of the life which they have pierced.

And now comes the final question to which all that I have thus far urged has been leading. What does theologic religion answer to the principles and to the doctrines of agnosticism? In contemporary discussion the answer is constantly obscured, but it is of the utmost importance that it should be given clearly. It says this: If we start from and are faithful to the agnostic's fundamental principles, that nothing is to be regarded as certain which is not either demonstrated or demonstrable, then the denial of God is the only possible creed for us. To the methods of science nothing in this universe gives any hint of either a God or a purpose. Duty; and holiness, aspiration and love of truth, are "merely shadows of our own mind's throwing," but shadows which, instead of making the reality brighter, only serve to make it more ghastly and hideous. Humanity is a bubble; the human being is a puppet, cursed with the intermittent illusion that he is something more, and roused from this illusion with a pang every time it flatters him. Now, from this condition of things is there no escape? Theologic religion answers, There is one, and one only, and this is the repudiation of the principle on which all agnosticism rests.

Let us see what this repudiation amounts to, and we shall then realize what, in the present day, is the intellectual basis which theologic religion claims. Theologic religion does not say that within limits the agnostic principle is not perfectly valid and has not led to the discovery of a vast body of truth. But what it does say is this: That the truths which are thus discovered are not the only truths which are certainly and surely discoverable. The fundamental principle of agnosticism is that nothing is certainly true but such truths as are demonstrated or demonstrable. The fundamental principle of theologic religion is that there are other truths of which we can be equally or even more certain, and that these are the only truths that give life a meaning and redeem us from the body of death. Agnosticism says nothing is certain which can not be proved by science. Theologic religion says, nothing which is important can be. Agnosticism draws a line round its own province of knowledge, and beyond that it declares is the unknown void which thought can not enter, and in which belief can not support itself. Where Agnosticism pauses, there religion begins. On what seems to science to be unsustaining air, it lays its foundations—it builds up its fabric of certainties. Science regards them as dreams, as an "unsubstantial pageant"; and yet even to science religion can give some account of them. Prof. Huxley says, as we have seen, that "from the nature of ratiocination," it is obvious that it must start "from axioms which can not be demonstrated by ratiocination"; and that in science it must start with "one great act of faith"—faith in the uniformity of nature. Religion replies to science: "And I, too, start with a faith in one thing. I start with a faith which you, too, profess to hold—faith in the meaning of duty and the infinite importance of life; and out of that faith my whole fabric of certainties, one after the other, is reared by the hands of reason. Do you ask for proof? Do you ask for verification? I can give you one only, which you may take or leave, as you choose. Deny the certainties which I declare to be certain—deny the existence of God, deny man's freedom and immortality, and by no other conceivable hypothesis can you vindicate for man's life any possible meaning, or save it from the degradation at which you profess to feel so aghast." "Is there no other way," I can conceive science asking, "no other way by which the dignity of life may be vindicated except this—the abandonment of my one fundamental principle? Must I put my lips, in shame and humiliation, to the cup of faith I have so contemptuously cast away from me? May not this cup pass from me? Is there salvation in no other?" And to this question, without passion or preference, the voice of reason and logic pitilessly answers "No."

Here is the dilemma which men, sooner or later, will see before

them, in all its crudeness and nakedness, cleared from the rags with which the cowardice of contemporary agnosticism has obscured it; and they will then have to choose one alternative or the other. What their choice will be I do not venture to prophesy; but I will venture to call them happy if their choice prove to be this: To admit frankly that their present canon of certainty, true so far as it goes, is only the pettiest part of truth, and that the deepest certainties are those which, if tried by this canon, are illusions. To make this choice a struggle would be required with pride, and with what has long passed for enlightenment; and yet, when it is realized what depends on the struggle, there are some at least who will think that it must end successfully. The only way by which, in the face of science, we can ever logically arrive at a faith in life, is by the commission of what many at present will describe as an intellectual suicide. I do not for a moment admit that such an expression is justifiable, but, if I may use it provisionally, and because it points to the temper at present prevalent, I shall be simply pronouncing the judgment of frigid reason in saying that it is only through the grave and gate of death that the spirit of man can pass to its resurrection.—*Fortnightly Review.*

THE ANIMAL WORLD OF WELL-WATERS.

By Dr. OTTO ZACHARIAS.

"WHAT! can it be that, in the well from which we obtain our drinking-water, there are animals?" This question will undoubtedly suggest itself to one or more of my readers on seeing the heading I have given to these lines. Some of them perhaps may, in view of the existence of a "well-fauna," take a solemn pledge of total abstinence so far as the drinking of water is concerned, and hereafter quench their thirst in something else. Others may perhaps, seemingly in jest, and yet withal in truth, seriously enough ascribe a catarrh of the stomach, contracted by drinking water that was too cold, not to their own carelessness, but to some little animal which they fancy they have swallowed. Others still will play the part of skeptics, and perchance, holding a glass of water from their well up to the light, peer critically into it and exclaim: "The story is merely another fable of the scientists; we shall not believe in the existence of these creatures until we see them."

Nor can any one be blamed for taking this view of the matter. However, right here, the fact should be mentioned that it is not the clear upper portion of the well-water that contains the animal organisms, but that they occur in the lower strata, close to

the bottom of the well and in the mud there. It is especially this mud that must be regarded as the native soil of the different organisms which are to be referred to in the following article; and this at once forcibly calls to our attention the fact that turbid well-water (that is, water which may be suspected of holding mud-particles in suspension) should under no circumstances be used for drinking purposes. Water, clear and sparkling, from a mountain brook, or water drawn from a good well, will, even under a microscope, present nothing that could arouse the aversion of the drinker, or raise doubts as to its desirability from a sanitary point of view.

It is but of late that the attention of naturalists, and especially of zoölogists, has been drawn to the peculiar kinds of animal life which exist in the depths of wells. Credit is due chiefly to Prof. Franz Vejdovsky, in Prague, for calling the attention of scientists to this realm of the animal world. Already many years ago the searching eye of Science had penetrated to the greatest depths of the oceans and inland seas; untiring zeal had discovered interesting phases of animal and plant life in dark caves and grottoes, as well as on the snow-fields of the Alps. But the wells had thus far been left unsearched, and here there still remained a wide field for the explorer, for the making of interesting observations and discoveries.

A peculiar circumstance led to a systematic examination of wells in search for the organisms they might contain. The death-rate at Prague had grown to be very high, and this created in the mind of the public the idea that the condition of the water-supply there was at fault. In 1879 a committee was appointed which was to make a practical investigation into this matter. At the request of this committee, Prof. Vejdovsky has, in a period extending over two years, examined with the microscope the water of more than two hundred wells of the city of Prague, in order to study the noxious organisms suspected of existing therein.

Of course, it is only possible to acquire knowledge of this kind by obtaining a sufficient quantity of mud from the well which is to be examined. This is done by sinking an apparatus especially constructed for the purpose into the well-shaft. The scoop consists of a stirrup made of iron, a foot and a half long and half a foot broad, to which a bag of coarse canvas is attached. This contrivance is fastened to a rope from twenty to thirty metres in length, and, in order that it should sink deep into the mud, a cannon-ball, weighing from eight to ten pounds, is fastened to it at the proper place.

According to the kind of well, the canvas bag is either dragged over the bottom, so that it may gather up the mud, or the rope is jerked up and down; the water is thus stirred up and rendered

turbid, so that in this manner the mud will be caught in the bag on drawing it up to the surface.

In order to make the investigation a thorough one, a small portion of this muddy matter, which generally consists of decaying organic substances, is placed at once under the microscope, and the organisms contained in it are determined. Besides doing this, it is desirable to put a large quantity of the mud, say about one hundred grammes, into a glass jar, which can be closed, and to add some water from the well from which the mud was taken. Then this should be quietly set aside for two or three weeks, in some light spot, where the warm sunbeams can penetrate, so that any eggs or germs present in the water may be destroyed. In this way a great deal may yet be ascertained that could not have been learned at the examination conducted immediately after obtaining the sample.

"But what does the mud from such a well contain?" will be asked by the reader with whom the question what it is that he must guard against is of prime importance. This question is here to be answered. First of all, let a glance be cast at the woodcuts subjoined. Excepting Figs. 6, 7, and 8, the organisms represented are visible only under the microscope, or at least require, in order to be distinguishable, the aid of a powerful magnifying lens. Nearly every particle of well-mud contains the amœbæ pictured in Fig. 1. They resemble drops of flowing liquid, and constantly change their form by sending out ray-like extensions. These extensions of the body are called *pseudopodia*, because their appearance creates the impression that the little animal is possessed of feet. But this is not the case; the pseudopodia (*ps*) are formed only in the moment when a change in location is desired, and they cease to exist when the place is reached which the little animal sought to attain. It can easily be proved that these amœbæ are animals, for they take up solid particles of food, digest the same, and cast out again whatever has not been assimilated. There is no vegetable organism which takes up solid particles into its interior for sustenance. The propagation of the amœba takes place in the simplest manner imaginable, by fission: a large specimen contracts at the center and ultimately divides into two parts, so that the mother-animal is actually rent into halves. In the body-substance of these beings, which are on the lowest plane of organic life, the microscope discloses a number of small particles, and a larger kernel (*k*), which is called the nucleus. Besides this there are yet one or more clear spaces called "vacuoles" (*v*). When fission takes place, the nucleus is also

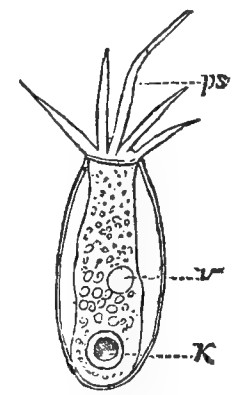


FIG. 1.

divided, and each of the newly formed organisms receives its share. These little beings are particularly entitled to our attention, because each higher organism is also originally evolved from a naked egg-cell, and devoid of any membrane or cuticle.* Moreover, such a cell shows essentially the same simple structure, and moves about in the same manner as the amœba—that is, by the aid of pseudopodia.

Hence the amœbæ are one of the lowest forms of organisms known; they have remained on the lowest plane of development, and, if one accepts, with Lamarck and Darwin, the evolution of the animal world from a simplest beginning, these creatures must be regarded as the original progenitors of all forms of animal life. Of course, every one is at liberty to doubt such progressive evolution of organized beings; but this much is certain, the individual development of each proceeds from a primary state, which is not greatly different from the structure of these amœbæ.

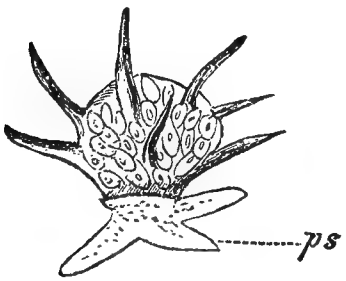


FIG. 2.

Fig. 2 represents a shell-bearing amœba (*Euglypha*), which is also to be found in great numbers in the mud of wells. In this organism the naked sarcode, which consists of a substance similar to albumen, is covered and protected by a membranous envelope, or "carapace," from which, through an opening, the pseudopodia (*ps*) appear. The little organism pictured in Fig. 3 stands in close relationship to the preceding (*Centropyxis aculeata.*) Its shell, made up of diatoms and fragments of small particles of stone, shows thorn-like protuberances.

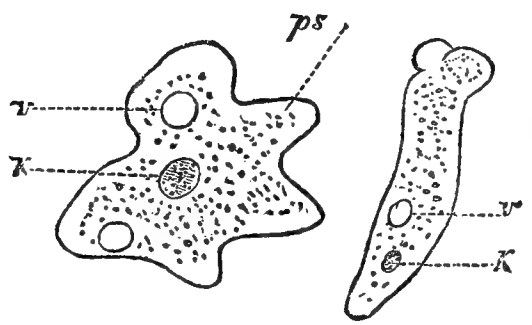


FIG. 3.

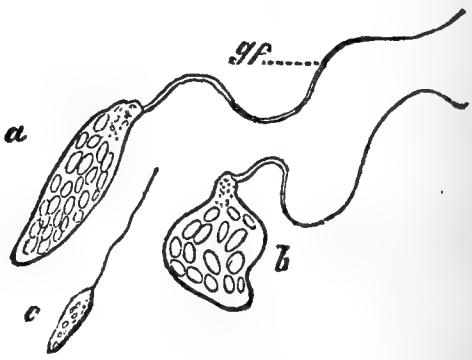


FIG. 4.

Fig. 4 makes us acquainted with the appearance of the flagellate infusoria. These are animals that have a delicate body, which can be contracted, and at one end of which there is a filament (*gf*) which is constantly in motion, and with which certain movements are executed. This filament is in reality nothing else than a long

* Authorities differ on the question as to whether the amœbæ are covered with a membrane or not.—TRANSLATOR.

pseudopodium, which has grown to be permanent, and which has a certain function to exercise, namely, to make motions of rowing and feeling.

Starting with the amœba, the flagellate infusoria represent the next higher phase of morphological differentiation — that is to say, they represent the division of the homogeneous substance of the amœba into distinct parts, to which different functions are assigned. In social science one would allude to this as the commencement of a division of labor.

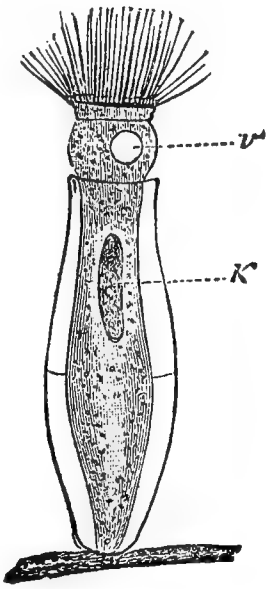


Fig. 5.

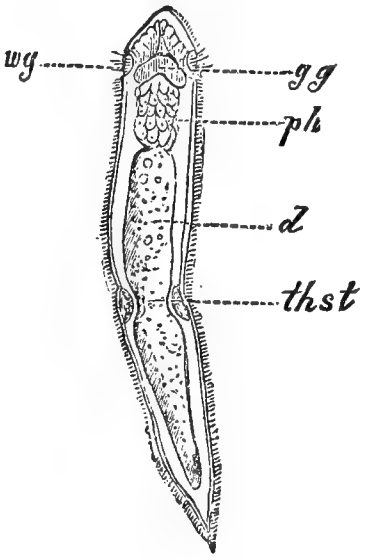


Fig. 6.

Fig. 5 represents an individual belonging to the genus *Cothurnia*, which is very frequently found in the depths of town and country wells. It possesses the power to withdraw with lightning speed into the transparent envelope which surrounds it whenever the cilia which are attached to its front come in contact with anything hard. *K* denotes the nucleus which no infusoria lack, and *v* represents the vacuole, which, however, at times may disappear.

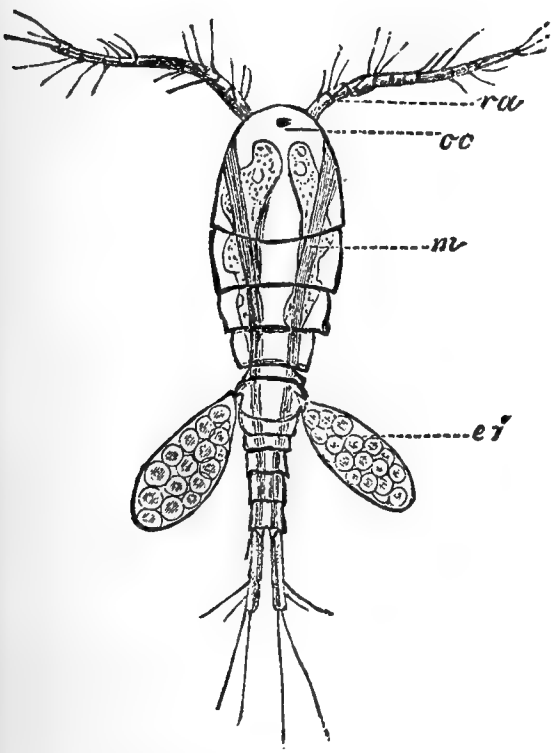


Fig. 7.

Fig. 6 pictures a small creature, the *Stenostonia leucops*, which attains a length of about one millimetre, and which appears to the naked eye like a minute white thread. This kind of worm is of frequent occurrence, and has received its name from the rotary motion which the cilia that are on the surface of its body impart to the water when the animal moves or swims: *g g*, is the nerve-center (brain-ganglion), which is very considerable in proportion to the size of the worm. The mouth is not shown in

the picture, but *p h* is the throat, and this is followed by the sac-like "stomach-intestine," *d*. These worms propagate likewise by simple fission, after a new brain-ganglion has been formed at *th s t*, by the thickening of the two sides. A new mouth is formed by a drawing in of the outer skin. On either side of the head there is a little indentation in which longer hairs are growing. These are probably organs of sense; however, their function has not yet been determined.

Figs. 7 and 8 show a pair of crab-like animals, which are among the regular inhabitants of wells. Fig. 7 is a cyclops; Fig. 8 represents a crustacean, the *Cypris*. The latter is rather a peculiar object, as the animal is inclosed in a shell-like structure, called a carapace, from which only a pair of caudal appendages protrude, which are provided with bristles and serve for the purpose of locomotion; *oc* is the eye.

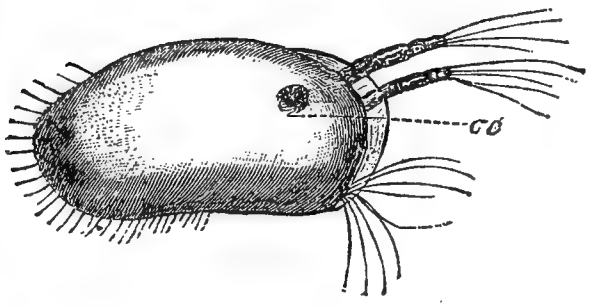


FIG. 8.

A considerable number of species of cyclops are to be found in the mud of wells. Fig. 7 shows the *Cyclops nanus*. This little animal travels rapidly through the water by means of its swimming apparatus, to which the powerful muscles (*m*) lend considerable assistance. The female carries two ovisacs (*ei*) with numerous eggs; *oc*, at the front part of the body, is the eye, which is of a reddish or brown color and possesses a fine lens.

In this article we have enumerated and pictured only the principal representatives of this fauna of the wells, so that a general idea might be gained of the appearance of the animals which live in the turbid water of wells. However, to show how rich in numbers this little animal world is, the fact should be mentioned that Prof. Vejdovsky, after his careful examination of the water of two hundred and thirty-one wells of Prague, was able to announce the existence of—(1) twenty varieties of amœba-like organisms; (2) twelve varieties of flagellate infusoria; (3) forty-five varieties of other infusoria; (4) twenty-four varieties of worms; (5) ten varieties of crustacea—making altogether a total of one hundred and eleven species of organisms. Most of these varieties were found in wells which had been polluted by the infiltration of urine and decaying organic matter. The organisms carried down by the surface water into these lower regions had found abundant food there, and were thus enabled to continue their existence. With regard to the question as to whether the water from wells that show an abundance of these forms of life is dangerous

to health or not, it may be said that the danger of partaking of such water is due, not so much to the presence of the minute infusoria, worms, and crustacea, as to the occurrence of putrefying organic matter which has found its way into these wells and there greatly favors the development of fungi. The intelligent reader will not, therefore, allow the existence of a well-fauna to interfere with his enjoyment in quaffing a cooling draught fresh from the pump; for, as already remarked, the organisms spoken of live only in the lower depths, and as a rule never reach the upper strata of the water.

Should, however, by any accident this normal state of affairs be changed, the turbid appearance of the water would indicate it, and bear at once warning to rather choose water from some other source until the well shall have resumed its normal condition, or shall have been subjected to a thorough cleaning.—*Translated from Ueber Land und Meer for the Popular Science Monthly.*

THE CHINOOK LANGUAGE OR JARGON.

By EDWARD HOLLAND NICOLL.

I WAS about to take a trip up the S——, one of the rivers which flow into Puget Sound. It was early in March, yet the grass was green, the trees were putting out fresh leaves, and the dogwood, salmon-berry, and wild rose were in blossom. The river was swollen by the melting masses of snow on the Cascade Mountains (a prolongation of the Sierra Nevadas), and its waters were rushing rapidly toward the sound. I was considering whether it would be practicable to make headway against the current, when I saw Jack, an Indian, who had been with me on one or two river-journeys, lying lazily in his canoe, enjoying the mild March sun. I went up to him, and our conversation ran thus:

"Klahowya," I said. "Hyas kloshe," replied Jack. "Nika tikegh klatawa kopa chuck; konsi chickamen potlatch?" "Kwinum dollar." "Hyas skookum chuck papet canim?" "Wake hyiu." This is Chinook, and put into English would read: "How do you do?" "Very well." "I want to go up the river." "How much will you give?" "Five dollars." "Will the current make it hard work?" "Not very."

Chinook, a language or jargon, the existence of which few people living east of the Rocky Mountains know of, is the sole medium of communication between the whites and Indians upon the northwest coast of America, from the Columbia River to Alaska, including the tribes scattered over Washington Territory and Oregon. Chinook is a conventional language, and, in this

respect, is like the *lingua franca* of the Mediterranean coast, and the "pidgin" English of the East Indies and China.

A century ago, in the year 1787, two vessels, the Columbia, commanded by John Kendrick, and the Washington, by Robert Gray, left Boston on a voyage to the northwest coast of America, to open up a fur trade, and, if possible, to trade with China. At the rendezvous in Nootka Sound, to the westward of Vancouver Island, which latter is a part of what is now British Columbia, the people on the vessels acquired a number of words used by the natives. The expedition going afterward up the Columbia River to Oregon, they carried these Indian words with them there, which, added to some common and easily pronounced English words, formed the beginning and basis of Chinook. Its vocabulary, however, was scant until the coming of the Astor expedition and the settlement of Astoria. It was then enlarged by numerous English words, together with many of French origin, or of the Canadian *patois*. The dialects of the Chinook and Chehalis tribes, which ranged about southeastern Oregon, furnished many words for its development. The Hudson Bay and Northwest Companies, and the early settlers in Oregon, further added to it; it came into use between Indians of different tribes, and even between Americans and Canadians; it spread to Puget Sound, and found its way, with trade, up the Pacific coast and rivers, as explorers and settlers advanced, gradually spreading until its use reached its present extent.

Chinook is not a written language, and the spelling given here is purely phonetic. Of the five or six hundred words in common use, about one third are of English and French derivation; a few can not be traced to any source, and the rest are taken from the Chehalis and Chinook dialects.

No words beginning with the letter *r* are used; the sound of that letter is modified into that of *l* or *p*, the pronunciation of which is the easier. This matter of pronunciation, and not the impression made upon the ear, seems in all tongues to be the true foundation of euphony. There are no words in Chinook which begin with the letters *f*, *j*, *q*, *u*, *v*, *x*, or *z*; but two begin with *g*, "get up," and "glease" (grease).

Turning to the words derived from the English, we find "bit," meaning dime, the bit being the general designation on the Pacific coast for a ten-cent piece, and "tea," "sun," "short," "papa," "oleman," "musket," "smoke," "man," "soap," "paint," "spoon," etc., all of which need no translation. Rice becomes "lice"; fish, "pish"; fire, "piah"; rum, "lum"; rope, "lope"; cry, "cly"; dry, "d'ly." A cat is "puss-puss."

The first white men with whom the Indians in Oregon associated intimately being those of the expedition under Gray and

Kendrick, from Boston, Americans have always been termed in Chinook "Boston men," while "Boston Illahee" ("illahee," the ground, or earth) stands for the "United States." An Englishman is "King George."

With few exceptions, the words of French origin begin with the letter *l*, that is, the article "le" or "la"; there is no article in Chinook except as found joined or prefixed with these French words. The following are some of the most common: "La pome," apple; "la chaise," chair; "la chandelle," candle; "la table"; "la bal," bullet, ball; "la messe," mass; "la pote," door; "la pois," peas; "diaub" (diable), devil; "marsi" (merci), thanks.

It is impossible, without a knowledge of the two dialects, Chinook and Chehalis, to say what native words in the Chinook jargon belong to each; the Chinook, however, predominates.

Many words have two or more equivalents; as, for example, "chickamen," which means iron, any metal, metallic money; with "dollar," it is silver; "chuck" stands for water, river, stream; "salt chuck" is the sea; "skookum chuck," a rapid; "solleks chuck," a rough sea. "Tum-tum" is the heart, will, opinion. "Mamook tum-tum" means to make up one's mind; "mamook kloshe tum-tum," to make friends or peace. "Polaklie" is night, dark, darkness. "Till" means tired, heavy, a weight. "Wau-wau" is to talk, speak, call, ask, tell, answer, conversation; "cultus wau-wau" is idle talk, nonsense.

Onomatopœia is frequent in Chinook. "Hee-hee," means laughter; "Kah-kah," a crow; "moos moos," a cow; "kal-ak-a-la-ma," a goose; "shwahkuk," a frog; all of these are imitations of natural sounds. These words are native, and their origin is due to the disposition to give an imitative complexion to those words which signify matters recognized by the ear, thus bringing about a similarity between the sign and the thing it stands for. But we have to do here with Chinook, not the "bow-wow theory" of the origin of language.

But few of the verbs are English, though many are formed by prefixing "mamook" to make, or do (native), to an English word; as "mamook pent," to paint; "mamook warm," to heat; "mamook bloom" (broom), to sweep; "mamook wash," to wash. It is a curious fact that neither the verb "to be," nor any of its moods or tenses, are found in Chinook. All verbs are understood wherever necessary in a sentence. There are a number of words which are used indifferently as nouns and verbs, though there are but few which are used solely as verbs.

One form of pronoun answers for the personal and possessive. "Nika" is I and mine; "mika," thou and thine; "yahka," he, his; "nesika" is we, us, ours; "mesika," you, yours; "klaska," they, theirs.

The numerals, probably, are taken from the native tongues, and some of them are as follows: 1, "ikt"; 2, "mokst"; 3, "klone"; 4, "lakit"; 5, "kwinum"; 6, "taghum"; 7, "sinnamoket"; 8, "stotekin"; 9, "kwaist"; 10, "tahtlelum"; 11, "tahtlelum pe ikt"; 20, "mokst tahtlelum"; 100, "ikt tukamonuk."

The missionaries who labor among the natives of the northwest coast from necessity learn Chinook. I once attended a church service in Washington Territory, where, the congregation being made up of Indians, the praying and preaching were both in Chinook. The Lord's prayer is rendered thus:

"Nesika papa klaksta mitlite kopa saghalie, kloshe kopa
"Our father who stayeth in the above, good in
nesika tum-tum mika nem; kloshe mika tyee kopa konaway
our heart (be) thy name; good thou chief among all
tillikum; kloshe mika tum-tum kopa illahee, kahkwa kopa
people; good thy will upon earth, as in
saghalie. Potlatch konaway sun nesika muckamuck. Spose
the above. Give every day our food. If
nesika mamook mesachie, wake mika hyas solleks; pe spose
we do ill, (be) not thou very angry; and if
klaksta mesachie kopa nesika, wake nesika solleks kopa
any one (do) evil toward us, (be) not we angry toward
klaska. Mahsh siah kopa nesika konaway mesachie."
them. Send away far from us all evil."

Any one can acquire Chinook whose memory is retentive enough to enable him to learn a certain number of words; and then, with practice, he will speak it fluently. It is not uncommon to hear young children in Washington Territory and Oregon talk in Chinook as easily as in English.

Many Chinook words have taken root in, and form part of, the Pacific coast vernacular. Some of the most common of these are "tillicum," friend; "tyee," chief, or boss; "kiutan," horse; "muckamuck," food; "cultus," worthless; and "siwash," which is always used for Indian. The motto on the seal of Washington Territory is a word used in Chinook, but native in origin, i. e., "Alki," meaning by-and-by, or in the future.

From what has been said, it will be seen that while Chinook does not rise to the dignity of a language, it is an important factor in every-day life as it exists on the northern Pacific coast. The Indians of that region are peculiar. They get their food easily by fishing, hunting, and gathering the wild roots and berries of the woods. Nomadic bodies hang about the towns and settlements, earning money from the whites in various ways. In a word, they procure their living too readily to develop habits of industry and thrift. The experiment of supporting them on Government reservations, and educating them in useful pursuits, is but partially successful. They become discontented, and long for the freedom

of their life on the sea-coast and rivers. The Indian, too, likes to associate with the white man, from whom, it must be confessed, he learns many of the vices, and but few of the virtues, of civilization. It is not probable that Chinook will fall into disuse for many years to come. Though it is difficult to determine whether or not the native population of this part of our country is materially decreasing at present, the race will, no doubt, in time become reduced to small proportions, and the *raison d'être* of Chinook will gradually cease.

SKETCH OF WILLIAM GRAHAM SUMNER.

WILLIAM GRAHAM SUMNER was born at Paterson, N. J., October 30, 1840. He is the son of Thomas Sumner, who came to this country from England in 1836, and married here Sarah Graham, also of English birth. Thomas Sumner was a machinist, who worked at his trade until he was sixty years old, and never had any capital but what he saved out of a mechanic's wages. He was an entirely self-educated man, but always professed great obligations to mechanics' institutes and other associations of the kind of whose opportunities he had made eager use in England. He was a man of the strictest integrity, a total abstainer, of domestic habits, and indefatigable industry. He became enthusiastically interested in total abstinence when a young man in England, the method being that of persuasion and missionary effort. He used to describe his only attempt to make a speech in public, which was on this subject, when he completely failed. He had a great thirst for knowledge, and was thoroughly informed on modern English and American history and on the constitutional law of both countries. He made the education of his children his chief thought, and the only form of public affairs in which he took an active interest was that of schools. His contempt for demagogical arguments and for all the notions of the labor agitators, as well as for the entire gospel of gush, was that of a simple man with sturdy common sense, who had never been trained to entertain any kind of philosophical abstractions. His plan was, if things did not go to suit him, to examine the situation, see what could be done, take a new start, and try again. For instance, inasmuch as the custom in New Jersey was store pay. and he did not like store pay, he moved to New England, where he found that he could get cash. He had decisive influence on the convictions and tastes of the subject of this sketch.

Prof. Sumner grew up at Hartford, Conn., and was educated in the public schools of that city. The High School was then under

the charge of Mr. T. W. T. Curtis, and the classical department under Mr. S. M. Capron. These teachers were equally remarkable, although in different ways, for their excellent influence on the pupils under their care. There was an honesty and candor about both of them which were very healthful in example. They did very little "preaching," but their demeanor was in all respects such as to bear watching with the scrutiny of school-children and only gain by it. Mr. Curtis had great skill in the catechetical method, being able to lead a scholar by a series of questions over the track which must be followed to come to an understanding of the subject under discussion. Mr. Capron united dignity and geniality in a remarkable degree. The consequence was, that he had the most admirable discipline, without the least feeling of the irksomeness of discipline on the part of his pupils. On the contrary, he possessed their tender and respectful affection. Mr. Capron was a man of remarkably few words, and he was a striking example of the power that may go forth from a man by what he is and does in the daily life of a school-room. Both these gentlemen employed in the school-room all the best methods of teaching now so much gloried in, without apparently knowing that they had any peculiar method at all. Prof. Sumner has often declared in public that, as a teacher, he is deeply indebted to the sound traditions which he derived from these two men.

He graduated from Yale College in 1863, and in the summer of that year went to Europe. He spent the winter of 1863–'64 in Geneva, studying French and Hebrew with private instructors. He was at Göttingen for the next two years, studying ancient languages, history, especially church history, and biblical science. In answer to some questions, Prof. Sumner has replied as follows:

"My first interest in political economy came from Harriet Martineau's 'Illustrations of Political Economy.' I came upon these by chance, in the library of the Young Men's Institute at Hartford, when I was thirteen or fourteen years old. I read them all through with the greatest avidity, some of them three or four times. There was very little literature at that time with which these books could connect. My teachers could not help me any, and there were no immediate relations between the topics of these books and any public interests of the time. We supposed then that free trade had sailed out upon the smooth sea, and was to go forward without further difficulty, so that what one learned of the fallacies of protection had only the same interest as what one learns about the fallacies of any old and abandoned error. In college we read and recited Wayland's 'Political Economy,' but I believe that my conceptions of capital, labor, money, and trade, were all formed by those books which I read in my boyhood. In college the interest was turned rather on the po-

litical than on the economic element. It seemed to me then, however, that the war, with the paper money and the high taxation, must certainly bring about immense social changes and social problems, especially making the rich richer and the poor poorer, and leaving behind us the old ante-war period as one of primitive simplicity which could never return. I used to put this notion into college compositions, and laid the foundation in that way for the career which afterward opened to me.

"I enjoyed intensely the two years which I spent at Göttingen. I had the sense of gaining all the time exactly what I wanted. The professors whom I knew there seemed to me bent on seeking a clear and comprehensive conception of the matter under study (what we call 'the truth') without regard to any consequences whatever. I have heard men elsewhere talk about the nobility of that spirit; but the only *body* of men whom I have ever known who really lived by it, sacrificing wealth, political distinction, church preferment, popularity, or anything else for the truth of science, were the professors of biblical science in Germany. That was precisely the range of subjects which in this country was then treated with a reserve in favor of tradition which was prejudicial to everything which a scholar should value. So far as those men infected me with their spirit, they have perhaps added to my usefulness but not to my happiness. They also taught me rigorous and pitiless methods of investigation and deduction. Their analysis was their strong point. Their negative attitude toward the poetic element, their indifference to sentiment, even religious sentiment, was a fault, seeing that they studied the Bible as a religious book and not for philology and history only; but their method of study was nobly scientific, and was worthy to rank, both for its results and its discipline, with the best of the natural science methods. I sometimes wonder whether there is any one else in exactly the same position as I am, having studied biblical science with the Germans, and then later social science, to mark the striking contrast in method between the two. The later social science of Germany is the complete inversion in its method of that of German philology, classical criticism, and biblical science. Its subjection to political exigencies works upon it as disastrously as subjection to dogmatic creeds has worked upon biblical science in this country.

"I went over to Oxford in the spring of 1866. Having given up all my time in Germany to German books, I wanted to read English literature on the same subjects. I expected to find it rich and independent. I found that it consisted of second-hand adaptation of what I had just been studying. I was then quite thoroughly Teutonized, as all our young men are likely to be after a time of study in Germany. I had not undergone the

toning-down process which is necessary to bring a young American back to common sense, and I underrated the real services of many Englishmen to the Bible as a religious book, exactly the supplement which I then needed to my German education. Ullmann's 'Wesen des Christenthums,' which I had read at Göttingen, had steadied my religious faith, and I devoted myself at Oxford to the old Anglican divines and to the standard books of the Anglican communion. The only one of these which gave me any pleasure or profit was Hooker's 'Ecclesiastical Polity.' The first part of this book I studied with the greatest care, making an analysis of it and reviewing it repeatedly. It suited exactly those notions of constitutional order, adjustment of rights, constitutional authority, and historical continuity, in which I had been brought up, and it presented those doctrines of liberty under law applied both to church and state which commanded my enthusiastic acceptance. It also presented Anglicanism in exactly the aspect in which it was attractive to me. It reawakened, however, all my love for political science, which was intensified by reading Buckle and also by another fact next to be mentioned.

"The most singular contrast between Göttingen and Oxford was this: At Göttingen everything one got came from the university, nothing from one's fellow-students. At Oxford it was not possible to get anything of great value from the university; but the education one could get from one's fellows was invaluable. There was a set of young fellows, or men reading for fellowships, there at that time, who were studying Hegel. I became intimate with several of them. Two or three of them have since died at an early age, disappointing hopes of useful careers. I never caught the Hegelian fever. I had heard Lotze at Göttingen, and found his suggestions very convenient to hold on by, at least for the time. We used, however, in our conversations at Oxford, to talk about Buckle and the ideas which he had then set afloat, and the question which occupied us the most was whether there could be a science of society, and, if so, where it should begin and how it should be built. We had all been eager students of what was then called the 'philosophy of history,' and I had also felt great interest in the idea of God in history, with which my companions did not sympathize. We agreed, however, that social science must be an induction from history, that Buckle had started on the right track, and that the thing to do was to study history. The difficulty which arrested us was that we did not see how the mass of matter to be collected and arranged could ever be so mastered that the induction could actually be performed if the notion of an 'induction from history' should be construed strictly. Young as we were, we never took up this crude notion as a real programme of work. I have often thought of it since when I

have seen the propositions of that sort which have been put forward within twenty years. I have lost sight of all my associates at Oxford who are still living. So far as I know, I am the only one of them who has become professionally occupied with social science."

Mr. Sumner returned to the United States in the autumn of 1866, having been elected to a tutorship in Yale College. Of this he says:

"The tutorship was a great advantage to me. I had expected to go to Egypt and Palestine in the next winter, but this gave me an opportunity to study further, and to acquaint myself with church affairs in the United States before a final decision as to a profession. I speedily found that there was no demand at all for 'biblical science'; that everybody was afraid of it, especially if it came with the German label on it. It was a case in which, if a man should work very hard and achieve remarkable results, the only consequence would be that he would ruin himself. At this time I undertook the translation of the volume of Lange's 'Commentary on Second Kings.' While I was tutor I read Herbert Spencer's 'First Principles'—at least, the first part of it—but it made no impression upon me. The second part, as it dealt with evolution, did not then interest me. I also read his 'Social Statics' at that period. As I did not believe in natural rights, or in his 'fundamental principle,' this book had no effect on me."

Mr. Sumner was ordained deacon at New Haven in December, 1867, and priest at New York, July, 1869. He became assistant to Dr. Washburn at Calvary Church, New York, in March, 1869. He was also editor of a broad church paper, which Dr. Washburn and some other clergymen started at this time. In September, 1870, he became rector of the Church of the Redeemer at Morristown, N. J.

"When I came to write sermons, I found to what a degree my interest lay in topics of social science and political economy. There was then no public interest in the currency and only a little in the tariff. I thought that these were matters of the most urgent importance, which threatened all the interests, moral, social, and economic, of the nation, and I was young enough to believe that they would all be settled in the next four or five years. It was not possible to preach about them, but I got so near to it that I was detected sometimes, as, for instance, when a New Jersey banker came to me, as I came down from the pulpit, and said, 'There was a great deal of political economy in that sermon.'

"It was at this period that I read, in an English magazine, the first of those essays of Herbert Spencer which were afterward collected into the volume 'The Study of Sociology.' These

essays immediately gave me the lead which I wanted to bring into shape the crude notions which had been floating in my head for five or six years, especially since the Oxford days. The conception of society, of social forces, and of the science of society there offered, was just the one which I had been groping after, but had not been able to reduce for myself. It solved the old difficulty about the relation of social science to history, rescued social science from the dominion of the cranks, and offered a definite and magnificent field for work, from which we might hope at last to derive definite results for the solution of social problems.

"It was at this juncture (1872) that I was offered the chair of Political and Social Science at Yale. I had always been very fond of teaching, and knew that the best work I could ever do in the world would be in that profession; also, that I ought to be in an academical career. I had seen two or three cases of men who, in that career, would have achieved distinguished usefulness, but who were wasted in the parish and the pulpit."

Mr. Sumner returned to New Haven as professor in September, 1872. Of the further development of his opinions he says:

"I was definitely converted to evolution by Prof. Marsh's horses some time about 1875 or 1876. I had re-read Spencer's 'Social Statics' and his 'First Principles,' the second part of the latter now absorbing all my attention. I now read all of Darwin, Huxley, Haeckel, and quite a series of the natural scientists. I greatly regretted that I had no education in natural science, especially in biology; but I found that the 'philosophy of history' and the 'principles of philology,' as I had learned them, speedily adjusted themselves to the new conception, and won a new meaning and power from it. As Spencer's 'Principles of Sociology' was now coming out in numbers, I was constantly getting evidence that sociology, if it borrowed the theory of evolution in the first place, would speedily render it back again enriched by new and independent evidence. I formed a class to read Spencer's book in the parts as they came out, and believe that I began to interest men in this important department of study, and to prepare them to follow its development, years before any such attempt was made at any other university in the world. I have followed the growth of the science of sociology in all its branches, and have seen it far surpass all the hope and faith I ever had in it. I have spent an immense amount of work on it, which has been lost because misdirected. The only merit I can claim in that respect is that I have corrected my own mistakes. I have not published them for others to correct."

The above statement of the history of Prof. Sumner's education shows the school of opinion to which he belongs. He adopts

the conception of society according to which it is the seat of forces, and its phenomena are subject to laws, which it is the business of science to investigate. He denies that there is anything arbitrary or accidental in social phenomena, or that there is any field in them for the arbitrary intervention of man. He therefore allows but very limited field for legislation. He holds that men must do with social laws what they do with physical laws—learn them, obey them, and conform to them. Hence he is opposed to state interference and socialism, and he advocates individualism and liberty. He has declared that bimetallism is an absurdity, involving a contradiction of economic laws, and his attacks on protectionism have been directed against it as a philosophy of wealth and prosperity for the nation.

As to politics, he says:

"My only excursion into active politics has been a term as alderman. In 1872 I was one of the voters who watched with interest and hope the movement which led up to the 'Liberal' Convention at Cincinnati, that ended by nominating Greeley and Brown. The platform of that convention was very outspoken in its declarations about the policy to be pursued toward the South. I did not approve of the reconstruction policy. I wanted the South let alone and treated with patience. I lost my vote by moving to New Haven, and was contented to let it go that way. In 1876 I was of the same opinion about the South. If I had been asked what I wanted done, I should have tried to describe just what Mr. Hayes did do after he got in. I therefore voted for Mr. Tilden. In 1880 I did not vote. In 1884 I voted as a Mugwump for Mr. Cleveland. In 1888 I voted for him on the tariff issue."

A distingushed American economist, who is well acquainted with Prof. Sumner's work, has kindly given us the following estimate of his method and of his position and influence as a public teacher: "For exact and comprehensive knowledge Prof. Sumner is entitled to take the first place in the ranks of American economists; and as a teacher he has no superior. His leading mental characteristic he has himself well stated in describing the characteristics of his former teachers at Göttingen; namely, as 'bent on seeking a clear and comprehensive conception of the matter "or truth" under study, without regard to any consequences whatever,' and further, when in his own mind Prof. Sumner is fully satisfied as to what the truth is he has no hesitation in boldly declaring it, on every fitting occasion, without regard to consequences. If the theory is a 'spade,' he calls it a spade, and not an implement of husbandry. Sentimentalists, followers of precedent because it is precedent, and superficial reasoners find little favor, therefore, with Prof. Sumner; and this trait of character has given him a reputation for coldness and lack of what may be

called 'humanitarianism,' and has rendered one of his best essays, 'What Social Classes owe to each other,' almost repulsive in respect to some of its conclusions. At the same time, the representatives of such antagonisms, if they are candid, must admit that Prof. Sumner's logic can only be resisted by making their reason subordinate to sentiment. Prof. Sumner is an earnest advocate of the utmost freedom in respect to all commercial exchanges; and the results of his experiences in the discussion of the relative merits and advantages of the systems of free trade and protection have been such that probably no defender of the latter would now be willing to meet him in a public discussion of these topics."

Prof. Sumner has published "History of American Currency," "Lectures on the History of Protection in the United States," "Life of Andrew Jackson," "Economic Problems," "Protectionism," "Essays in Political and Social Science," and "What Social Classes owe to each other," besides a large number of magazine articles on the same line of subjects.

CORRESPONDENCE.

"CHRISTIAN SCIENCE," "KORESHAN SCIENCE," ETC.

Editor Popular Science Monthly:

AN article appears in your valuable journal for April, page 798, on the subject of "Christian Science." On page 800 an item is given concerning Dr. Teed, of Chicago, in which is stated that said Benedict was a victim of faith-cure, and that C. R. Teed will be called upon to answer criminal charges, etc. I do not know the address of our friend Mr. Fernald, so I can not write him to correct this item. I am personally acquainted with Dr. Teed and the case in question, and I desire to state, in justice to all concerned, that the statement used as an argument by our friend is not true. Dr. Teed is editor of "The Guiding Star." His system of science and philosophy is wholly different in every one of its tenets from "Christian science." He is an eclectic physician, and has had years of practice. He was called to see Mr. Benedict, and gave him medicine. The man died of inflammation of the lungs. Dr. Teed had lately moved from New York to Chicago, and he had not taken out a State license to practice medicine. This was the charge against him. He had a good physician in regular practice in consultation in the case. The man died just as millions of others do. Though both medicine and mind-cure—not "Christian science"—were employed in the case, they both failed. The charges against Dr. Teed were not sustained, and he won the case. I hope you will ask Mr. Fernald to correct this item in his article; at least mail him my statement, and see if he is human enough to undo what he has tried to do—bring reproach on a fine man in fine practice.

Respectfully, R. O. SPEAR.

CITY HOTEL, WAITSBURG, WASHINGTON TER'Y, *April* 1, 1889.

Editor Popular Science Monthly:

As to "Koreshan science" being wholly different from "Christian science," Prof. Spear's authority might seem unquestionable, as he is a graduate of the "Koreshan College," and a writer of "Koreshan" pamphlets. But, to the impartial scientific investigator, this particular hotch-potch of astrology and speculative theology named "Koreshan science" is essentially the same, in whatever *curative action* it may have, as "Christian science," the "faith-cure," and all other varieties of designed or accidental mental healing.

Now to answer the more important part of Prof. Spear's letter. The newspaper report of the Benedict case, from which I quoted, gave more particulars, which I omitted simply to save space. I intended to ask you to print the rest of that report, but I have obtained something better. The physician who was called to see the patient at the last moment has kindly furnished me

the appended account of the matter, which I think will satisfy your readers that I was fully justified in classing this case among the blunders of mental healing.

Very truly yours,

FREDERIK A. FERNALD.

NEW YORK, *May* 8, 1889.

269 CHESTNUT STREET, CHICAGO, *May* 6, 1889.

FREDERIK A. FERNALD, ESQ.

Dear Sir: The man Teed, whom you speak of as doctor, was at the time of Benedict's death the founder and president of the World's College of Life, pastor of the Arch-Triumphant Church, editor of the "Guiding Star," proprietor of a restaurant, etc., all conducted in one or two office-rooms in Central Music Hall. The fellow claimed to be a graduate of the New York Eclectic Medical College, but at the coroner's inquest could not produce a diploma, claiming as an excuse that it was lost. As I remember it, his method consisted in healing by prayer and faith, including absent treatment, all of which was employed in the case of Benedict from the beginning of his illness until about two or three days previous to his death, when medicine was prescribed by an eclectic practitioner whom Teed called to his assistance. At this stage of the case Teed partly or wholly abandoned his system, and also prescribed medicines; but, inasmuch as his knowledge of the pathological conditions which were present, and with which he had to deal, amounted to almost nothing, the treatment was of no avail. According to his statements, made to me the morning of Benedict's death, the patient was regarded as having had diphtheria, pleurisy, intercostal neuralgia, and heart-disease, all existing at one and the same time! The absurdity of such a thing is apparent to almost any one. The *post-mortem* examination proved death to be due to broncho-pneumonia. In my opinion, under proper treatment the case would have recovered. The following is a copy of the verdict of the coroner's jury:

"We, the jury, recommend that one Cyrus R. Teed, who treated and prescribed for the deceased during his sickness without being properly authorized to do so, be held by the proper authorities to the grand jury for violating sections 10, 11, and 12 of an act approved January 16, 1887, regulating the practice of medicine in the State of Illinois; and we furthermore recommend that the penalty for the violation of the above act should be made more severe, so as to include imprisonment in addition to fine, in the future."

In his instructions to the jury the deputy coroner made a few remarks in which he hinted at quacks, impostors, and "voodoo" doctors, and declared that the public was sick of having such frauds running at large.

Respectfully yours,

C. W. LEIGH, M. D.

THE POSITION OF THE AGNOSTIC.

Editor Popular Science Monthly:

WHILE sympathizing heartily with the *spirit* of your editorial article on "Intellectual Liberty," in the May number of the "Monthly," yet it seems to me you have overlooked an application of the word agnostic which it is important that all lovers of truth should recognize. Nay, more, in the words of Nicole, whom you cite with approval, it is "the duty" of the modern thinker to declare himself an "agnostic" in regard to many questions that are still discussed in theological circles.

It is one of the chief merits of the school of philosophy of which Prof. Huxley is so brilliant a member that it distinctly recognizes what Mr. Spencer declares to be "the conviction . . . that has been slowly gaining ground as civilization has advanced," viz., that "human intelligence is incapable of absolute knowledge," and that "our duty is to submit ourselves with all humility to the established limits of our intelligence; and not perversely to rebel against them." Hence, when questions are propounded, to which, *from their nature*, neither an affirmative nor a negative answer can be given, and which do not admit of solution by any natural process, but can only be solved by the acceptance of a supernatural authority—that authority being generally the very question at issue—then it becomes the duty of those who follow the scientific method in their search for truth to declare themselves on all such subjects "agnostics."

Our theological friends occupy much of their time in discussing questions of this character, such as the origin of the universe, the nature and personality of God, the divinity of Christ, the immortality of the soul, and the like. But all these are inscrutable questions, incapable of solution by the human intellect. They have been discussed ever since the dawn of philosophy, and are no nearer solution to-day than when they were first propounded. If settled to any one's satisfaction at all, they can only be so accepted without proof and upon authority. Moreover, there are many questions capable of solution by the scientific method, which theologians discuss only from premises founded upon the supposed solution of the primary questions referred to above. This inevitably prevents their proper discussion and solution. The premises can not be accepted by the scientific thinker who is convinced of the futility of all ontological speculation as a means for establishing the truth. This does not mean—as so many seem to think—that science only concerns itself with those things which can be seen and felt. Nor does it even deny to the individual, who feels that his intellectual and moral integrity can be best conserved by such speculations, the right to indulge in them, and believe in them if needs be. By all means let him do so, if he is made a hap-

pier and a better man by such faith. But let him not upbraid his fellow-man whose faith is not as his is; let him not imagine that truth is entirely on his side; and, above all, let him beware of dogmatism. So "with malice toward none, with charity for all," he may cultivate that openness of mind which a genuine search for truth fosters and intellectual liberty maintains.

I think you will agree with me that much ontological speculation is a distinct loss to sound philosophy, and that there would be a great saving of time and talent if all thinkers accepted and acted upon "the conclusions of Hume and Kant, so well stated by the latter in a sentence" quoted by Prof. Huxley:

"The greatest and perhaps the sole use of all philosophy of pure reason is, after all, merely negative, since it serves, not as an organon for the enlargement (of knowledge), but as a discipline for its delimitation, and, instead of discovering truth, has only the modest merit of preventing error."

ROBERT MATHEWS.

ROCHESTER, N. Y., *May* 3, 1889.

EDITOR'S TABLE.

THE CLAIMS OF "CHRISTIAN SCIENCE."

WE print in this number of the "Monthly" a defense of "Christian science," and an explanation is due our readers for the appearance of such a paper in the pages of a scientific journal. Our April issue contained a carefully prepared article, which aimed to give a just statement of the claims and the results of "Christian science." The writer of that article had good authority for all his statements, and his only purpose was to tell the truth about the new theory. Notwithstanding his efforts in respect to fairness, he is charged, in the reply which we publish, with the most ignorant misrepresentation of the doctrine. We do not concede the truth of this charge, but we print Mr. Bailey's exposition for two reasons: first, to remove all possible ground for the charge of one-sidedness; and, second, to give our readers a fuller idea of what kind of stuff "Christian science" is. Of the half-dozen replies sent us we selected for publication the one that came from the most authoritative source—from the editor of "The Christian Science Journal"—although it was the only one of the whole number which did not explicitly concede the honesty of purpose of Mr. Fernald's article. The reader will observe in the reply frequent quotations from Mrs. Eddy's book, "Science and Health," which, being written by the inventor of the doctrine, is generally accepted as the authoritative expression of the tenets of the sect. Reference to Mr. Fernald's article will show that his statement of the claims of "Christian science" was based upon quotations from exactly the same source, and hence is no more open to the objection of being a "fanciful representation" than is the exposition of Mr. Bailey.

If a doubt remained in the mind of any reader as to whether this doctrine deserves the name of "science," it must be destroyed by Mr. Bailey's article. This writer defines man as "a state of consciousness," comprising, first, the impressions received through the five senses, and, second, "the impressions of Spirit." He asserts that sense-impressions can be kept out of consciousness by these other impressions, and hence that the former are unreal and not to be trusted. This is a good sample of the jumping at conclusions which passes among "Christian scientists" for legitimate induction. The pretension that the senses are "unreal," and that their "testimony can not be true," is too absurd for serious discussion. Nobody who has either any knowledge of science or any plain common sense can accept it—even the "Christian scientists" do not themselves believe it. We venture to say that Mrs. Eddy governs her actions by her sense-impressions a thousand times a day. She would not step off from the

top of her house distrusting the testimony of her eyes that it was a long way to the ground; she would not eat food which her sense of taste told her was unfit to eat; nor remain on a railroad-track when her hearing told her that a train was coming. It is absurdly illogical to trust the senses in such cases, and to refuse to trust them in the precisely parallel cases when they testify to a headache, or the inflammation of a joint, or the presence of a malignant tumor. Our senses are occasionally deceived by close resemblances, but with these exceptions the experience of every day of our lives embraces a countless host of instances in which we find it safe to trust our senses. All the observations which furnish the material of science are made by the senses, and any doctrine which denies the trustworthiness of the senses certainly is not science, whatever else it may be. "Christian science" makes itself ridiculous by strutting about in the borrowed plumage of a system whose data and method it affects to despise. The application of the name of science to this vague metaphysical doctrine is utterly unwarranted. In trade, art, politics, religion, and every other field in which wealth or fame can be achieved, spurious articles are being palmed off continually under the name of something else which enjoys a well-earned repute. Especially has there been of late years an eagerness to tack the name of science on to all sorts of schemes and theories which have no particle of right to the designation, in order that they may share its glory and gain the aid of its prestige.

Mr. Bailey claims that "Christian science" has been vindicated by numerous successes in healing disease. Many persons with various complaints have been subjected to "Christian science" treatment and have ceased to complain. From this he infers not only that the treatment cured them, but also that all these grotesque notions about "the impressions of spirit" and the falsity of the senses must be true. As was shown by the contributor to our April number, it is not necessary to accept the "Christian science" theory in order to explain the process of mental healing. When there is any real effect, it is due to the stimulating influence exerted upon the patient's mind, and it makes no difference whether the stimulus is truth or error, if the patient only is stirred up by it. The alleged results of "Christian science," and the number of its believers, have been paralleled by many delusions which have had their day and then disappeared. Mesmer was a greater prophet in his time than Mrs. Eddy. Mesmerism had its host of cured patients, many of them very worthy persons, who gave enthusiastic testimonials to its efficiency and truth. Spiritualistic healers have paraded their alleged cures, and have argued for their doctrine as persistently as the "Christian scientists," but they have never gained any scientific standing. Every other absurd quackery that bids for the dollars and homage of the ignorant multitude has the same sort of indorsements, but time and science deal mercilessly with all alike. Witchcraft and diabolic agency have been wide-spread and eminently reputable doctrines, but they have ignominiously fallen beneath the attacks of scientific investigators. The reader will find in a note to Dr. White's article in our present issue some of the leading authorities which have combated these myth-making and wonder-mongering agencies. A comparison of one of these books with "Science and Health" will show the difference between a scientific and a visionary treatment of a subject. Mrs. Eddy's book, as shown in the extracts which Mr. Bailey gives, is an incomprehensible, because meaningless, mass of rant and rubbish, consisting of capricious inferences from scanty facts, of far-fetched analogies, of hysterical appeals to sentiment, and fanciful twisting of language. The fact that such a baseless speculation as

"Christian science" can find believers shows that what is referred to in our other editorial as the fancy of the multitude for theories which save them trouble and minister to their love of the marvelous has not yet disappeared from the world. The fascination for holding odd notions seems to be a weakness of the human mind which is hard to eradicate. Such beliefs have been pretty well driven out of chemistry, physics, zoölogy, and other fields of science which can be searchingly investigated, and they remain only in psychology and medicine, dealing with the living human organism, which can not be freely experimented upon. Human credulity has been greatly lessened by the march of scientific enlightenment, and what remains has taken on a new form. In earlier times it delighted in the supernatural, now it revels in its own false ideas of the natural. Then it trusted the revelations of self-appointed prophets, now it pins its faith to the slipshod reasoning of sham investigators. Science has done such wonderful things of late that a certain class of people, including many of excellent judgment in other fields, has come to believe any marvels put forth under its name. Hence we have a modern class of mystery-mongers which will flourish until the spread of scientific culture has diffused the power of discriminating between science and base imitations of science.

DR. ABBOTT'S DEFENSE OF THE DEVIL-THEORY.

REPLYING to our recent article on "The Devil-Theory," Dr. Lyman Abbott says that he objects to it because it is "unscientific." Will the reverend doctor allow us to say that we object to his article because it is evasive? It is evasive, in the first place, because, though he declares our position to be unscientific, he does not attempt to show in what way, but leaves his readers to discover it for themselves, as he expresses it, "between the lines." It is evasive, in the second place, because it does not attempt to defend the particular version of the devil-theory put forward by the doctor in his "Sunday afternoon" discourse and criticised by us; but, without a word of warning or apology to the reader, cleverly switches that version away and substitutes a completely different one. It will be remembered that the view which Dr. Abbott advocated, in the essay to which we referred, as being most in harmony both with reason and with Scripture was that the victims of devil possession were unhappy creatures who, by a long course of sin, had virtually lost control of themselves and were compelled to act as they might be moved by the malign spirit or spirits to whom they had "voluntarily" surrendered themselves. We pointed out that this was not in harmony with Scripture, which nowhere dropped the slightest hint that the possessed were other than the involuntary and helpless victims of their diabolical persecutors. One would have expected some notice by Dr. Abbott of this direct challenge of the "Scriptural" character of his teaching; but no, not one word have we on this point in his last deliverance in the "Christian Union." We are treated instead to a reproduction of something written by him twenty years ago, which, as he says, expresses perfectly the opinions he holds to-day. What, then, is the drift of the resuscitated article? The reader may judge by a few extracts:

"It may be confidently asserted that, if there are no cases of demonstrable demoniacal possession in modern times, there are mental phenomena which the hypothesis of such possession better solves than any other. What more reasonable explanation has science to afford of the case of that nurse who begged to be dismissed from her mistress's service because, in undressing the child whom she devoutly loved, an almost irresistible passion seized her to tear it to pieces; or that young girl who, otherwise exemplary, seemed to herself to be im-

pelled by a spirit to acts of incendiarism; . . . or that distressed chemist, of a naturally amiable character, who went to an asylum that he might be prevented from indulging in a propensity to kill some one; or that respectable old lady who endeavored to strangle her own daughter?" etc., etc.

But, if these are types of devil possession, what becomes of the theory recently advanced by Dr. Abbott that a devil "never becomes the possessor of a human soul except by its own gradual and voluntary subjection to his hateful despotism"? As an honest man, the doctor will have to admit that the facts marshaled in his article of twenty years ago were destined to support a view *the direct opposite of that which we criticised*—the view, namely, that diabolical agency may be most reasonably assumed when, the general character being sound, some morbid or criminal propensity for which no natural cause can be assigned is manifested in one particular direction. He says he holds the same views now; and yet, the other day, he took up the entirely irreconcilable position that, before the fiend could do anything with a human being, there had to be a "gradual, voluntary" yielding to his infernal suggestions. Dr. Abbott says that he does not "maintain the doctrine of demoniacal possession upon theological grounds"; but surely if he maintained it at all as a sincere, independent conviction, he could hardly put forward two so directly contradictory views without being aware of the contradiction. Will not the doctor say which of the two theories it is he really holds? Is the presence of the devil to be argued from the general excellence of character of those who, in some one respect, are urged by an inexplicable impulse to crime? Or is it the other way—does the fiend simply in the end claim, as it were, his due from those who have "gradually and voluntarily" surrendered themselves into his hands?

Leaving our respected opponent to make his election between the above two views, both of which he singularly professes to maintain, let us, from our own point of view, briefly inquire what light the devil-theory throws either upon the phenomenon of morbid impulses or upon that of hardened, habitual iniquity. If it is a devil who besets an amiable chemist or a respectable old lady, when one or the other wishes to commit some senseless act of violence, the only remedy would seem to be exorcism, which, however, there is reason to fear, is a lost art—outside, at least, of the Roman Catholic Church. But it is perfectly known to Dr. Abbott, as to every one else, that these morbid influences do, more or less, yield to various curative measures in which exorcism has no part whatever. If evidence on this point is wanting it is supplied in the further article we print in our present number from the pen of Dr. Andrew D. White. To know the cause of an evil ought to be a great help to the discovery of a cure, provided the cause is a natural one; but of what assistance would it be to any one to know that his friend or neighbor was afflicted with a devil, if there were no devil-chaser accessible? On the other hand, what mischief might not be wrought by the assumption of a supernatural cause, if the cause were really natural, and therefore, possibly, removable by natural means? We doubt very much whether Dr. Abbott has sufficiently reflected on the mischief he may be doing in encouraging people to believe in devils, instead of urging them to a patient, untiring search after the natural causes and appropriate remedies of all ills, bodily and mental. In this great controversy a man of Dr. Abbott's intelligence ought to be on our side. We would respectfully call upon him to probe his conscience, and ask whether he is really being just to himself, or doing the world a service, by inciting his readers and hearers to attribute to Satanic agency every manifestation of evil that they can not

clearly trace to a natural cause. He knows as well as we do the general inertness of the human mind, and how readily multitudes abandon the search for natural causes in favor of supernatural explanations that, in their eyes, have the double merit of saving them trouble and ministering to their love of the marvelous. Is this a disposition that a man of culture should set himself to aggravate and render more potent for the fabrication of mischievous illusions? That is what Dr. Abbott is now doing, however, and we scarcely understand how he can be blind to the fact.

The other hypothesis—that after a gradual and voluntary subjection of the nature to sin in some form or other the individual passes under the power of a fiend—errs in the direction of superfluity. If Dr. Abbott should elect to stand by this view of the matter, and, in spite of his very recent indorsement, to dismiss his theory of twenty years ago about amiable and respectable people becoming the victims of diabolical possession, we should then only have to ask him how he distinguishes between slavery to a devil and that slavery to evil propensities long indulged which the world has for ages recognized as a familiar and deplorable phenomenon. The devil in this case seems to be a fifth wheel to the coach, and even worse than a fifth wheel; for it is hard to see how the weight of the vehicle is going to be made to rest, in the slightest degree, on so unnecessary an adjunct.

LITERARY NOTICES.

NATURAL INHERITANCE. By FRANCIS GALTON. London and New York: Macmillan & Co. Pp. 259. Price, $2.50.

THE name of the author of this work is identified with studies of problems that lie at the base of the science of heredity, more closely, perhaps, than that of any other who has written upon the subject. Upon it he has published five books and fifteen memoirs and review articles, the earliest of which appeared in 1869. That work, which covered the subject of "Hereditary Genius," could only have been the fruit of long-continued, careful studies, such as Mr. Galton is still pursuing, but under more and more methodized forms. This volume contains the more important of the results of these continued researches, set forth in an orderly way, with more completeness than has hitherto been possible, together with a large amount of new matter. The inquiry relates to the inheritance of moderately exceptional qualities by brotherhoods and multitudes rather than by individuals. Among the problems to be dealt with to which particular attention is called are the one that refers to the curious regularity observed in the statistical peculiarities of populations during a long series of generations, in which certain marks that may not recur prominently in the groups most closely related to one another, appear most distinctly through the whole; the average share contributed to the personal features of the offspring by each ancestor severally; and the nearness of kinship in different degrees. The discussion is opened with an account of the processes in heredity, in which a distinction is marked between natural and acquired peculiarities, and family likeness and individual variation, latent characteristics, blending and mutually exclusive heritages, and petty influences are considered. The man being usually one twelfth larger than the woman, a rule is found for transmuting female into male measures so as to fix a uniform standard, applicable to either sex. The term "particulate inheritance" is defined as relating to the bits of elements which we inherit from this progenitor and that, and as covering the incalculable number of small and mostly unknown circumstances that influence our development. In a chapter on "Organic Stability" the effort is made to show, by familiar illustrations from common things, how types may come about and be perpetuated; how "sports" may suddenly appear and then endure; and, from this, that evolution is not by minute steps only, but may occur by jumps. The account of the method by which the author's "schemes" and his rules for estimating the value of his results were prepared is minute and exact, hard as a mathematical demonstration to follow, but, like a mathematical demonstration, clear

when the processes are matured. By it is deduced an equation suggesting a theory of descent, to be applied in the subsequent investigations. The investigations were made by the aid of experiments on sweet peas (the sizes of the peas of a crop), and on moths bred for the purpose, and of about a hundred and fifty family records. The records, of course, include facts relating to a vastly larger number of persons. The chief subjects to which they relate are stature, eye-color, temper, the artistic faculty, some forms of disease, marriage selection, and fertility. The item of stature offers many advantages in the study—from the ease and frequency with which it may be measured and its practical constancy during many years, from the fact that it is not a simple element, but is the sum of the accumulated lengths or thicknesses of many bodily elements, and because its discussion need not be entangled with considerations of marriage selection, and its variability is normal. To the inheritance of stature each mid-parent (median between the two parents) contributes an influence marked as one half, each individual parent one quarter, and each individual grandparent one sixteenth. A like hereditary relation is found to exist between the man and his ancestors in the matter of eye-sight. In point of the artistic faculty, highly artistic people intermarry, while moderately artistic people do not so usually, because, "A man of highly artistic temperament must look on those who are deficient in it as barbarians; he would continually crave for a sympathy and response that such persons are incapable of giving. On the other hand, every quiet unmusical man must shrink a little from the idea of wedding himself to a grand piano in constant action, with its vocal and peculiar social accompaniments; but he might anticipate great pleasure in having a wife of a moderately artistic temperament, who would give color and variety to his prosaic life. On the other hand, a sensitive and imaginative wife would be conscious of needing the aid of a husband who had enough plain common sense to restrain her too enthusiastic and frequently foolish projects." And *vice versa*. Of the problem as related to disease, the author observes: "The vital statistics of a population are those of a vast army marching rank behind rank, across the treacherous table-land of life. Some of its members drop out of sight at every step, and a new rank is ever rising to take the place vacated by the rank that preceded it, and which has already moved on. The population retains its peculiarities, although the elements of which it is composed are never stationary; neither are the same individuals present at any two successive epochs. In these respects a population may be compared to a cloud that seems to repose in calm upon a mountain plateau while a gale of wind is blowing over it. The outline of the cloud remains unchanged, although its elements are in violent movement and in a condition of perpetual destruction and renewal. . . . Both in the cloud and in the population there are continual supply and in-rush of new individuals from the unseen; they remain awhile as visible objects and then disappear. The cloud and the population are composed of elements that resemble each other in the brevity of their existence, while the general features of the cloud and of the population are alike in that they abide." One of the striking facts disclosed in the classification of the diseases of each family is their great intermixture. We know very little about the effects of such mixture, how far they are mutually exclusive, and how far they blend; or how far, when they blend, they change into a third form. Owing to the habit of free intermarriage, no person can be exempt from the inheritance of a variety of diseases, or of special tendencies to them. While death by mere old age and failure of vital powers appears common, it is not found, as a rule, that the children of persons who die of old age have any marked immunity from specific diseases. Applying the inquiry to consumption, the law of heredity found to govern the other faculties examined appears to govern that of liability to this disease also, although the constants of the formula differ slightly. It is not possible that more than one half of the varieties and number of each of the parental elements, latent or personal, can, on the average, subsist in the offspring; for a calculation based upon the supposition that they can all be conveyed would soon lead into absurdities. But if the personal and latent elements are transmitted on the average in equal numbers, it is difficult to suppose that

there can be much difference in their variety. Mr. Galton's inquiries, as a whole, can be hardly regarded as more than pioneer work, the determinate and accurate results of which have yet to be brought out. The conclusions, he remarks, "depend on ideas that must first be well comprehended, and which are now novel to the large majority of readers, and unfamiliar to all. But those who care to brace themselves to a sustained effort, need not feel much regret that the road to be traveled over is indirect, and does not admit of being mapped beforehand in a way they can clearly understand. It is full of interest of its own. It familiarizes us with the measurement of variability, and with curious laws of chance that apply to a vast diversity of social subjects. This part of the inquiry may be said to run along a road on a high level, that affords wide views in unexpected directions, and from which easy descents may be made to totally different goals from those we have now to reach."

THE CRITICAL PERIOD OF AMERICAN HISTORY. 1783–1789. By JOHN FISKE. Boston: Houghton, Mifflin & Co. Pp. 368. Price, $2.

ON hearing the news of the treaty which ended the Revolutionary War, Thomas Paine stopped the publication of "The Crisis," declaring, "The times that tried men's souls are over." So far from this being the case, Prof. Fiske says, "The most trying time of all was just beginning. It is not too much to say that the period of five years following the peace of 1783 was the most critical moment in all the history of the American people." The American commonwealth was then a tender plant, beset by many and varied dangers, and only the most judicious management could have preserved its life until it had taken firm root. Prof. Fiske in his first chapter recounts the negotiations at Paris in 1782 and 1783 in regard to the treaty of peace, giving especial attention to King George's troubles with his successive cabinets, and their bearing on the questions at issue. This is followed by a survey of the changes in forms of government, and in regard to the succession of property, slavery, and church establishment made by the thirteen commonwealths in consequence of obtaining independence of England. The next two chapters tell of the obstacles thrown in the path of Congress by the discontent of the unpaid army; by the unwillingness of the people to pay taxes for the support of the General Government, or to pay their debts to British creditors; by their jealousy of any semblance to royal power or hereditary privilege; by the commercial hostility between the States, and State quarrels over conflicting boundary claims; by the poverty of the country and the confusion of the currency —until finally insurrections in some of the States forced upon a majority of the people the conviction that something must be done, and done quickly. The author then shows how a spirit favorable to strengthening the national Government grew out of various occurrences. One of these was the settlement of the conflicting claims of the States to lands west of the Alleghanies by the surrender of all these claims to the United States; another was a difficulty with Spain in regard to the navigation of the lower Mississippi. The convention which drew up the new Constitution was led up to in a most cautious way. "At first," says Prof. Fiske, "it was to be just a little meeting of two or three States to talk about the Potomac River and some projected canals"; then commissioners from all the States were invited to be present and discuss some uniform system of legislation on the subject of trade; and, finally, the plan for a convention to devise provisions "to render the Constitution of the Federal Government adequate to the exigencies of the Union" was officially adopted by Congress.

The story of the work done by the Federal Convention forms the chief chapter of the volume, and is told in a way to show the interactions of the opposing and diverging forces whose resultant was the Constitution of the United States. Then follows an account of the discussion and ratification of the document by the several States, and the election and inauguration of Washington as President, and the critical period of American history was safely passed. Prof. Fiske offers his book to the student of American history, not as a complete summary of the events of the period which it covers, nor as a discussion of the political questions involved in them, but rather as a grouping of the main facts in such a way as to bring out their causal sequence.

THE PLAYTIME NATURALIST. By Dr. J. E. TAYLOR, F. L. S., Editor of "Science-Gossip." With 366 Illustrations. New York: D. Appleton & Co. Pp. 287. Price, $1.50.

No better statement of the scope and spirit of the "Playtime Naturalist" can be given than by quoting its preface entire. It is as follows: "The writer of this book has a liking for intelligent English lads, just as some people have for blue china and etchings. He ventures to think the former are even more interesting objects. And, as the writer was once a boy himself, and vividly remembers the never-to-be-forgotten rambles and observations of the objects in the country; and, moreover, as he treasures up such reminiscences as the most pleasant and innocent of an active man's life, he thought he could not do better than enlist this younger generation in the same loves and the same pleasures. He has endeavored to do his best for his human hobbies, and hopes their lives may be richer and sweeter and more manly for what he has introduced them to in the following pages."

The book is a story of the collecting done by the boys of "Mugby School," and its style may be seen in the section relating to fish-scales, published in the May number of this magazine. There is a delightful chapter early in the volume entitled "Among the Birds," and this is followed by a fascinating account of moth and butterfly collecting. A variety of insects of land and water, land shells, frogs, newts, etc., and microscopic animals and plants, receive attention in turn. The descriptions are accompanied by an abundance of illustrations, which aid in identifying the creatures described, and add much to the attractiveness of the volume. No book better adapted to arouse a love of nature in the young has been published in a long time.

AN ELEMENTARY TEXT-BOOK OF CHEMISTRY. By WILLIAM G. MIXTER, Professor of Chemistry in Yale University. New York: John Wiley & Sons. Pp. 459. Price, $2.50.

THE author states as the aim of this book, to enable the student to grasp the fundamental principles of the science, and at the same time to learn something of the chemistry of common things. The work is adapted to students of college age. The "periodic classification" has been made the basis of arrangement. The acidic and basic groups are treated alternately in order to discuss bases and salts early in the course, as well as to give constant variety to the character of the experiments performed. Compounds of the rare elements are described, to make evident the reasons for the classification, and also to serve as a basis for the summaries of the groups. Graphic and constitutional formulas are much used. The reasons for a number of constitutional formulas are given, and, in case of compounds whose constitution is not understood, care is generally taken to state that the constitutional formulas employed are assumed from analogy. Considerable matter intended for reading rather than recitation is distinguished by small type. The volume is introduced by a short chapter on the physics of chemistry, which includes an account of crystallography and of the laws of gases. Detailed directions for experiments, and a large number of figures of apparatus, are given. Much pains is taken to show the relationship between the members of each group by means of summaries. Presentations of chemical principles are scattered at intervals through the book.

NATURE AND MAN. ESSAYS SCIENTIFIC AND PHILOSOPHICAL. By WILLIAM B. CARPENTER, with an Introductory Memoir by J. ESTLIN CARPENTER. New York: D. Appleton & Co. Pp. 483. Price, $2.25.

THE fifteen essays contained in this volume represent chiefly the latter phases of Dr. Carpenter's thoughts on the problems concerned with the interpretation of nature and man. He believed some of the conclusions which they embody to be of high importance in the guidance of life. They were the result of long observation, and in some cases differed widely from the ideas which his early education and his first studies had led him to adopt. Mr. J. Estlin Carpenter undertakes in the "Memorial Sketch" to indicate some of the processes which contributed to this change, and to present briefly the connection between Dr. Carpenter's varied work and the personality from which his many-sided energy flowed out. An interesting and instructive delineation is given of the various phases which Dr. Carpen-

ter's views, particularly those bearing upon the relations of theological and scientific thought, underwent in the course of his transition from strict teleologism to the full acceptance of the theory of evolution. He received his early education under the superintendence of his father, a Unitarian minister, who was accustomed to insist in his teaching on the importance of bringing the reasoning powers to bear upon observed facts—a principle which the philosopher applied well in his after-studies. In his sixteenth year he became interested in Mr. Exley's "New Theory of Matter," a book devoted to showing that "all the attractions of gravitation, cohesion, electricity, chemical, magnetic, etc.," can be explained upon the same principles. It was a first attempt to demonstrate the correlation of forces. While Dr. Carpenter was active in prosecuting his physiological investigations, and had already touched upon the similarity in the character of the laws regulating vital and physical phenomena, the affairs of his religious society obtained a nearly equal share of his interest. He cultivated music, particularly organ music, with great assiduity. With this taste, and partly directing it, perhaps, was associated the preparation of a collection of psalm-tunes for his little chapel at Edinburgh. His adherence to the Unitarian faith barred him from a professorship in the university, for which he desired to be a candidate. When he had removed from Edinburgh, he felt the loss of public worship more than any other inconvenience of his situation, and wished he could be back at his old post, where he could take his part in leading the "devotional feelings of the congregation." When the "Vestiges of Creation" appeared, a few of its conceptions were found to be so similar to thoughts that he had expressed, that some readers attributed it to him; but he was not prepared to accept the main doctrine of that book, and answered it by saying that, as we had scriptural authority for believing that the Creator formed man out of the dust of the earth, he must confess his predilection for believing that the Creator had at some period "endowed certain forms of organic matter with the properties requisite to enable them to combine at the fitting season into the human organism"—rather that that we are descended from a chimpanzee. He taught that a common designed plan reigned in the evolution of the solar system, of human forms, and of the entire organic world; believed thoroughly in the reality of miracles; and held that man is accountable to the Creator for all his acts, even those that are really God's own. While this was going on, his views concerning the correlation of forces were taking more definite shape, his studies of the nervous system were becoming expanded and leading him to modified opinions concerning the will and moral responsibility. When Darwin's "Origin of Species" appeared, "he was well fitted to appreciate the general argument," for he had long thought on the subject of modification by descent, and while he had rejected the theory of the "Vestiges," "it had been on the grounds of insufficient evidence and physiological error, not from theological prepossession." He had written to his brother Russell in 1874, that one of his great desires was "to be of some use as a mediator in the conflict which has now distinctly begun between science and theology. I see quite clearly that it is of no use to try to grapple with the subject unless one thoroughly masters the question on both sides." His views on the questions raised by Darwin's theory are specifically expressed in a semi-autobiographical article on "Darwinism in England," which he published in Malta in 1881, and which is given in Mr. Estlin Carpenter's "Memorial." His theological views were disturbed by this course of thinking, but he wrote in a letter: "I believe that these difficulties are a necessary result of the habits of thought which have been growing up with me; and, as they never obscure my view of duty, I find it better not to trouble myself too much about them, but to apply myself to the business of the time." Through these difficulties, Dr. Carpenter, we are told, "after no long interval, worked his way. The strong religious needs of his nature found their satisfaction in the view of the world depicted in the later essays in this volume." Of the essays in the present collection, five relate to physiology, the brain, muscular movement, and force; three, to man as the interpreter of nature, the psychology of belief, and the "Fallacies of Testimony in Relation to the Supernatural"; two, to human automatism; one, to "The

Deep Sea and its Contents"; four, to "The Force behind Nature," "Nature and Law," "The Doctrine of Evolution in its Relations to Theism," and "The Argument from Design in the Organic World." The list of Dr. Carpenter's writings contains two hundred and ninety-three titles.

THE PLANTATION NEGRO AS A FREEMAN. By PHILIP A. BRUCE. "Questions of the Day Series." No. LVII. New York: G. P. Putnam's Sons. Pp. 262. Price, $1.25.

THE estimate of negro character which prevails in the Northern States, where negroes are few, has been more influenced by knowledge of the wrongs which the race has suffered than by acquaintance with the actual habits of the black people. Mr. Bruce's volume will dispel any too ideal view of the black race which the reader may hold. It is a very thorough presentation of their mental and moral traits, as exhibited in all the important relations of life, based upon observations of the author extending over a long series of years since emancipation, in "Southside Virginia," a region containing a colored population of about two hundred and fifty thousand. Mr. Bruce represents the negro as a careless and capricious parent, as being decidedly lax in regard to the marriage tie, as depending on firm management for his value as a servant, and as humble or impertinent in demeanor toward the whites according to the way he is treated. His crimes are of the impulsive class—he is not a cool and calculating villain. As a voter he is easily led astray, and is becoming readily purchasable. His religion is emotional, and has but little influence on his conduct. He is highly superstitious, and has great faith in the trick doctor. The author thinks that the ordinary sort of education furnished the negro hurts him in some ways, as well as helping him, and that a system modified so as to be adapted to his character would be much more of a benefit. About the same that was said of the black as a servant applies to him as a farm laborer. He delights to own or rent land, but his laziness makes him an undesirable tenant. As a mechanic he is generally only a helper. Mr. Bruce regards the negro not as being essentially depraved, but as having many unfortunate weaknesses, and this opinion dominates the view as to the future of the race which he gives in the closing chapter. He regards the proper solution of the negro problem as a matter of profound solicitude to a large and important part of our country.

A MANUAL OF INSTRUCTION IN THE PRINCIPLES OF PROMPT AID TO THE INJURED. By ALVAH H. DOTY, M. D. New York: D. Appleton & Co. Pp. 224. Price, $1.25.

IN order that the subject of this volume may be well understood, it is essential to know something of the construction of the human body and the functions of the different organs. For this reason the author devotes about a third of the volume to anatomy and physiology. Coming to the application of this knowledge, he describes the use of roller bandages, of four-tailed, square, triangle, and cravat bandages; of slings, compresses, and tampons; also the tying of knots, the making of poultices, and the application of moist and dry heat. Half a dozen pages are devoted to antiseptics and deodorants. The various forms of injury are then described, and the proper treatment for each is stated. Under wounds, the bites of dogs and snakes are included. The chapter on hæmorrhage contains a diagram showing the position of the important arteries, and a cut of a suspender so devised as to be especially useful in case of emergency for constricting a bleeding limb. The use of various articles likely to be at hand as temporary splints and slings in cases of fracture is described. A variety of injuries, many of them involving unconsciousness, receive due attention. Among these are burns, frost-bite, fainting, stunning, intoxication, fits, hysteria, and heat-stroke.

In the treatment of drowned persons, three methods of artificial respiration are given, with figures. There is a chapter on poisons, and another in which a variety of injuries and affections are treated, including convulsions of children, bed-sores, chafing, etc. The last chapter is on transportation of the patient, either with or without a litter, manufactured or extemporized, and includes by permission that part of the "Manual of Instruction for Hospital Corps, U.S.A." which relates to transportation of the wounded, with the cuts. The author states that special effort has been made to so arrange the matter and to introduce such points as

will make the book of use to the ambulance corps connected with the different military organizations. He has endeavored to explain each topic in a simple manner, and when medical terms are used their lay synonyms are also given. Numerous illustrations have been inserted to aid in making the work readily intelligible.

THE INSANE IN FOREIGN COUNTRIES. By WILLIAM P. LETCHWORTH. New York: G. P. Putnam's Sons. Pp. 374. Price, $3.

THIS volume, by the President of the New York State Board of Charities, is an important contribution to the literature of its subject. It embodies an examination of European methods of caring for the insane, especially the insane in public institutions, pursued without interruption for seven months, supplemented by information obtained since the time of the author's visit. By way of contrast, a brief introductory sketch of the ways in which the insane were treated in earlier times is given. The systems employed in England, Scotland, and Ireland are then described in turn, and the characteristics of representative Continental institutions are set forth. A chapter each is given to the insane colony of Gheel, in Belgium, where is the celebrated shrine of St. Dymphna, and to the colony-hospital at Alt-Scherbitz in Saxony. The final and longest chapter, and the most important portion of the volume, presents a *résumé* of the author's observations and his conclusions drawn from them. Based upon the results of his inspections of foreign and American asylums, and of his own experience in the supervision of the defective classes of New York State, Mr. Letchworth offers his views as regards the selection of sites and locations of asylums, the kind of buildings to be provided; the questions of sewage disposal, water-supply, protection against fire, the laying out of the grounds, the furnishing and decoration of wards and rooms, the difficult problem of the disposition of the acute, the chronic, and the criminal insane; the practice of restraint and the amount of liberty that may be granted; the character of the attendants to be chosen; the religious exercises, amusements, employments, dress and clothing, visitation and correspondence of patients, *post-mortem* examinations; the methods of admission and discharge, and the value of summer resorts. All these subjects are treated clearly and explicitly. Besides these, the author gives his personal views respecting the insane in poor-houses, local or district care of the insane, state care, the boarding-out system, state supervision, and kindred topics. The book is beautifully printed and richly illustrated with engravings and heliotype reproductions of plans of buildings and asylum interiors, and pictures of historical interest.

GEOLOGICAL SURVEY OF NEW JERSEY. FINAL REPORT OF THE STATE GEOLOGIST. Vol. I. Topography, Magnetism, Climate. By GEORGE H. COOK, State Geologist. Trenton: John L. Murphy Publishing Company. Pp. 439, with Maps, etc.

THE survey was authorized by the State Legislature in 1864, and has been continued regularly till the date of the report. The act contemplated a completion of the work, previous partial surveys having been carried on by Henry D. Rogers in 1836–'40, and Dr. William Kitchell in 1854–'56. While the yearly reports of the present work that have been made and liberally distributed among the people have been somewhat miscellaneous as to the subjects discussed, on account of the prominence of special wants and interests, the various branches of the survey have been kept advancing, so that it has been found practicable to include the final geographical reports in this volume. The State Geologist has enjoyed the co-operation and assistance of the United States Coast and Geodetic Survey; and the expense of conducting the latter half of the topographical work has been borne by the United States Geological Survey. Of the several parts of the present volume, the article on the Geodetic Survey, by Prof. Bowser, of the Coast Survey, gives accurate determinations, in latitude and longitude, of several hundred points, the stations of which are exactly described, and the primary ones distinctly marked on the spot. In the "Physical Description," Mr. C. C. Vermeule, after defining the geographical position and outlines of the State, relates the history of the questions of boundary and limits of jurisdiction from the beginning; marks the political divisions, with measurements of the areas of the counties and townships, and describes the topography of the State as being "readily classed

in belts which correspond closely with the outcrops of the various geological formations. Beginning at the northwest, we have the Kittatinny Mountain and Valley, occupying the western half of Sussex and Warren counties, and corresponding to the Palæozoic formation; next, the Archæan Highlands; then the rolling Triassic or red sandstone plain; then the furrowed and irregularly hilly cretaceous plain; and, lastly, the triangular, extremely level, sandy, and pine-clad plain of the Tertiary formation, fringed seaward by a belt of tide-marsh inclosed from the sea by sand-beaches. These features are common to the Atlantic slope southwest." In the detailed review these belts divide themselves up into alternating streaks of mountain and valley, table and plain, of which twenty-four are described. These divisions present, considering the limitations of the area, much diversity of aspect, from the mountain lands of the northwest, studded with lakes, with the trap dikes of the "red sandstone plain" intervening, to the swamps and pine plains and tidal plain and beach sands as we approach or when we reach the sea-coast. The description is supplemented by a table giving the areas of the several water-sheds, with the percentage of forest upon them, and their population per square mile, a list of bench-marks at which the elevation above the sea is exactly recorded; and a much larger list of elevations, from the latest and best determinations of prominent points, referred to mean sea-level. The paper on the Magnetic Survey, recording observations at one hundred and fifty-eight stations, reveals some noteworthy irregularities in declination, particularly in regions of Archæan rock, and near the trap ridges, where a tendency of the needle toward a perpendicular to the crest-line of the ridge is remarked upon. This paper is accompanied by a chart showing equal lines of declination for 1888. Prof. Smock describes four natural climatic provinces in the State, each of which has its peculiar features: the Highlands and Kittatinny Valley; the Red Sandstone Plain; the Southern Interior; and the Sea-shore, or Atlantic Coast Belt. The first is not generally marked by excessive extremes of temperature, but has rather a northern climate. The last, though having nowhere a truly mild winter climate—like that of southern Florida and California, etc.—affords pleasant winter resorts. In view of the small area of the State, the variety of conditions to be found in New Jersey appears a little remarkable. A fine topographic map, and an altitude map, in which nine grades of elevation are indicated by as many distinct shades of coloring, are furnished in pockets.

ACTIVITY is resumed by the Society for Political Education by the issue of a pamphlet, No. 25 in its series, on Electoral Reform." It sets forth the grave defects in the electoral systems of most of the States, and explains the remedies therefor in secrecy of ballot and other reforms. The "New York (Saxton) Bill" and the "Massachusetts Ballot Reform Act" are appended. The next forthcoming publication of the society will deal with the "Liquor Question in Politics," and as soon as possible it will revise and reissue its list of standard works on economics, political history and science, and economic reforms, for the direction and aid of students and the general reading public. The society aims at awakening an intelligent interest in governmental methods and purposes, and at diffusing information concerning the rights and duties of citizens. Mr. George Iles, secretary, 330 Pearl Street, New York, invites the co-operation of all interested in the society's work.

The Self: What is it? is the problem which Mr. *J. S. Malone* attempts to answer (J. P. Morton & Co., Louisville, 75 cents). He divides the human mind into two parts —intellect and sensibility—and affirms that the faculty which causes all human activity is desire, a subdivision of sensibility, challenging any one to find one voluntary human action that can be traced back to intellect as its primal cause. He deems intellect only instrumental. He affirms that moral responsibility belongs also to sense, and that the end of existence concerns only this department of mind. In the second division of his book he maintains that intellect is an offshoot from sense, and examines some of Kant's doctrines.

Mr. *Frederic E. Ives* has privately printed in Philadelphia a brief account of his process of photographing in colors, under the title *A New Principle in Heliochromy.* He

alludes to the various attempts which have been made to produce photographs in natural colors, and then states the essential features of his own method. He says in conclusion that there is much yet to be done in perfecting the print-making part of the process, and that for the present he is satisfied to obtain perfect heliochromic prints on glass, so that the result may be shown with the optical lantern. He appends a reply, which he made in the "Journal of the Franklin Institute," to a criticism on his claims by Mr. C. H. Bothamley. The *brochure* has a photo-engraved portrait of Mr. Ives as frontispiece.

A lecture entitled *Outlines of a New Science*, by *E. J. Donnell*, has been published in the "Questions of the Day Series" (Putnam, $1). The author maintains that *exchangeability* is the source of economic value, that all wealth is the fruit of commercial exchange, and that, when this is going on actively, all departments of productive industry have health and vigor. Further, that the recent enormous increase in the productive powers of labor has created a problem which demands an immediate solution; that the problem is especially pressing in this country because our productive powers are greater and the restrictions on our commercial exchanges more oppressive than in any other of the advanced industrial nations; and that our tariff system taxes the many for the benefit of the few.

The Trustees of the Peabody Museum of American Archæology and Ethnology have begun to issue from time to time such special papers as have heretofore been published in connection with the annual reports, in a separate form, but of uniform octavo size with the reports. Each number will be sold separately at a specified price, which will vary according to the number of pages and illustrations. The papers will be omitted from the annual reports. The first of these papers published is an interesting essay by Mrs. Zelia Nuttall, on a "Relic of Ancient Mexico—Standard or Head-dress?"—with three colored plates, to which is appended a note "On the Complementary Signs of the Mexican Graphic System."

The *Plans for furnishing an Abundant Supply of Water to the City of New York from a Source independent of the Croton Water-shed*, proposed by *John R. Bartlett and Associates*, contemplate the utilization of the Passaic water-shed in New Jersey; the reservoirs to be located about fifteen miles from the city, and the water to be brought in by a tunnel under the Hudson River. The supply of all the New Jersey towns suburban to New York, and of Brooklyn, is declared to be practicable by the same system, and it is claimed that the quantity of water available for this purpose is sufficient to furnish them all abundantly. The water-privileges of the region in question are owned by private corporations, from which the author has obtained concessions of the right to construct reservoirs and collect and use the surplus waters. In behalf of this scheme, it is claimed that the Passaic water-shed has three times the area of the Croton water-shed, and is therefore capable of affording a much larger supply of water than can ever be derived thence; that it is much nearer to the city; that the water can be brought direct to the lower part of the city, where it is most needed; that it will be pure and wholesome, and, being delivered under a head-pressure of three hundred feet, will go of its own force to the tops of the highest houses, and with sufficient energy to be instantly available in extinguishing fires; and that it possesses other somewhat less important but obviously convenient advantages. The book in which the scheme is developed and explained contains several addresses and memoirs, legal opinions, and opinions of experts on the various questions brought out in the discussions of it, with maps, plans, profiles, and views.

Mr. *Charles W. Darling*, Corresponding Secretary of the Oneida Historical Society, has published privately, in a pamphlet of 43 pages, some *Historical Notes concerning the City of New York* as it appeared in its earliest days. They have been gathered from the writings of the chief historians, earlier and later, of the city, and from manuscript folio volumes of public records. They contain matter that is omitted by one or other, or more, of the writers quoted from, and form a picture as a whole which it will be hard to find in its fullness anywhere else. The notes date back to the period when trading and fishing huts were first erected upon Manhattan Island, and embrace the years between

the discovery by Hudson in 1609 and the recall of Governor Wouter Van Twiller in 1637.

Business is one of half a dozen thoughtful little books by *James Platt*, on kindred subjects and with equally terse titles (Putnam, 75 cents). It is a clear, vigorous, and direct statement of the nature and importance of each of the qualities which make up the mental fittings of the successful man of business. The author has long advocated the teaching of business methods in English schools, so that the youth of that country might be competent to fill the clerkships which English merchants are constantly giving to Germans and Swiss. He regards commercial life as a remorseless struggle for existence, in which the men of greatest skill and perseverance defeat their fellows. He repudiates the doctrine of the weak, indolent, and thoughtless that puts all failure upon the Lord, and says that if men do not succeed it is because they are not equal to the requirements of the age they live in. Mr. Platt does not hold that reading books alone will make any one a thorough man of business, but that books can supply knowledge of laws and principles which, if intelligently applied, will prevent failure or be productive of success.

D. C. Heath & Co. are about to publish *Thirty-six Observation Lessons on Common Minerals*, by *Henry L. Clapp*, designed as a practical guide for the use of the teacher in directing the pupil's energies, and cultivating the true scientific habit of thinking and working. The same firm will issue *The Laws of Health in Relation to School Life*, by *Arthur Newsholme*, M. D., intended for the guidance of all who are charged with the responsibility of watching over the mental and physical well-being of pupils of both sexes in public or private schools. The book is in use in English training schools, and the American edition has been carefully revised to adapt it to our climate and the needs of our schools.

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Angerstein, E., M. D., and Eckler, G. Home Gymnastics for the Well and the Sick. Boston and New York: Houghton, Mifflin & Co. Pp. 94. $1.25.

Bennett, Alfred W., and Murray, George. A Hand-book of Cryptogamic Botany. London and New York: Longmans, Green & Co. Pp. 478. $5.

Bastin, Prof. Edson S. College Botany. Chicago: G. P. Engelhard & Co. Pp. 451. $3.

Benson, Lawrence Sluter. Mathematics in a Nutshell, etc. 25 Bond Street, New York. Pp. 10.

Bert, Paul. Primer of Scientific Knowledge. Translated and adapted for American Schools. Philadelphia: J. B. Lippincott Company. Pp. 186. 36 cents.

Boylston, Peter. John Charáxes: A Tale of the Civil War in America. Philadelphia: J. B. Lippincott Company. Pp. 289. $1.25.

Branner, John C. Annual Report of the Geological Survey of Arkansas. Little Rock. Pp. 320, with Maps.

Bryce, James. The American Commonwealth. London and New York: Macmillan & Co. 2 vols. Pp. 750 and 743. $6.

Burt, Stephen Smith, M. D. Views on the Prevention and Treatment of Typhoid Fever. New York. Pp 11.

Connecticut Agricultural Experiment Station. Bulletin No. 97. Fungous Diseases of Plants. Pp. 13.

Crothers, T. D., Editor. "The Quarterly Journal of Inebriety." April, 1889. Hartford, Conn.: The Case, Lockwood & Brainard Company. Pp. 100.

Danmar, William. The Tail of the Earth; or, the Location and Condition of the "Spirit World." Brooklyn, N. Y. Pp. 60. 25 cents.

Dexter, Seymour. A Treatise on Co-operative Savings and Loan Associations. New York: D. Appleton & Co. Pp. 299. $1.25.

Dunham, O. M. "The American Workman." An Illustrated Magazine. New York. Pp. 16. 5 cents; $2.50 a year.

Foote, E. B., Jr., M. D. Dr. Cyrus Edson's Plea for Compulsory Vaccination reviewed. Pp. 16.

Foster, Michael, and others. "The Journal of Physiology." Vol. X. Nos. 1 and 2. Pp. 151 and iv, with Plates. $5 a volume.

Groh, Israel W. Did Man fall? New York: The Truth-Seeker Company. Pp. 21. 10 cents.

Hill, Robert T. Events in North American Cretaceous History illustrated in the Arkansas-Texas Division. Austin, Texas. Pp. 10.

Hitchcock, C. C. The Influence of Science on Religious Thought. Ware, Mass. Pp. 17.

Illinois, University of. Agricultural Experiment Station. Field Experiments with Corn. 1888. Pp. 102.

Ingersoll, Robert; Coudert, Frederick A.; and Woodford, Stewart L. The Limits of Toleration. A Discussion. New York: The Truth-Seeker Company. Pp. 44. 10 cents.

Iowa Agricultural College Experiment Station. Ames. Bulletin No. 4. Pp. 48.

Jacobi, Mary Putnam, M. D. Physiological Notes on Primary Education and the Study of Language. New York and London: G. P. Putnam's Sons. Pp. 120. $1.

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POPULAR MISCELLANY.

John Goldie.—This industrious botanist was born near Maybole in Ayrshire, March 21, 1793; died at Ayr, Ontario, Canada, where he had long resided, in June, 1886, in his ninety-fourth year. Mr. Goldie was educated as a gardener; and most Scotch gardeners in those days were botanists. From the Glasgow Botanic Garden, then in charge of Sir William Hooker, he came to America for botanical exploration in the year 1817. The interesting particulars of this expedition are here given in an abstract from his "Description of some New and Rare Plants discovered in Canada in the Year 1819," published in the "Edinburgh Philosophical Journal," vol. vi, April, 1822. "Having had for many years a great desire to visit North America, chiefly with a view to examine and collect some of its vegetable productions, I contrived in 1817 to obtain as much money as would just pay my passage there, leaving when this was done but a very small surplus." He sailed from Leith to Halifax, went to Quebec, whence he dispatched his collections of living roots and dried plants in a vessel bound for Greenock, "but never heard of them afterward." At Montreal he found Pursh, who advised him to explore the northwest country, and promised to obtain for him permission to accompany the traders going to that region the following spring. "I traveled on foot to Albany, thence proceeded by water to New York. . . . I explored the eastern part of New Jersey, a country which, though barren and little inhabited, yet presents many rarities to the botanist, and gave me more gratification than any part of America that I have seen. At a place called Quaker's Bridge I gathered some most interesting plants, and, having accumulated as large a load as my back would carry, I took my journey to Philadelphia"—thence to New York, whence a ship was about to sail to Scotland, "and, having again committed my treasures to the deep, I had again, as the first time, the disappointment of never obtaining any intelligence whatever of them. My finances being now extremely low and winter having commenced, I hardly knew what to do; but, after some delay, went up to the Mohawk River, where I found employment that season as schoolmaster"—thence in the spring

to Montreal, and, failing to make the connections necessary to reaching the northwest district, he "took to the spade" all summer long, except two days in the week which he devoted to botanizing. "In the autumn I shipped my collection of plants, and in two months had the mortification to learn that the vessel was totally wrecked in the St. Lawrence. During the next winter I did little, except employing myself with such skill as I was able in designing some flower-pieces, for which I got a trifle. Early the following spring I commenced labor again, and by the beginning of June had amassed about fifty dollars, which, with as much more borrowed from a friend, formed my stock of money for the next summer's tour. I started in the beginning of June from Montreal, and passing through Kingston went to New York [meaning the State, evidently], to which, after an excursion to Lake Simcoe, I returned; then visited the Falls of Niagara and Fort Erie, and crossed over to the United States, keeping along the eastern side of Lake Erie"; he crossed over to Pittsburg, back by way of Olean, Onondaga, and Sackett's Harbor to Montreal, and thence safely home to Scotland, "the plants I carried with myself being the whole that I saved out of the produce of nearly three years spent in botanical researches." Hard lines these and in those days for collecting botanists, which those who "stay at home at ease" do not appreciate. In the year 1824 he was commissioned to take charge of a cargo of living plants sent by the Edinburgh Botanic Garden to that of St. Petersburg. On his return he went into the nursery business in his native country. Then, with a laudable wish to better the prospects of his family, in 1844 he transported his home from the Scotch to the Canadian Ayr, in the province of Ontario, where he flourished and prospered for over thirty years of green old age, and died in the midst of numerous and prosperous children, grandchildren, and great-grandchildren.

Tornadoes.—Mr. J. P. Finley says that there are two principal conditions upon which the occurrence of tornadoes depends: one is a state of unstable equilibrium in the air, and the other a circulatory motion with reference to any center of disturbance. Tornadoes are most likely to occur in regions where warm moist air flows underneath a colder and drier stratum coming from another direction. Such regions are found in the Mississippi, Missouri, and Ohio Valleys, and in Alabama, Georgia, and the Carolinas. The summer season is the most favorable for tornadoes, when the interior of the continent is warmed up, and the air of the lower strata is drawn from lower latitudes far up into the northern portions of the country on the eastern side of the Rocky Mountains. If this unstable condition does not of itself induce a disturbance, one is readily brought about by the addition of any small effect from some other cause, as from extremely warm weather, in which the air strata close to the earth's surface become still hotter than those above them. Tornadoes very generally accompany an area of low barometer, and are to be looked for in the southeast quadrant only of the "low," at distances generally of from two hundred to five hundred miles from the center. But as the unstable state in a "low" very rarely extends down to the earth's surface, tornadoes are not necessarily visible in every general storm. The destructive violence of a tornado is sometimes confined to a path a few yards in width, or it may widen to the extreme limit of eighty rods. The tornado, with hardly an exception, occurs just after the hottest part of the day—most frequently between 3.30 and 5 P. M. The month of greatest frequency is May, April coming next. It is estimated that one hundred and forty-six tornadoes occur in the United States yearly. The vortex wind-velocities of the tornado-cloud vary from one hundred to five hundred miles an hour, from actual measurements. Velocities of from eight hundred to one thousand miles an hour are extremes that have been reported, but may not be altogether reliable. The cloud generated by the vortex assumes the form of a funnel, with the smaller end toward the earth. The characteristic effects of a tornado are objects drawn into the vortex from all sides, whirled upward and thrown outward by the circling air: structures are literally torn to pieces, as shown by the fineness of the *débris;* light objects are carried to great heights and also to great distances; persons are stripped of clothing; fowls and birds are denuded of feathers and killed; trees are whipped to bare poles, uprooted or

twisted off near the roots; heavy timbers are driven through the sides of buildings or deep into the solid earth; men and animals are terribly mangled by contact with flying *débris*, and by being swept over the surface of the ground; bowlders weighing tons are rolled along; railroad trains are thrown from the tracks; and iron bridges are carried from their foundations.

Economical Uses of Flowers.—The dried flowers of *Hemerocallis graminea* and the young flowers of the plantain pickled in vinegar are choice Chinese foods. Capers are the flower-buds of a *Capparis* or a *Zygophyllum;* and cloves are the unexpanded flower-buds of *Caryophyllus aromaticus.* The petals of safflower, *Carthamus tinctorius*, yield a beautiful dye of various shades of color between red and yellow. It is the carthamine of the pink saucers, and this, mixed with powdered mica or talc, forms a rouge for ladies' toilet-tables. The dried flowers of two species of *Butea*, locally known as *dhak*, *tisso*, *toolsee*, and *kassaree*, are extensively used in India for the production of orange and red dyes. The orange-red flowers, which grow in clusters, are pressed when fresh, or boiled or steeped when dried, in a weak solution of lime in water. The flower-buds of *Calasaccion*, which resemble a clove, the blossoms of a larkspur of Khorassan, and the white flowers of *Cedrela Toona*, give yellow dyes. The *Sophora Japonica*, a well-known ornamental shrub of our gardens, is cultivated in China for the sake of the imperial yellow dye obtained from its bunches of flowers and undeveloped flower-buds. Flowers of marigold are made into garlands in India for the idols and for the decoration of houses in festivals. The red flowers of *Hibiscus rosa-sinensis* supply a red dye, and have been used to polish boots and shoes. A fleeting orange or buff dye is extracted in India from the corolla tubes of *Nyctanthes*, which are also strung in necklaces for women. The flowers of the teak and of the pomegranate are used in India for dyeing red. The dried stigmas of the crocus are a source of saffron. Cake saffron is made of the florets pressed together with mucilage. Insect-powder is the pulverized dried flowers of *Pyrethrum.* In medicine, the female flowers of hops are tonic and narcotic; the Provence rose is considered astringent; the flowers of the hollyhock are mucilaginous and demulcent; those of *Grislea tomentosa* astringent and tonic; those of camomile tonic and anodyne. Infusion of linden-flowers is given as an antispasmodic. The flowers of the Abyssinian *Brayera anthelmintica* and the flower-heads of *Artemisia* act as vermifuges. Violets are considered purgative; but a conserve of the flowers with sugar has a grateful flavor for covering nauseous medicine. The flowers of the Indian *Mohwa* (*Bassia latifolia*) secrete much sugar, and are gathered by the natives during their season, in March and April. A single tree will yield many hundred-weights of corollas. They are eaten by the poorer classes in various parts of India. The ripe flowers have a sickly smell and a sweet taste, resembling manna, and are stored as a staple of food; when dried they have somewhat the odor and appearance of Sultana raisins; containing 63½ per cent of sugar, they are as nourishing as grain, but people could not live on them alone for any length of time. They are distilled by the Parsees, and yield a powerful, coarse spirit. Cowslip-flowers are used in wine-making, and the flowers of meadow-sweet to improve the flavor of certain wines. Some of the Chinese teas are often scented with flowers. The kinds of flowers and the processes are various, but the object of all is to make the tea more attractive.

Forestry in Spain.—Action was taken for the promotion of forestral science in Spain toward the close of the fifteenth century; and there is reason to believe that measures had been adopted to check the destruction of timber even previous to the reign of Ferdinand and Isabella. The school of forestry, projected in 1835, went into operation ten years later, and was attached to the Escurial in 1868. It is under the direction of a head administrator and chief engineer, with nine professors and three assistants. The number of students, now ninety-two, is not limited, and is dependent on the number of successful candidates for entrance each year. On the completion of the course at the school, which lasts four years, the successful candidates are appointed to the corps of forest engineers. The course of instruction is divided into preparatory and profes-

sional categories. Candidates for admission must be qualified in Spanish and Latin grammar, geography, Spanish history, the elements of natural history, theoretical mechanics, geometry and its relations to projections and perspective, physics, chemistry, lineal, topographical, and landscape drawing, and French and German. Especial attention is given in the course to topography, chemistry, and mathematics. Branches bearing particularly on forestry are introduced in the second year, and are made more prominent in the succeeding years. The custody of the public forests is vested in the civic guard. The country is divided into forty-six forestral departments, the forests in each of which are under the care of a chief engineer.

Evening Continuation Schools. — In a paper read before the Society of Arts, London, Dr. William Lant Carpenter considered the best means of continuing the education of children who are taken from the day school as early as the law allows and set at work. He said that education to be given in the evening must be such as will attract, interest, and *recreate* tired children. It has to compete with the social gambolings of the street, or even with the gaudy, specious amusements which too often allure them. In the second place, it must touch and draw forth the opening nature of children of that age, so that their instinctive impulses and growing powers, both of body and mind, shall be rightly nourished and trained. Lastly, it must bear directly upon the practical work of their daily life, upon the pure enjoyments that are possible to them, and upon the noble duties that will devolve on them. In Nottingham a very successful attempt had been made to ingraft upon the instruction required by the Government, exercises of a more practical and recreative character, conducted by voluntary teachers, such as calisthenics, musical drills, drawing, modeling, demonstration in elementary science, geography with special reference to physical phenomena and to commerce, shopping and workshop arithmetic, needlework, historical and other readings illustrated by the lantern. Moreover, seven working men were appointed to be the managers of each school, and these men so labored that during the first year of their service the attendance was doubled. The "Recreative Evening Schools Association" was formed in London in 1886 with a similar purpose, and had accomplished valuable work, both within and outside of the metropolis. Dr. Carpenter said in regard to the use of the lantern that its value as an educational agent is only beginning to be recognized. Eyes wearied with long use during the day can not endure the fatigue of much book-work at night, but they are revived and charmed by the splendor of gay color and brilliance of light. He urged the teaching of science, not only as a preparation for technical education, but still more to put the young people into an intelligent relation with the phenomena of the world in which they live. In order to deal with the distress arising from unthrift, vice, self-indulgence, and reckless and improvident marriage in a great city like London, Dr. Carpenter said: "We must capture the boys and the girls who will be the fathers and mothers of five or ten years hence. If when captured their lives and habits are molded at the impressionable age, from fourteen to twenty-one, so as to become good citizens, and not reckless pleasure-hunters, unaccustomed to resist the impulse of passion or the suggestions of desire, we are, in point of fact, sterilizing the unfitness latent in them, and thus preventing the formation of a new national debt of vice and crime."

NOTES.

Dr. F. P. Wightnick sounds another note of alarm against danger from lead-poisoning from using fruit canned in tin. Three cases have lately come under his observation in which he assigns the cause of trouble to this source. One case is that of a patient who had been using canned tomatoes for three years, and who had for several months suffered painful disorders of digestion. Analysis of the tomatoes revealed the presence of 0·987 grain of oxide of tin and 0·339 grain of chloride of lead per pound of preserved vegetables. The other cases are of a mother and son who have eaten canned tomatoes freely, and are suffering from similar digestive disorders. The evidence of lead-poisoning is not presented in so positive a form as in the other case. Medical men and chemists have usually inclined to the opinion that the danger of poisoning from canned fruits was insignificant.

The "Quarterly Journal of Inebriety" has called attention to the indiscriminate

administration of policemen's discipline to so-called drunken cases in hot weather. Most frequently such cases are suffering far more from other causes than from liquor —from debility, heat-stroke, or some other cause peculiar to or resulting from the weather—added to a degree of intoxication which under ordinary circumstances might not attract an officer's attention—not unfrequently from the policeman's club or rough handling. The thing they need is medical attention, or at least medical examination, before being thrust into a hot, close cell.

THE meeting of the British Association for this year is to be held at Newcastle-on-Tyne, under the presidency of Prof. W. H. Flower, F. R. S. The presidents of the various sections are as follows: A, Mathematical and Physical Science, Captain W. De W. Abney, R. E., C. B., F. R. S.—B, Chemical Science, Sir I. Lowthian Bell, F. R. S.—C. Geology, Prof. James Geikie, LL. D., F. R. S. —D, Biology, Prof. J. S. Burdon-Sanderson, M. A., M. D., LL. D., F. R. S.—E, Geography, Colonel Sir Francis de Winton, K. C. M. G., F. R. G. S.—F, Economic Science and Statistics, Prof. F. Y. Edgeworth, M. A., F. S. S.—G, Mechanical Science, William Anderson, M. Inst. C. E.—H, Anthropology, Prof. Sir W. Turner, LL. D., F. R. S.

A BOTANICAL CONGRESS has been called by the Botanical Society of France, to be held in Paris in August, for the presentation and discussion of treatises on botanical subjects, pure or applied. Particular attention will be given to considering the usefulness of establishing joint action looking to the preparation of maps showing the distribution of species and genera over the globe; and to the characters for classification furnished by anatomy.

THE French Association for the Advancement of Science will meet in Paris, August 8th to 15th.

AN affection similar to sunstroke is described by the "British Medical Journal" as produced by the electric light, and is called "electric-light stroke." It is very liable to attack the men working at the electric furnace of the Creuzot steel-works. As the heat emitted by this furnace is not felt to any great degree, the fact lends probability to the supposition that the "stroke" is an effect of light rather than of heat.

THE French Academy of Sciences offers for 1889 the *Prix Vaillant*, of three thousand francs, for the best work on diseases of cereals in general; a grand prize of three thousand francs for the complete study of the embryology and development of any animal; the *Prix Bréant*, of one hundred thousand francs, for a specific against cholera; and a prize of five hundred francs for a theoretical and practical essay on the progress of aërial navigation since 1880.

OBITUARY NOTES.

M. CHEVREUL died at his home in Paris, from natural exhaustion of his vital force, April 9th, at the age of one hundred and two years, eleven months, and nine days. He had lived very quietly since the celebration of the completion of his one hundredth year, August 31, 1886. He was accustomed to drive daily to see the progress made in the erection of the Eiffel Tower. His son, M. Henri Chevreul, had recently died; and, although the fact had not been communicated to him, he seemed to have some suspicion of it, and to be anxious. On his return from his last drive, the Wednesday before his death, he was very weak, and had to be helped, with some difficulty, up to his apartments; and it was evident that the end was approaching. He sank gradually, without pain, till the morning of the 9th, when he expired.

CHARLES MARTINS, an eminent student in several branches of science, died in Paris, March 7th, in his eighty-third year. He was appointed a Fellow in Natural History in the Faculty of Medicine in 1839; lectured on geology at the Sorbonne; became Professor of Botany at Montpellier in 1851; was elected to the Academy of Sciences, Section of Rural Economy, in 1863. He was also a great traveler; in his long career, he devoted himself with equal success to the study of meteorology, physics, botany, paleontology, comparative anatomy, and physiology. Wherever he went, he studied alike the customs, fauna and flora, and the physical phenomena of the region, and he described them all in his book, "From Spitzenberg to the Sahara." With Bravais and Lepileur he ascended Mont Blanc in 1844, and verified the results which De Saussure had reached.

PROF. DONDERS, of the University of Utrecht, one of the first of contemporary physiologists, has recently died. He was the author of valuable studies on accommodation (of eye-sight), binocular vision, astigmatism, and phonation, which have become standards.

THE Rev. Dr. Frederick A. P. Barnard, late President of Columbia College, died at his home in this city, April 27th, a few days less than eighty years of age. We gave a sketch of his earlier life in the "Monthly" for May, 1877, and purpose to publish in a future number a fitting memorial of the great services which he rendered to the cause of education.

M. G. MENINGHINI, Professor of Geology in the University of Pisa since 1849, died January 29th, seventy-eight years of age.

SIGNOR ANGELO GENOCCHI, President of the Academy of Sciences of Turin, died March 7th, aged seventy-one years.

HENRY CARVILL LEWIS.

THE

POPULAR SCIENCE MONTHLY.

JULY, 1889.

WHAT IS CIVIL LIBERTY?

By W. G. SUMNER,

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IT might seem that liberty was one of the most trite and worn of all subjects. It will be the aim of this paper to show that liberty is the least well analyzed of all the important social conceptions, that it is the thing at stake in the most important current controversies, and that it needs to be defended as much against those who abuse it as against those who deride it.

In the first place, I put together some citations which will, I think, justify me in bringing this subject forward again:

1. Rodbertus is the one of the recent socialists with whom it is best worth while to deal, for he is the master of them all. He is also best understood in his writings on Roman taxation, in which his historical text and his social dogmas throw important light on each other. He defines liberty to be a share in the power of the state.* He then defines "free trade," in the following pages, so as to make it cover all civil liberty, according to Anglo-American institutions, and attributes to "free trade," in this sense, no less harm than the destruction of civilization. It is amusing to notice how this denunciation of free trade, which it would have been so satisfactory for the opponents of free trade to quote, has been fenced off and marked with the strongest kind of a danger-signal, so that it is never quoted at all, because it is an assault on all modern liberalism as broad as the Pope's "Encyclical" of 1864. In fact, this parallelism must be noted more than incidentally, for it helps to show what I here have in view: that all forms of liberty are *solidaire* with each other, and all forms of assault on liberty, as well the revolutionist and socialistic as the extreme reactionary, are

* 5 Hildebrand's "Jahrbücher," 269.

also *solidaire* with each other. A criticism of Rodbertus is a task which I reserve for another occasion, but, as germane to my present subject, I ask attention to the following proposition, as illustrating the sort of dogma which shows the need of re-analyzing liberty: "Moral freedom is conditioned on historical necessity." Some of our contemporaries take that sort of proposition as the profoundest wisdom. To me it is oracular in more senses than one.*

2. From a large collection of similar cases I select the following: "Life appears to the Manchester party to run its course under the form of a parliamentary debate, and not otherwise. An assertion is followed by an objection, this by a rejoinder, and so on. The decision of the majority is final." The view here stigmatized is held by all those who believe in government by deliberation. "The great affair in this world is, not to convince a man's intelligence, or to increase his knowledge, but it is at least equally important to lead his will and to *conquer* it." † The writer goes on to argue that, if men are allowed to act freely, they will not act by deliberation, but selfishly. There he leaves the matter, apparently believing that he has routed the "Manchester Schule," and established something of philosophical or practical importance. He must, of course, assume that himself and his friends are to decide when others and their friends are acting selfishly, and ought to have their wills conquered.

3. To take another citation from a popular writer: "Not one liberal principle but is admirable in the abstract; yet not one liberal measure that has not worked terrible mischief in our time. The liberty of thought, for instance; who dare gainsay it? Yet it has proved destructive of the principle of religion, without which there is less cohesion among men than among a herd of swine. The liberty of settlement and circulation has given rise to the pestilence of large towns, in which men congregate and live together on terms worse than a pack of wolves. The liberty of industry has reduced four fifths of the population to a state of serfdom more cruel than negro slavery, while more than half of the remaining population is engaged in a perpetual struggle, more savage than the intermittent warfare of cannibals. Free trade among nations has ruined, first individually, then industrially, then financially, and finally politically, prosperous countries, such as Turkey, while in England it has destroyed, not only agriculture, but all those sterling qualities which formerly characterized British industry and trade. . . . Parallel to the deception experienced by the modern world through the progress of industry, aided by discovery and invention, have come down on this genera-

* 8 Hildebrand's "Jahrbücher," 420, note.

† Von Eichen in "Preuss. Jahrbücher," 1878, p. 382.

tion the fatal effects sprung from the spread of education. While thoughtless or superficial writers pretend to find in education the remedy of all social evils, as a matter of fact education has become the source of a vast amount of human suffering in modern times, under which those whose education is their only patrimony or source of income suffer most." * This is sufficiently explicit, and also manifests the solidarity of all forms of liberty and modern civilization. Those who attack them all show that they appreciate the truth of things a great deal better than those who try to attack some and save others.

4. Then there are the philosophers of the newest school, who, seizing upon the plain fact that all liberty is subject to moral restraints, as we shall presently see, are forcing upon us, or trying to force upon us, by legislation, restraints on liberty derived from altruistic dogmas, and, in general, under the high-sounding name of ethics, are assuming a charter for interference wherever they choose to allege that they have moral grounds for believing that things ought to be as they want them.

5. Finally, the anarchists, taking liberty to mean that a man ought to be a law unto himself, and that there should be no other law, have shown from another side that we should try to find out what liberty is.

THE HISTORY OF THE DOGMA OF NATURAL LIBERTY.—The history of the dogma of the natural liberty of all men, with the cognate dogma of the natural equality of all men, would be an important topic for exhaustive treatment by itself. From the notes which I have made on the subject I condense as far as possible the following view of it:

Slavery in the classical states seems to have rested upon the law of war, that the vanquished man with his family and all his property fell under the good pleasure of the conqueror. Xenophon states this law explicitly: "The law is well known among all men that, when a state goes to war, the property and bodies of all in the state are the property of the captors. You will, therefore, not possess wrongfully whatever you get, but, if you permit them to retain anything, it will be out of humanity." † It seems that the reason why slaves in antiquity so universally accepted their fate was that they understood that such was the fortune of war. They acquiesced in it as according to the rules of the game. The earliest writer in date whom I have found who utters the dogma of liberty is Philemon (fl. c. 350 B. C.): "No one by nature ever was born a slave, but ill-fortune enslaved the body." ‡ Aristotle discusses the subject in the third and fourth chapters of the first

* Karoly, "The Dilemmas of Labor and Education," London, 1884, introd., x.

† "Kyroped.," vii, 5, 73. Cf. "Memorab.," ii, 2, 2, and Polybius, ii, 58, 9.

‡ Frag. 39 in Meineke, "Com. Graec.," iv, S. 47.

book of the "Politics." He says that some held that slavery was against nature. Such persons, whoever they were, must have derived their opinions entirely from humane impulse and poetic enthusiasm. Aristotle was not of that tone of mind. He could not find in history any example of a state which had not slavery. When he examined the state in which he lived he easily saw that slavery was of its very essence. He therefore held that slavery was a natural necessity. Such it was in the sense that it was rooted in the nature of the classical state. It is undeniable that the classical state could not have grown up and could not have produced its form of civilization without slavery. It must also be recognized as a fact that no other organization of society has yet shown itself capable of that degree of expansion which the Roman state developed by means of slavery. The mediæval state broke down under the first expansive requirement which was made upon it. Whether the modern state, based on natural agents and machinery, is capable of expansion or not, is yet to be proved. There seems to be ample reason to believe that it is, unless the modern world votes not to go on; but, if the modern world votes to go on and not be afraid, it can only do so by virtue of education, and then it is subject to the remonstrance of Mr. Karoly at the head of this article, and of others who think like him. To return to the classical state: it remains only to observe that slavery was likewise the fate of that state which, having enabled it to grow up to immense power and achievement, also inevitably carried it down to ruin and disgrace. It is free to us all to speculate on the question whether every force which makes high expansion possible will not also bring with it its own form of inevitable destruction or decay. Aristotle, therefore, proceeding upon the historical method and upon observation, found that slavery was necessary and expedient within the limits of the age and the form of society he was discussing.

Fuller expression of the dogma of natural liberty comes only with the Christian era. Dio Chrysostom, at the end of the first century, expresses himself in favor of it, but his declaration is incidental and can be taken only as rhetorical.* It is among the Christian writers that it first finds distinct and enthusiastic expression. With them it is rather an inference from fundamental doctrines of the faith than an actual article of the creed, although they quote texts freely in support of it. The doctrines of Christianity are undoubtedly favorable to it, and the inference was direct and easy. Tertullian (fl. c. 200 A. D.), addressing heathen, declares, "We are your brothers by the right of one mother—Nature." †

It was not confined to Christians, however. It is very probable

* "Orat.," vii, 138.

† "Apologet. ad Gent.," c. 39.

that it may have entered into the Stoic philosophy in some vague way. We find it in the lawyers of the third century. Ulpian says: "In civil law, slaves are considered null. Not, however, by natural right; because, as regards natural right, all men are equal."* And Florentinus: "Liberty is the natural faculty of that which it is permitted to any one to do, unless something has been prohibited to him by force or law. Slavery is an institution of the law of nations, by which any one is subjected to the rule of another, against nature. *Servi* are so called because military commanders are wont to sell captives, and so to preserve (*servare*) them and not kill them." † The doctrine, therefore, gets into the Institutes of Justinian: ‡ "Slavery is the institute of the law of nations by which a human being is subjected to another's control against nature." These propositions, however, in the law, remained entirely barren, and were not different from the academical utterances of the philosophers. It was the voice of reason and conscience recognizing a grand abstract doctrine, but without power to solve the social problems which would arise if that doctrine should be in any measure admitted into the existing order. The Christians alone seem to carry on the doctrine as something more than a pious hope, something not more distant than any other feature of the kingdom of heaven, and easily realizable in that kingdon. The vague elements of social and political innovation in the revolt of the Donatists and the Bagaudes bear witness to the extent to which some such doctrines had been popularized. The latter had a very *naïve* definition of natural rights, and, on the whole, as good a one as has ever been given: "Natural rights are born with us, *about which nothing is said.*" #

By the seventh century, the churchmen had made the doctrine of natural liberty one of the tenets of the Church. Gregory the Great writes: "Since our Redeemer, Creator of all creatures, deigned to put on human form, in order by his divine grace to break the bonds of the servitude by which we were held as captives, that he might restore us to our ancient liberty, it is fitting and advantageous that those whom Nature has made free, and whom the law of nations has made subject to the yoke of servitude, should be restored, by enfranchisement, to that liberty in which they were born." ‖ This passage became authoritative for the middle ages, as well for the point of view of the doctrine, and the sanction of it, as for its substance. It is a familiar fact that

* "Digest," I, 17, 32. † "Digest," v, 4. ‡ I, tit. iii, 2.

See Jung, Sybel's "Zeitschrift," xlii, 65. He gives no authority for the definition of natural rights. Another topic which might be investigated with great advantage to social science is the history of popular revolts, with especial attention to their common elements of political and social dogma.

‖ Epistles, book vi, ep. 12; 77 Migne, 803.

the current reason then alleged for enfranchisements was one's soul's health in the realization of a high Christian ideal. About 825 Bishop Jonas, of Orleans, asks: "Why are not master and slave, rich and poor, equal by nature, since they have one Lord in heaven, who is not a respecter of persons? . . . The powerful and rich, taught by these [church fathers], recognize their slaves and the poor as equal to themselves by nature."* In the twelfth century Bishop Ivo writes: "If we consult the institutes of God, and the law of nature, in which there is neither bond nor free," etc.† In the thirteenth century the doctrine appears in Bracton.‡ When describing the classes of men as free, villains, serfs, etc., he says: "Before God, there is no acceptance of men as free, or of men as slaves." Here we see the doctrine, such as the churchmen had been elaborating it, with its scriptural warrant, pass into the English common law.

In the fourteenth century the kings of France, in enfranchising the communes on the domains, repeatedly allege this doctrine as one of their motives.# Undoubtedly, the real motive was that more revenue could be got from them by taxing them as communes than by exacting feudal dues from the members as serfs, but it all helped to spread the doctrine as an idea of what would be "right."

This review now shows that the doctrine of liberty and equality by "nature," by birth, and by natural right was not by any means an eighteenth-century dogma. It had been growing and spreading for eighteen hundred years. It had begun in skepticism about the fairness of slavery. It could not begin with anything else. It went on until it became a philosophical notion of liberty, meaning the natural right of every one to pursue happiness in his own way, and according to his own ideal of it. It could not stop short of that.

This dogma did not emancipate slaves or serfs. During a thousand years, from the sixth to the sixteenth century, the peasants of France and England passed through the stages of slavery, serfdom, villainage, and compulsory settlement,‖ by persistent struggles of their own, aided by economic improvements and po-

* "De Instit. Laic.," ii, 22; 106 Migne, 213. He quotes Coloss. iv, 1.

† Epist. 221; 162 Migne, 226.

‡ Book i, ch. 8, ed. Twiss, 1878.

The originals of these documents are not accessible to me. One of Philippe le Bel is quoted: "Seeing that every creature who is formed in the image of our Lord ought, in general, to be free by natural right," etc.; and one by Louis le Hutin: "Seeing that, by the right of nature, each one ought to be born free," etc.

‖ In September, 1860, the correspondent of the "Augsbürger allgemeine Zeitung" wrote from New York that the correct solution of the American slavery question would be to determine upon five steps: 1, forbid separation of negro families; 2, bind the slaves to the soil; 3, change them into serfs; 4, change serfdom to villainage; 5, abolish the last. (Quoted by Rodbertus, with approval, 2 Hildebrand's "Jahrbücher," 266.) This is as

litical vicissitudes, but the dogma of natural rights was aiding them all the time, by undermining the institutions of the law, and by destroying the confidence of the ruling classes, so far as they were religious and humane, in the justice of the actual situation.

Therefore the most important fact in regard to the history of the dogma of natural liberty is that *that dogma has never had an historical foundation,* but is the purest example that could be brought forward of an out-and-out *a priori* dogma; that this dogma, among the most favored nations, helped and sustained the emancipation of the masses; and that, by contagion, it has, in the nineteenth century, spread liberty to the uttermost parts of the earth. At no time during this movement could anybody, by looking backward to history, have found any warrant for the next step to be made in advance. On the contrary, he would have found only warning not to do anything. Such must always be the effect of any appeal to history, as to what we ought to do, or as to what ought to be. It is a strange situation in which we find ourselves, when those of us who are most unfriendly to "metaphysics," and have most enthusiastic devotion to history, find ourselves compelled to remonstrate against half-educated denial of what speculative philosophy has done and may do for mankind, and also to remonstrate against the cant of an historical method which makes both history and method ridiculous. To go off and begin to talk about history, in the crisis of a modern discussion, is the last and best device of reaction and obscurantism.

Let it be noticed also that from our present standpoint this doctrine has lost nearly all the arguments which were ever brought to its support. The notion of natural rights is not now held by anybody in the sense of reference to some original historical state of the human race. The biblical scholars would scarcely avow the exegesis by which the doctrine was got out of the Scriptures. The dogma to-day does not stand on the ground of an inference from any religious doctrine. The doctrine of evolution, instead of supporting the natural equality of all men, would give a demonstration of their inequality; and the doctrine of the struggle for existence would divorce liberty and equality as incompatible with each other. The doctrine, thus stripped of all the props which have been brought to its support, would remain only a poetic inspiration; but, if all this is admitted, if its historic legitimacy is all taken away, does that detract anything from the beneficence of the doctrine in history, or render invalid a single institution

refined and beautiful an application of the "teachings of history" as could possibly have been made to that case, yet it requires very little knowledge of the case as it really stood to see that this programme was as unpractical and pedantic as the wildest proposition which could have been made by an *a priori* philosopher.

which rests upon it now? Shall we any of us return into serfdom, because it is proved that our ancestors were emancipated under a delusion or a superstition?

On the other hand, it is when we turn to the present and the future that the rectification of the dogma becomes all-important. The anarchists of to-day have pushed the old dogma of natural liberty to the extremest form of abstract deduction, and they propose to make it a programme of action. They therefore make of it a principle of endless revolution. If, however, the basis on which it once rested is gone, it is impossible that we should hold and use it any more. With our present knowledge of history, we know that no men on earth ever have had liberty in the sense of unrestrainedness of action. The very conception is elusive. It is impossible to reduce it to such form that it could be verified, for the reason that it is non-human, non-earthly. It never could exist on this earth and among these men. The notion of liberty, and of the things to which it pertains, has changed from age to age even in modern history. Never in the history of the world has military service weighed on large bodies of men as it does now on the men of the European continent. It is doubtful if it would ever have been endured. Yet the present victims of it do not appear to consider it inconsistent with liberty. Sumptuary laws about dress would raise a riot in any American State; a prohibitory law would have raised a riot among people who did not directly resist sumptuary laws. A civil officer in France, before the Revolution, who had bought or inherited his office, had a degree of independence and liberty in it which the nineteenth-century official never dreams of. On the contrary, the more this nineteenth-century civil and political liberty is perfected, the more it appears that under it an official has freedom of opinion and independence of action only at the peril of his livelihood.

So far our task has been comparatively easy. It requires only industry to follow out the history of what men have thought about anything. To find out how things have actually taken place in the life of the human race is a task which can never be more than approximately performed, in spite of all our talk about history. To interpret the history is still another task, of a much more difficult character.*

Liberty in History and Institutions.—We are blinded by the common use of language to the fact that all social actions are attended by reactions. To take the commonest and often noticed

* The Emperor Paul, of Russia, showed what may be done in the interpretation of history. When he heard of the excesses of the French Revolution, he turned to his sons and said, "Now you see that it is necessary to treat men like dogs" (Masson, "Mémoires sur la Russie," 219). It is true that he was crazy, but we all have our personal limitations, which are most important when we undertake interpretation.

instance: We talk of buyers and sellers, as if they were independent of each other. We call those who have money buyers, and those who have goods sellers. We find, however, that no transaction can be correctly understood until we regard it as an exchange, having two parts, an action and a reaction, equal and opposite. In the language of the market, also, we speak of being long or short of the market, but every one who has either money or goods is in the market, and is both long and short of it all the time. He is either long of goods and short of money, or long of money and short of goods. The philosophy of the market can not be understood unless we study it from this point of view.

The fallacy of a great many doctrines in social science, and the philosophy of a great many errors in social policy, is that they divorce the action from the reaction. If there is not a reaction with equivalence and equilibrium, then there is an expenditure from one side toward the other, a drain of force from one side and an accumulation of it at another, until there come a crisis and a redistribution. When the return and equivalence are suspended, there is a necessary continuance of the movement, in the tendency toward a stable equilibrium of another kind, which would come about when all the force had been transferred. For instance: You give good schools for less than their market value; you must, then, give free schools; then you must give free books and stationery; then "hot breakfasts,"* and so on in succession. The fact that one thing has been given is made an argument for more. You are told: You have established free schools; "why should not you" do whatever else the proponent favors. The argument that, because you have given a man one thing, you ought to give him another, is not good in logic, but it is intensely strong in human nature and in history. The saying is attributed to Danton, the revolutionist: "The revolution came, and I and all those like me plunged into it. The *ancien régime* had given us a good education, without opening an outlet for our talents." The great fallacy of socialistic schemes is that they break off the social reaction. A man is to have something simply because he is a man—that is, simply because he is here. He is not to be called upon to render any return for it, except to stay. On the other hand, the tax-payer, who has provided all there is, is not on that account to be entitled to a recompense of any kind. He has only incurred a new liability—viz., to do the next thing which is demanded of him. The only stable equilibrium under this system would be universal contentment. But bounty does not lead to contentment, and can not, until the recipient has everything for nothing. The movement, therefore, runs to a crisis, a redistribution, a re-

* "The Economist," 1889, p. 430

commencement. The further it goes, the further it approaches anarchy, impoverishment, and barbarism.

At various times, in primitive society, in ancient Egypt, and in the Roman Empire, when women have possessed the forces which were efficient in the society, they have had dominion over men. They abused the power when they had it, too. At other times the subjection of women has been due to the fact that they have needed protection. They did not possess the forces which, at the time, were required for self-defense in the society. Since they accepted protection, they could not be free. When they fell into dependence, they could not be independent. If they could claim protection, and at the same time dominion, they would be privileged; and any one who enjoys privilege, which some one else has to furnish, is of course superior. Hence, there are three positions only in social relations: servitude with inferiority, privilege with superiority, and a middle state of neither, with equality.

Peasant proprietors turn into colons and serfs through misery.* They abandon personal liberty in order to get protection, and they accept servitude to get security, because they find that they have not enough of the force which prevails in the society to defend themselves. Their lords maintain superiority and exact for themselves social privilege. Such was the course of things at the downfall of the Roman Empire. When things began to improve in western Europe, the slave thought that it was comparative freedom when he was bound to the soil, because his family could not be separated, and he could not be removed from his home. A villain, however, would have thought it slavery to be reduced to the status of the serf, with unlimited servitudes to render. The serf, in his turn, thought it immeasurable gain to get his servitudes made definite, although a free man would have thought it slavery to be reduced to villainage. A villain could not go if he wanted to, but he could not be evicted if any one wanted to send him away. A free man can go if he wants to, and may be evicted if the other party chooses. At what point does the servitude of the villain, who must stay and work and pay feudal dues, turn into the blessing of the free tenant, who has fixity of tenure, but works and enjoys, subject to taxes? Evidently it is at that point where the rights and benefits of holding and using become equal to the burdens and duties of taking and using—always with reference to the comparative value of other chances which present themselves. If a villain wants to stay, it is a privilege that no one can evict him; if he wants to go, it is a servitude that some one can retain him. If the landlord wants to force tenants to stay and till his land, it is a privilege for him to be able

* This is a disputed point, on which a great deal has been written, with very great divergence of opinion. The above seems to me to be the best opinion.

to force them to stay.* If the landlord wants to turn his land to other use, it is a servitude for him if he can not evict his tenants. The modern peasant proprietor is one in whose status all these privileges and servitudes have met, coalesced, and disappeared, so that they are all summed up in the question whether his land is worth holding and tilling, subject to the taxes which must be paid on it.

In all these variations and mutations of social status and of the relations of classes, which we might pursue with any amount of detail through the history of the last fifteen hundred years, where is there any such thing as personal liberty of the sort which means doing as one likes? None have had it but those who were privileged—that is to say, it has lain entirely outside of civil liberty. It has had the form of an artificial social monopoly, and the fact has come out distinctly that liberty to do as you please in this world is only possible as a monopoly, but that it is the most valuable monopoly in the world, provided you can get it as a monopoly. You would realize it when you got into the position of Nero, or Louis XIV, or Catharine II.

We may gather some other cases in point.

A man who expects to go to the almshouse in his old age may regard a law of settlement as his patent of security, because it defines and secures his place of refuge. A man who is in the same status, but who is determined to better his condition by energy and enterprise, tries to move. He finds the law of settlement a curse, which may hold him down and force him to become a pauper.

If you are not able to make your own way in the world, you want to be protected by status. If you have ambition and ability to make a career for yourself, you find that status holds you down. In the former case it holds you up, or keeps you from falling; in the latter it holds you down, or keeps you from rising. On the whole, therefore, it keeps the society stagnant. If numbers do not increase very much, there may not be much suffering. If numbers do increase, there will be mendicancy, pauperism, vagabondage, and brigandage. It is a matter of great surprise that so little investigation has been expended on the vagabondage of the middle ages. The students of that period have kept their attention on those who were inside of its institutions. The test of the mediæval system is to be found in a study of those who were kept out of its institutions.

If it is a mark of a free man, as in early Rome, to do military duty, every one may regard that function as a right or privilege, rather than as a burden or duty. It may carry with it privileges

* It was so in Denmark in the last century. See Falbe-Hansen, "Stavnsbaands-Lösningen," and the "Nation," 1889, p. 123.

of citizenship which make it worth more than it costs. If, however, the privileges of citizenship are lost and the burden of military duty increases, men will, as in the dark ages, sacrifice personal liberty as well as civil liberty in order to get rid of military duty. If, as in Russia, at least formerly, the privileges of citizenship are *nil* and the burdens of military duty very heavy, to be taken as a soldier is like incurring a capital sentence.

If a man enjoys a position of advantage compared with others, he is anxious to entail it on his children. If he is under shame or disadvantage, he is anxious to break the entail. One who is born of a duke is anxious to maintain hereditariness, but one who is born of the hangman rebels against it. The two were part of one system, and, in the long run, must stand or fall together.

He who is not able to attain to his standards of happiness by his own efforts is one of the "weak." He does not want to be let alone. He wants some one to come and help him. He who is confident of his own power to accomplish his own purposes, wants to be let alone; he is "strong" and resents interference. In the long run, however, he who may be called upon for aid in the former case will insist on his right to interfere in the latter case, and he who claims freedom in the latter case will find that he must bear his own burdens in the former. Any other course would simply lead to a new system of privilege and servitude, for he who can choose his own ends and make somebody else help him attain them has realized privilege in its old and ever-abiding sense.

Privilege and servitude, therefore, are the poles between which all forms of social status lie when we classify them with reference to our present study. Rights lie on the side toward privilege. Duties lie on the side toward servitude. Rights and duties, however, are not separated by any gulf nor even by a line. They overlap each other. Not only are they parallel and connected by the social reaction, but also often to different men or at different times the same thing presents itself either as a right or a duty, e. g., military duty. Somewhere between, however, lies *the middle point or neutral point, where there is neither privilege nor servitude, but where the rights and duties are in equilibrium, and that status is civil liberty* in the only sense in which it is thinkable or realizable in laws, institutions, and history.

We have seen cases above in which the same men were under privilege and servitude at the same time, having accepted one as the price of the other. We have also seen cases in which the privilege of some involved the servitude of others. The former class of cases have been those which have had the most unhappy issue, for the privileges have often faded with time and the servitudes have been intensified. It is a bargain which a rational being can rarely afford to make, to incur servitude in the hope of privilege.

Herein lies the curse of socialistic schemes when viewed from the side of the supposed beneficiary. They are a bait to defraud him of his liberty. I do not see how the German accident and workman's insurance can fail to act as a law of settlement, thereby, under a pretense of offering the workman security, robbing him of his best chance of improving his position. Still, the cases where a man incurs his own servitude for the sake of his own privilege are not as bad in some respects as those in which some have privileges for which others bear servitudes.

The modern jural state, at least of the Anglo-American type, by its hostility to privileges and servitudes, if not by direct analytical definition of its purpose, aims to realize the above definition of liberty. It is the one which fills our institutions at their best, and the one which forms the stem of our best civil and social ideals. If all privileges and all servitudes are abolished, the individual finds that there are no prescriptions left either to lift him up or to hold him down. He simply has all his chances left open that he may make out of himself all there is in him. This is individualism and atomism.* There is absolutely no escape from it except back into the system of privileges and servitudes. The doctrine of the former is that a man has a right to make the most of himself to attain the ends of his existence. The doctrine of the latter is that a man has a right to whatever he needs to attain the ends of his existence. If the latter is true, then any one who is bound to furnish him what he needs is under servitude to him.

The fact, however, is rapidly making itself felt that this civil liberty of the modern type is a high and costly thing. A generation which has been glorying in it and heralding it to all the world as a boon and a blessing, to be had for the taking and to be enjoyed for nothing, begins to cry out that it is too great for them; that they can not attain to it nor even bear it; that to be a free man means to come up to the standard and be it; and that it is asking too much of human nature. They want somebody to come and help them to be free. It has always been so. Men have failed of freedom not because kings, nobles, or priests enslaved them, but because liberty was too high and great for them. They would not rise to it. They would submit to any servitude rather. Therefore they got servitude.

The strain of civil liberty is in the demand which it makes on the whole mass of the people for perpetual activity of reason and conscience to re-examine rights and duties, and to readjust their equilibrium. Civil liberty is not a scientific fact. It is not in the

* The writer of an otherwise good book (Rauber, "Urgeschichte des Menschen," ii, 291, fg.) indulges in an extraordinary screed against the atomists. He reaches the conclusion that fate is the state. To me it seems that fate is one's father and mother.

order of nature. It is not positive and objective; therefore it is not capable of constant and easy verification. It is historical and institutional. That means, however, that it is in the flux and change of civilization, wherefore the reason and conscience of men are kept in constant activity to re-examine accepted principles, and to reach new and more correct solution of problems. On account of this activity, institutions are modified constantly, and the concrete contents of the public creed, about rights and duties, are undergoing constant change. It does not appear that this ever can be otherwise. There is an assumption that we can attain to social stability by finding out the right "form of government," or the correct "social system," but no ground for such a notion can be found in philosophy or history.* *The equilibrium of rights and duties constitutes the terms on which the struggle for existence is carried on in a given society,* after the reason and conscience of the community have pronounced judgment on those terms. The very highest conception of the state is that it is an organization for bringing that judgment to an expression in the Constitution and laws. A state, therefore, is good, bad, or indifferent, according to the directness and correctness with which it brings to an expression the best reason and conscience of the people, and embodies their judgment in institutions and laws. The state, therefore, lives by deliberation and discussion, and by tacit or overt expressions of the major opinion.

The fact that laws and institutions must be constantly remolded, in the progress of time, by the active reason and conscience of the people, is what has probably given rise to the notion, just now so popular, that ethical considerations do, or ought to, regulate legislation and social relations. The doctrine, however, that institutions must, in the course of generations, slowly change to conform to social conditions and social forces, according to the mature convictions of great masses of men, is a very different thing from the notion that rights and duties should be at the sport of all the crude notions which, from time to time, may gain the assent of even an important group of the population.

Among the most important tides of thought at the present time which are hostile to liberty are *socialism,* which always has to assume a controlling organ to overrule personal liberty and set aside civil liberty, in order to bring about what the socialist authorities have decided shall be done; *nationalism,* really a cognate of socialism, with opposition to emigration or immigration; *state*

* One of the most remarkable signs of the confusion reigning in social science is the fact that current discussion is marked by an attempt to force positive character upon the doctrines of the state, or to make a science of "political science," which never can be anything but historical and institutional, and at the same time to deny scientific character to economic laws, and to insist that they are historical and institutional.

absolutism, which, in its newest form, insists that the individual exists for the state; and *altruism,* which, when put forward as an absolute dogma, is as anti-social as selfishness. These all are only the latest forms of the devices by which some men live at the expense of others. In their essence and principle they are as old as history, and not even the device of making the victims vote away their own liberty, apparently of their own free will, because they think they ought to do so, has anything new in it.

A STUDY OF SUICID

By CHARLES W. PILGRIM, M.D.

AS the love of life is generally acknowledged to be the strongest instinct of the human mind, it is but natural that the subject of voluntary death should have attracted, at all times, a great amount of attention from moralists and sociologists.

Some of the noblest men and women of ancient times advocated and practiced self-destruction, and the frequency of the act in our own day demonstrates that the fear of death is by no means general. Prof. Mayer, of Paris, in a lecture on this subject, declared that every one of his hearers had, at some time, thought favorably of committing the deed. He challenged contradiction, but no one responded.

This longing for "restful death," which comes to nearly all of us sooner or later, can usually be resisted; but often the desire is so great that the will is not strong enough to overcome it, and another name is added to the long list of suicides which statistics show us is increasing with terrible rapidity.

Very exhaustive statistics in regard to this subject have been compiled by Profs. Bertillion and Morselli, and they both arrive at about the same conclusions. Taking each million of inhabitants, the following results were obtained: In Austria the number was increased between 1860 and 1878 by from 70 to 122 annually; in Prussia, between 1820 and 1878, by from 71 to 133; in the smaller German states, between 1835 and 1878, by from 117 to 289; in France, between 1827 and 1877, by from 52 to 149, the greater proportion being in the larger cities. Peasants rarely commit suicide, statistics showing that in Belgium, where laborers can generally find employment, the increase between 1831 and 1876 was only from 39 to 68. In Sweden and Norway about the same result was obtained, viz., an increase from 39 to 80 per year during the same period. Italy, Spain, and Ireland show the lowest number, the increase between 1864 and 1878 being only from 28 to 35 in the former, while in Spain and Ireland it was still less, the latter show-

ing an increase of but from 14 to 18 per year during the same period. This result is probably due to a great extent to the influence of the Catholic priesthood, for it is the Roman Church, above all others, that has firmly "fix'd its canon 'gainst self-slaughter."

On account of the more settled social condition of England the statistics of that country do not show the same alarming increase as those of France, Germany, and Austria, but the regularity of the number for each five years, from 1855 to 1875—viz., from 1855 to 1860, 65; from 1860 to 1865, 66; from 1865 to 1870, 67; and from 1870 to 1875, 66—supports in a remarkable degree the statement made by Buckle that, "when the social conditions do not undergo any marked change, we find year by year the same proportion of persons putting an end to their existence, so that we are able to predict, within a very small limit of error, the number of voluntary deaths for each ensuing period."

Both Profs. Bertillion and Morselli express some doubt as to the reliability of their statistics showing an increase in the United States on account of its rapidly increasing population; but any one who will pay attention to the subject will be convinced, I am sure, that a marked increase is annually taking place; and there are many reasons why it should be so. Our country is young, social changes are rapid, and the struggle for wealth is severe. In brief, we are living in what is justly called a "fast age." The modern youth "consumes in an hour, by useless brilliancy, the oil of the lamp which should burn throughout the night," and soon finds that the infirmities of age have supplanted the vigor of youth; the business man who to-day is at the very height of prosperity, by some rash speculation becomes a bankrupt to-morrow; the professional man, who is ambitious of distinction, does not rest when the sun goes down, but prolongs his work far into the quiet hours of night. In fact, almost every one is madly pursuing either pleasure, wealth, or fame, and, under such circumstances, is it a wonder that often an overpowering sense of *ennui* and disgust of life occurs, or that the delicate structure of the brain breaks down, impelling the unfortunate victim to seek rest in the suicide's dishonored grave?

Besides dissipation, reverses of fortune and overwork, love, jealousy, and remorse play an important part in the etiology of self-destruction. Marc Antony fell upon his sword and killed himself because he believed that Cleopatra had played him false; and she, overcome by remorse and grief, placed the asp to her breast that it might "the knot intrinsicate of life untie," and thus unite her in the grave with him whose absence filled her life with woe; and the same motives which, thirty years before the birth of Christ, made Antony and Egypt's queen "a-weary of the sun," rule just as powerfully to-day in modern hearts.

Such causes, though occurring everywhere, are, of course, more frequent in large cities like Paris, London, and New York, the former probably taking precedence, it being no uncommon sight to see upon the marble slabs of the Morgue three or four dead bodies which have been recovered from the Seine. When the history of such cases can be learned, they show, in the majority of instances, the absence of domestic ties, coupled either with misguided love and jealousy or dissipation and remorse. Indeed, so far as men are concerned, we must consider marriage, with its accompanying influences of home and children, a most important prophylactic. In regard to women, however, this statement does not hold good, for with them suicide is more frequent among the married than the single, the proportion being 10 to about 9 or 9·4. This may be explained to some extent by the mental disturbances produced by pregnancy and childbirth, but the strongest reason undoubtedly is that a girl's youthful dreams of happiness are often shattered by the realities of married life.

One of the most interesting tables in this connection is that compiled by Bertillion, and first published in the "Revue Scientifique" for 1879. He found that among a million of inhabitants, taken from all classes, the following numbers committed suicide, viz.:

Married men with children..	205	Married women with children.....	45
Married men without children.....	470	Married women without children.....	158
Widowers with children.....	526	Widows with children.....	104
Widowers without children.....	1,004	Widows without children.....	238

We here learn the interesting facts that, when marriage is childless, the number of suicides is doubled in men and trebled in women; and also that maternal love diminishes the number of suicides among widows with children by one third over those of childless unions.

This table also shows that males exceed females in the frequency of the act in the proportion of four to one. While this is true of suicides in general, it certainly is not the case in those who are insane. My experience leads me to believe that suicidal tendencies in the insane are quite as frequent among women as among men, and I am sure that the former frequently show the more determination and persistence. In the outside world men lead more exciting lives and are subject to greater mental strain than women, and it is therefore natural that they should more frequently resort to suicide. Another probable reason for the comparative infrequency of suicide among women is that they are better endowed with religious fervor and possess a larger share of hope. In India and Japan only does this rule fail to hold.

good, and there the number of suicides among women is twice as great as among men. This fact bears striking witness to the hardships of woman's lot in countries removed from the influences of civilization.

Statistics show that the months in which the fewest suicides occur are October and November, while the greatest number occur in April, May, and June. July and September also have a goodly share, the latter possessing a peculiar fascination for women. This refutes the old idea that suicides occur most frequently in damp and gloomy weather, for the months just mentioned as being the most prolific are certainly those in which the skies look brightest and the earth is fairest. Another remarkable fact in this connection is that the progressive increase and decrease in the number of suicides coincide with the lengthening and the shortening of the days, and, as M. Guerry has shown, not only the seasons of the year, but the days of the month and of the week, and even the hours of the day exert an influence, the constancy of which can not be mistaken. As a result of his elaborate research he found that the greatest number of suicides among men occurred during the first ten days of the month, and from Monday to Thursday of the week. This is accounted for by remembering that the majority of workingmen receive their wages either on the first of the month or the last of the week, and that "pay-day" is often followed by dissipation, debauchery, and remorse. Oettingen completed this interesting observation by showing that the larger number of suicides among women take place during the last half of the week, when they are most apt to feel the effects of man's prodigality and wrong-doing. In regard to the hours of the day, we know, from Brierre de Boismont's examination of 1,993 cases of suicide in Paris, that the maximum number occurred between 6 A. M. and noon, and thereafter regularly declined, reaching the minimum at the hour before sunrise.

It is also an established fact that the more rugged natures of men impel them to seek coarser means of self-destruction, such as the revolver, the razor, and the rope, the latter being most frequently used by those in whom the vigor of manhood is lost. Women, on the contrary, seldom resort to measures which they think will disfigure them, and therefore most frequently seek death by poisoning, asphyxia, or drowning. This, of course, only refers to cases in which the suicide has opportunity to adopt the method preferred. In hospitals for the insane almost all suicides, both male and female, and of whatever age, are accomplished by suspension, that being generally the most available method.

Epidemics of suicide frequently occur, and he who introduces any unusual method is sure of having numerous followers. In 1793 an epidemic occurred in Versailles, and the population was

decreased within a single year by 1,300 self-sought deaths. In the Hôtel des Invalides an inmate hung himself upon a certain cross-bar, and within a fortnight five more did the same thing, although there had not been a single case of suicide in the establishment for two years before, and the threatened epidemic was only averted by the removal of the fatal bar.

Lord Bacon, in his "Essay on Death," says that, "after Otho, the emperor, had slain himself, pity (which is the tenderest of affections) provoked many to die out of mere compassion to their sovereign." Plutarch tells us that the women of the ancient city of Miletus, becoming melancholy over the absence of their husbands and lovers, resolved to hang themselves, and vied with each other in the alacrity with which they did the deed. Various other epidemics have occurred in more recent times—viz., at Rouen, in 1806; at Stuttgart, in 1811, etc.

What might almost be called an epidemic prevailed in the New York State Lunatic Asylum in July, 1850. According to the report for that year, there were at one time twenty-eight persons in the institution bent upon destroying themselves. There were admitted during that month forty-four patients, nineteen of whom were suicidal. The first successful attempt occurred on the 12th, and on the following day two more, who had been in the asylum for a long time and had never shown suicidal tendencies, attempted strangulation, and were so persistent that they were only prevented from carrying out their designs by mechanical restraint. On the 17th, 20th, and 22d other attempts were made by various patients, and before the end of the month, at which time it subsided, there had been fourteen distinct attempts by eight persons, while several others, in whom the propensity was strong, required constant watching to prevent them from accomplishing their object.

These epidemics are, to a great extent, the result of the principle of imitation, and it may be said that suicide is almost as much the subject of fashion as is dress or household decoration, and that each particular method reigns for a time and then gives way to some newer means. For instance, a man destroys himself by plunging from the heights of a tower. The newspapers graphically record the fact, and straightway a dozen more do the same thing, and the practice is only stopped when some one who is tired of life sends a bullet through his brain. This method is then adopted until another takes a dose of carbolic acid, when that in turn becomes the prevailing means.

Another proof that suicide is often due to the faculty of imitation is the fact that many cases are recorded of children committing the deed, without apparent cause, after having heard of a case in which their interest was aroused.

Among the most remarkable attempts at suicide upon record is that of a man in Fressonville, in Picardy, as related by Dr. Winslow, who was actuated by a desire to ring his own death-knell. To accomplish this object he hanged himself to the clapper of the church-bell. But, fortunately, he chose an hour at which it was not customary for the bell to ring, and attention was attracted in time to save his life. Another very deliberate attempt, probably the most extraordinary ever known, was that made by an Italian shoemaker, named Matthew Lovat. This case was originally reported by Dr. Bergierre, afterward enlarged upon by Dr. Winslow in his "Anatomy of Suicide," and has since been frequently quoted by various writers. The history of the case in brief is that the man determined to imitate as nearly as possible the crucifixion of our Saviour, and therefore deliberately set about making a cross, and providing himself with all the adjuncts of that scene. "He perceived that it would be difficult to nail himself firmly to the cross, and therefore made a net which he fastened over it, securing it at the bottom of the upright beam and at the ends of the two arms. The whole apparatus was tied by two ropes, one from the net and the other from the place where the beams intersected one another. These ropes were fastened to the bar above the window, and were just sufficiently long to allow the cross to lie horizontally upon the floor of the apartment. Having finished these preparations, he next put on his crown of thorns, some of which entered his forehead; then, having stripped himself naked, he girded his loins with a white handkerchief. He then introduced himself into the net, and, seating himself on the cross, drove a nail through the palm of his right hand by striking its head upon the floor until the point appeared on the other side. He now placed his feet upon a bracket he had prepared for them, and with a mallet drove a nail completely through them both, fastening them to the wood. He next tied himself to the cross by a piece of cord around his waist, and wounded himself in the side with a knife which he used in his trade. The wound was inflicted two inches below the hypochondrium, toward the internal angle of the abdominal cavity, but did not injure any of the parts which the cavity contains. Several scratches were observed upon his breast which appear to have been done by the knife in probing for a place which should present no obstruction. The knife, according to Lovat, represented the spear of the passion. All this he accomplished in the interior of his apartment, but it was necessary to show himself in public. To accomplish this he had placed the foot of the cross upon the window-sill, which was very low, and by pressing his fingers against the floor he gradually drew himself forward until, the foot of the cross overbalancing the head, the whole machine

tilted out of the window and hung by the ropes which were fastened to the beam. He then, by way of finishing, nailed his right hand to the arm of the cross, but could not succeed in fixing the left, although the nail by which it was to have been fixed was driven through it, and half of it came out on the other side. This happened at eight o'clock in the morning. Some persons by whom he was perceived ran up-stairs, disengaged him from the cross, and put him to bed. By medical care his wounds ultimately healed, but he was ever afterward morose and singular."

A person bent upon suicide will sometimes await a favorable opportunity for months, or overcome apparently insurmountable difficulties by the exercise of ingenuity which, if it were devoted to the accomplishment of a better object, would be worthy of the highest commendation. Dr. Wynter cites the case of a man who was placed under medical observation because he had attempted to commit suicide. He was watched with the greatest care; during nine months all means—so far as his attendants knew—by which he could injure himself were removed. But one morning he was discovered hanging by his neck from the bedstead, quite dead. How he became possessed of the cord was an enigma which was afterward solved by the discovery that he had carefully preserved every piece of string from the parcels that had been sent to him from time to time. With them he had twisted a rope sufficiently strong to accomplish his purpose. The newspapers a few months ago reported the case of a man named Frederick Helbig, of Zanesville, Ohio, who also showed considerable inventive talent. He was blind and disconsolate, and therefore resolved to die, but as none of the common methods were suited to his purpose he made his way to the cellar, broke off a piece of the gas-pipe, and then covering the end of the pipe and his head with a heavy quilt, quietly suffocated himself with the gas.

Another extraordinary case is that of a man who was quite recently admitted to the Buffalo Insane Asylum. He had attempted suicide the day before while in the station-house, and, owing to his dangerous tendencies, he was placed under the care of a special night-watch, who sat outside his door. For three nights all went well, but on the fourth he jumped from the head of his bed for the transom over his window, the only exposed glass in the room, crashing through the panes and seizing the bars on the outside. Before the attendant could prevent it he had, with a bit of glass, cut into his throat, severing the thyroid cartilage. The patient was in a frenzied condition, and it required the efforts of five attendants to keep him from tearing open the wound. The cartilage was united and the wound sewed and dressed. Foiled in his attempts to tear open the wound, he fixed his lips and jaws tightly and exhaled forcibly. He succeeded literally in blowing

himself up, for the air found its way through the slit in the cartilage into the tissues about the wound, and in a few seconds the emphysema extended as low as the clavicles and so high that his features lost all expression. He refused food and resisted nutritive enemas and shortly died of exhaustion.

The question, "Is suicide an evidence of insanity?" is one which has given rise to much discussion. In olden times it seems always to have been considered a crime, and very severe laws were enacted against it. The Hebrews did not bury the bodies of suicides until after sunset, thus treating them as they did executed criminals. The Armenians cursed and burned the house in which the suicide had lived. At Thebes their bodies were burned and no funeral rites allowed; while the Greeks, on the contrary, among whom it was the custom to burn the bodies of those who died a natural death, buried suicides immediately, as they thought it a wrong to contaminate fire, which they deemed a holy element, by burning in it the bodies of those who had been guilty of self-slaughter. In England it was formerly attended by some of the consequences of felony,* hence the term *felo de se*. All of the personal property which the party had at the time of committing the deed, even including debts to him, was forfeited to the crown, and his remains were interred, without the rites of Christian burial, in the public highway, with a stake driven through the body. In fact, everywhere was the act proscribed and considered a crime, until the present century, when it began to be regarded by many writers as a positive proof of insanity. Esquirol says, "I believe that I have proved that all suicides are mentally diseased"; and Dr. Winslow, one of the greatest authorities on this subject, supports Dr. Rowley's assertion that "suicide should ever be considered an act of insanity." On the other hand, Blandford, Griesinger, Bucknill, Tuke, Gray, and nearly all modern authorities think that suicide is often committed by people in whom no disease of the brain exists. Indeed, Dr. Gray went much further, and in one of his lectures said, "Suicide, though always an unnatural act, is, in the large proportion if not in the majority of cases, committed by persons who are entirely sane." Whether it is or is not the act of insanity can only be determined by a careful inquiry, as there are many cases to support either side of the argument, and each one must be a "law unto itself." For instance to be insane enough to commit suicide does not imply that a man must be a raving lunatic, "cutting strange antics before high Heaven," which make his madness apparent to the most unpracticed observer. Indeed, in many instances the attempt at suicide is the

* The new penal code makes it in this State a felony to attempt to commit suicide. Lawrence Ballard was sentenced to one year's imprisonment under this section, on February 8, 1883. This was the first conviction for the crime in New York under the new code.

first prominent symptom of insanity, and frequently the intensity of the suicidal tendency subsides with the progress of the disease. All who know anything about the insane will admit that lunatics very frequently possess extraordinary cunning in concealing their lunacy, and that the malady, in many cases, is successfully hidden from friends and acquaintances until some remarkable departure from the ordinary ways of life brings it to light. A case in point is that of Hood Alston, who committed suicide in New Orleans in the early part of 1879, after writing a full explanation of why he wished to die. He had been an able writer for the newspapers in many of the large cities, his habits had been those of a gentleman, and his death, in the absence of the letter which he left, would have been inexplicable. He was in the Interior Department at Washington, and was afterward appointed the secretary of a mining company in California. He was married and had every requisite for domestic happiness. "Last November," he wrote, "I became possessed of an impulse to kill my friends. I could hardly resist an opportunity. The desire would be but for a moment and then pass away. An infant was born to us two months ago. I loved it, was proud of it. When it first looked upon me the desire seized me to prey upon its young life. My friends were ignorant of my mental condition. I imparted it to no one, not even to my darling wife. I die that others may live." Dr. Winslow relates a singular case of a man who was heard to exclaim: "Do, for God's sake, get me confined, for if I am at liberty I shall destroy myself and wife; I shall do it unless all means of destruction are removed, and therefore do have me put under restraint. Something above tells me I shall do it, and I shall." Mr. Chevalier also tells us of a young lady of delicate constitution, although she had never given any symptoms of mental derangement, who suddenly started up from the tea-table and rushed to the window, out of which she endeavored to throw herself. It was with great difficulty that she was prevented from accomplishing her design. She remained insane during the rest of her life, which he adds, "was fortunately not long protracted." Such cases illustrating the frequency and intensity of the suicidal and homicidal propensity abound in every work on mental disease and are found in every asylum. But, on the other hand, there are undoubtedly many cases of suicide in which the hypothesis of insanity is untenable. Cato stabbed himself rather than live under the despotic reign of Cæsar; Themistocles poisoned himself rather than lead the Persians against his countrymen; Zeno, when ninety-eight, hung himself because he had put his finger out of joint; and Hannibal and Mithridates poisoned themselves to escape being taken prisoners. When we search Scripture we find that Saul, rather than fall into the hands of the Philistines, commanded his

armor-bearer to hold his sword that he might plunge upon it; Samson, for the sake of being revenged upon his enemies, pulled down the house in which they were reveling and "died with them"; and Judas Iscariot, after selling the Saviour for thirty pieces of silver, was overcome by remorse "and went and hanged himself." The examples quoted from ancient history show that the deed was the result of Stoic philosophy, and those from the Bible show motives sufficient for the act, and in all must we discard the theory of insanity.

To come down to our own times, we may take, for example, the case of Benjamin Hunter, the Camden murderer. For four or five days before his execution he made a practice of sitting over the prison register, with his legs covered by a blanket, and, under the pretense that they were cold, kept rubbing them with his hands, leading those who saw him to believe that he did so only for the purpose of increasing their warmth by restoring the circulation through them. Upon the night preceding the execution he managed to secrete a basin in which he placed his feet, and after cutting through the vessels with a piece of sharpened tin he commenced the process of rubbing, and was actually forcing out his life with every movement when his appearance attracted the attention of the keeper. His object had almost been gained, and, under the circumstances, can we say that it was an insane one? He was a proud man, who dreaded the disgrace of a public execution; he also possessed in a marked degree the desire to cheat the law of its deserts, which is a characteristic tendency of the criminal mind; in one constituted and situated as he was there were sufficient reasons to account for the attempt, and, instead of its being the act of a madman it was merely the effort of a determined will to accomplish a desired end. Cases innumerable might be cited, did space permit, where persons of undoubted sanity have committed suicide for the purpose of escaping suffering, punishment, or disgrace. In fact, a great many of the suicides of which we daily read, probably the majority, can not be considered due to cerebral disease, but must be looked upon rather as the result of social laws, combined with false training and education.

"Is suicide ever justifiable?" is another mooted question, and many writers have answered it in the affirmative. Epictetus, Zeno, Pliny, Seneca, and Plutarch were its advocates. Hume, in his "Essay on Suicide," says: "It would be no crime for me to divert the Nile or Danube from its course if I could; where, then, is the crime of turning a few ounces of blood out of its natural channels?" Rousseau taught, "To seek one's own good and avoid one's own harm in that which hurts not another, is the law of Nature." Budgel believed that, "when life becomes uneasy to support, and is overwhelmed with clouds and sorrows, man has a

natural right to deprive himself of it, as it is better not to live than to live in pain." Montesquieu, Montaigne, Dr. Donne, and others have advanced similar ideas; but it is needless to say that their arguments can find support only in the minds of those who believe that "death endeth all."

The tendency has always been to palliate the act, and the verdict, "committed suicide while laboring under temporary aberration of mind," has become a stereotyped phrase. This verdict was frequently rendered in earlier times for the purpose of preventing the property of the deceased from reverting to the crown, and it has been kept alive in more recent times by the desire, which is inherent in every human breast, to speak kindly of the dead. It is evident, however, that such a verdict should only be rendered when the actions of the deceased have been such as to point very strongly to insanity, or where the autopsy shows undoubted lesions of the brain. Under such conditions no other verdict would be just. But when one becomes "a deserter from the army of humanity," and resorts to suicide as a means of escape from the trials of life, the act is merely a confession of weakness, which, while it may awaken feelings of compassion, certainly does not call for palliation. There are conditions of life, I will admit, to which death might seem far preferable; but though our misfortunes may be such as to make us long for the grave, we must, to slightly change the noble words of Burke, "even in despair live on," remembering that—

> "Our time is fixed, and all our days are numbered;
> How long, how short, we know not; this we know,
> Duty requires we calmly wait the summons,
> Nor dare to stir till Heaven shall give permission."

SEA-BUTTERFLIES.

By Prof. CARL VOGT.

THE little boat lay ready at the dock of Nice; I had at that time to depend upon my own hands. The idea that a permanent station could be established on the sea-coast, with laboratories in which the student could find in one place all the aids he would need in the investigation of sea-animals, had not yet occurred to any one. It was not till I had worked two years in Nice, and had suffered all the inconveniences and loss of time that come from deficiency of means, that I devised plans for building such an establishment, which all came to no result till Herr A. Dohrn, with unexampled energy, founded the zoölogical station in Naples, a model that has been imitated in nearly all coast countries.

Thirty years ago, we did the best we could. I was living in Nice in a private house, since turned into a hotel, which stood on a projecting rock. My fishing-ground was in the Bay of Villafranca, which, cutting deep into the shore a few kilometres to the eastward, was inexhaustibly rich in swimming creatures. I had come to an understanding with an intelligent fisherman. When the weather seemed favorable to the flowing of rich tides into the bay, Joacchino would come early in the morning to my house and tell me that the Graziella lay at the dock. Then he would pack two baskets with large, wide-mouthed glasses; I would stuff into my pockets as many small glasses as they would hold, and take a net made of the finest bolting-cloth stretched upon a copper ring, and furnished with a long, strong handle. Joacchino had a similar net of his own in the boat. Magnifying glasses and compasses, hung by ribbons from the neck, completed the outfit, which was quickly deposited in the boat; Joacchino rowed, for we only went out when the air was still, and I steered. In about an hour we were in the bay.

"Do you see the tide, Joacchino?"

"There, sir, before the Sanita," answered Joacchino, after having risen and looked around.

I saw, indeed, the clear streaks with smooth, unruffled surface that usually denote the coming in of the tide.

"I hardly think," I said, "that we shall fill our vessels to-day. It is getting cloudy, and the sun is not shining."

"So much the better, sir. The sirocco is blowing outside on the sea, and will come in here in the afternoon. Do you see the long swells on the tide which run from the offing along the coast to the back of the bay? I will wager that the stream reaches to the other side of the bay, over by the lighthouse, and from there to the mouth. That is a good sign. The more cloudy the sky is, the more butterflies we shall catch."

"We must go out from the land to catch butterflies. We might perhaps get a few swallow-tails, mourning-cloaks, or a few pretty Jasons out there; but here—"

Joacchino somewhat nervously drove the boat by vigorous oar-strokes to the edge of the stream, which was really swarming with animals of various kinds.

While the *Medusæ* and the polyps had some attractions for him, he aimed particularly for a place where a transparent animal was making a fierce eddy in the stream. I at once recognized the indomitable creatures that turn so wildly in circles. It was a perfectly transparent *Pterotrachea*, about a span in length, as thick as one's finger, which keeps its long snout incessantly foraying around.

"Where you see them," said Joacchino, "the butterflies are not

far off. There! you have a handsome one, of the largest kind." He handed me a glass, with which he had dipped some out of the water.

I am quite proud of young Joacchino. He has eyes like a lynx, and has learned that the more delicate animals must not be touched with a net, but must be let run in with the water into a glass held out to receive them. In deep water the net must be handled so as to cause an eddy by the side of the animal that shall draw it along on the surface.

"Bravo, Joacchino!" I said, after examining the animal in the glass. "I know now what you know about butterflies." The animals which have been named *Pteropoda*, or wing-footed, really deserve the name. They are excitable creatures, that fly round in the broad glass, often strike the walls in their vehement movements, then suddenly draw in their wings, turn downward, and slowly sink to the bottom, to spring up again after a time and begin the old play anew. I recognized at once the boat-butterfly, dedicated to the famous seaman Peron, the *Cymbulia peroni* (Fig. 1). A little way off, one sees merely the eddy in the water

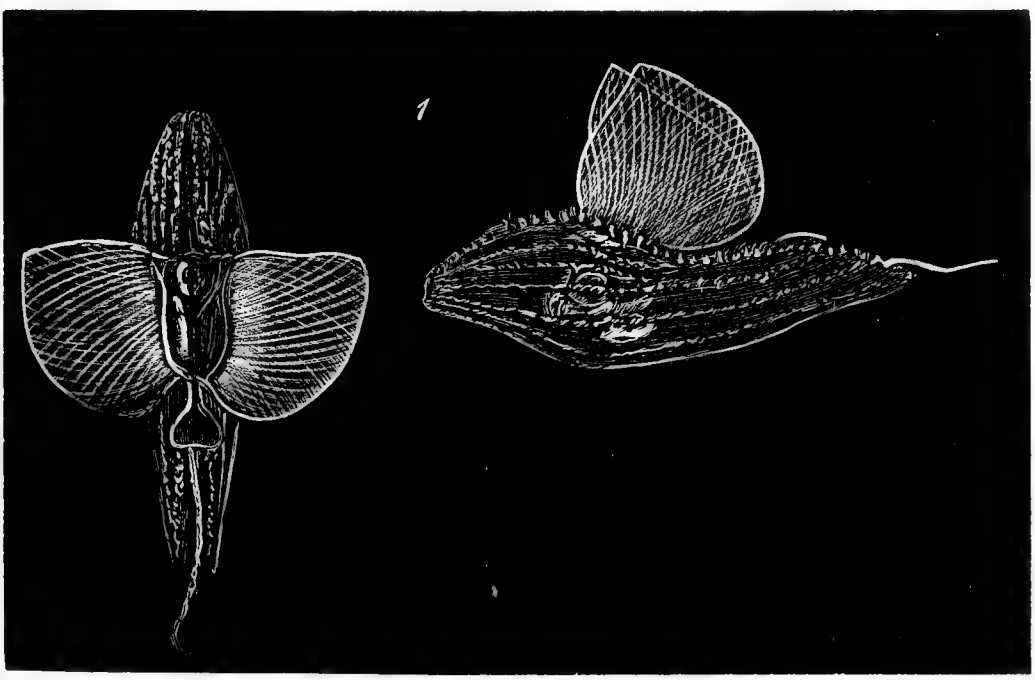

FIG. 1.—CYMBULIA PERONI.

and a brownish kernel about the size of a grain of wheat; only on a closer inspection can we distinguish two large, roundish wings, as clear as glass, that sit upon a yellowish body drawn backward in length, that rests in a crystal boat, the contour of which can not be exactly discerned, because the substance of which it is formed has the same refractive power as water. It is only when the animal is put, hardly covered with water, in a flat saucer of glass, against a black ground, that we can see the figure

of a boat hollowed above, rounded in front, and drawn out into two points behind (Fig. 1) the outer surface having wart-like processes, while fine points like the teeth of a saw rise from the upper edges in front of and behind the body.

The body itself lies in the upper hollow of the boat, and is so loosely fixed to it that if carelessly handled it is easily separated from the shell. The shell is made of a uniform and structureless substance, about midway in consistence between jelly and gristle. The animal does not appear to be especially affected in its motions by separation from the boat, but flies around in the water as before; but, as it does not live long in captivity, it has not been possible to determine whether or not it is able to form a new shell. It may be said, against such a supposition, that besides perfect animals, only empty shells or rarely shelless animals are found in the sea, while none have ever been observed with imperfect shells, as must have been the case did a new growth take place.

The body is very curiously constructed. Leaving out the wings, it appears insignificant in proportion to the shell, and as if buried in it. The fore-part corresponds with the thicker, bluntly rounded part of the boat. In the posterior channel plays a thread-like tail-appendage, starting from a heart-shaped, extremely thin, and transparent fin, which is attached to the body by a thicker stem. There is no head; in front, at the spot where the wings join in the central line, lies the mouth, projecting in the shape of a little round mast, behind which a dark-brown, crescent-shaped streak may be perceived. This is the pharynx-head shining through the body-cover. Like other mollusks, this animal bears a peculiar inner armament which has been wrongly named the tongue, but has not the least in common with the tongue of vertebrates. This tongue is variously formed, according to the food of the animal—like a file or rubber in plant-eaters, or provided with teeth, hooks, and thorns in carnivores. All the sea-butterflies have on their tongues rows of strong, pointed hooks; they are—perhaps with a few exceptions—distinctively carnivorous. But our fishing did not end with the capture of a few *Cymbuliæ* and slipping them into the glasses which we had provided, for inspection at home. The *Cymbuliæ* are the giants among the sea-butterflies of the Bay of Villafranca; a multitude of small fry also swim in the tide which even the most skilled eye can not distinguish from the water, so clear and transparent are they.

"Slowly, Joacchino! Let us drift with the stream!"

I sink the fine net into the water, so that its rim is barely under the surface, and set the long handle on the edge of the boat against the thole-pin. Joacchino slowly pushes the boat onward without beating the water.

"Stop! Give me the lager-beer glass!"

Blessed be Gambrinus! Without his invention, nobody perhaps would have thought of furnishing beer-glasses with fixed handles. The net, which was filled with a mass of swimming creatures that could not escape, was raised above the water till there was room to dip out of it with a beer-glass. We have been fortunate, for we have fallen upon a swarm of needle-butterflies,

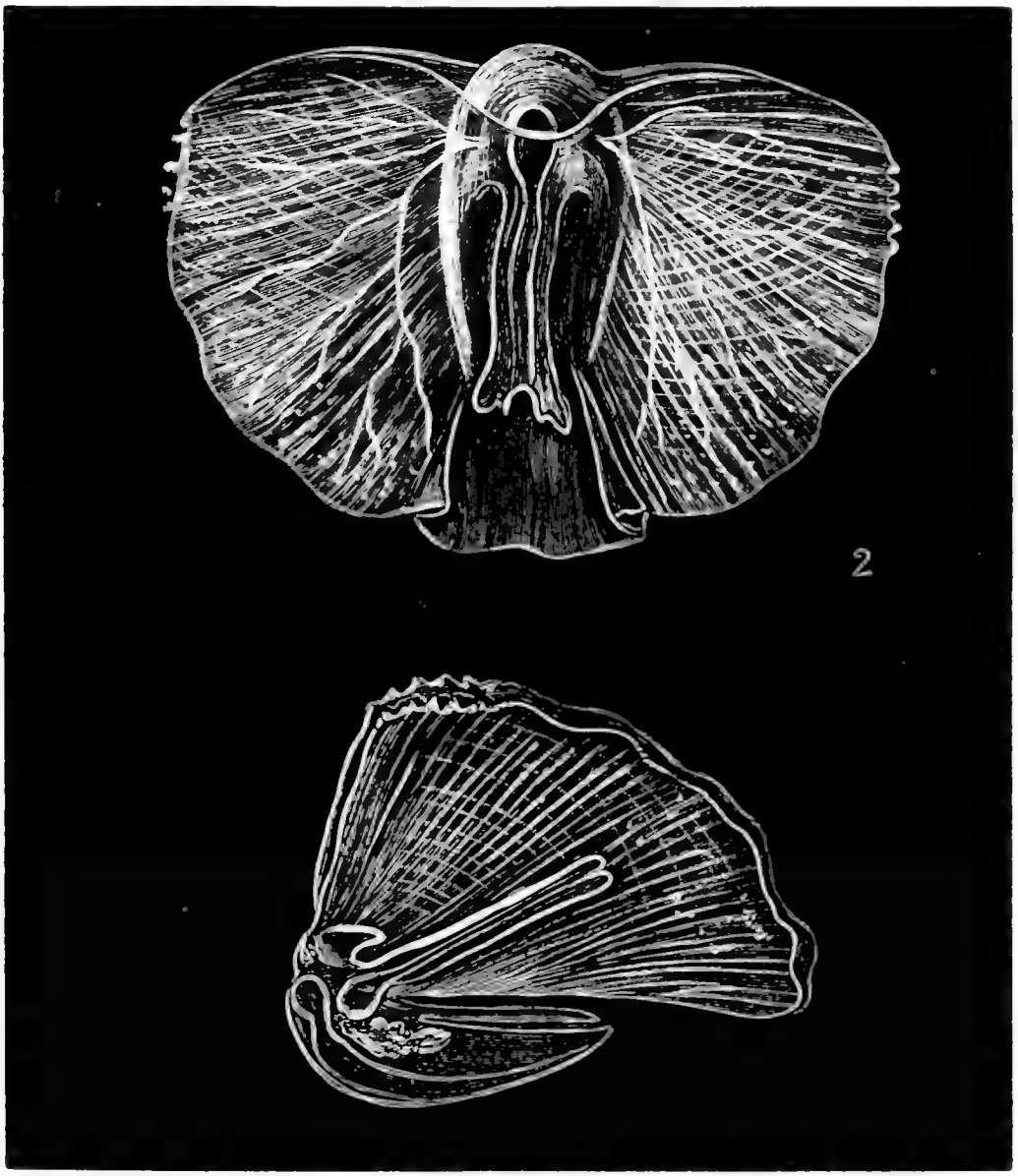

FIG. 2.—TIEDEMANNIA.

Creseis acicula (Fig. 3), and have caught a considerable number of them in our glass, besides other shelled species, such as *Hyalea tridentata* (Fig. 4), and *Cleodora lanceolata* (Fig. 5). But it is best to isolate them, and to separate from among the other little transparent minnows certain crustaceans, some of which might take a notion to attack the butterflies and eat them. Then we turned toward home. The hour and a half occupied in the journey back was spent in selecting out.

I let the water run out of the net into a small glass, so as to be sure that it contains no other animals, and take a glass tube long enough easily to reach the bottom of the mug. The life here is all in a confusion of panic on account of the cramped quarters. I introduce the tube, holding the upper end tightly closed with my forefinger. The air contained within it permits very little water to enter.

We have now to keep a sharp lookout. When I perceive a butterfly which perhaps has sprung at a bound to the surface and is now gently sinking back, I try to bring the lower end of my tube close to it. My forefinger is then suddenly raised; a stream of water, stronger as the tube is deeper in, presses out the escaping air and draws the animal in with it. My forefinger is then brought down to close the upper end, the tube is drawn out, and the animal in it is transferred to the collecting-glass. This is a simple method of catching such small and delicate animals, but must be well practiced if one would acquire any skill in it. It can not be used successfully in a rough sea, and when that is the condition the student must wait till he gets home. But when the animal is secured, it is a real joy to lose one's self in contemplating it with the lens and microscope. The needle-butterflies are a beautiful object. Their cylindrical, glass-clear shell is firm enough to stand a slight pressure. An animal is caught in the prescribed way and put in a compressorium; a small instrument, a thin glass-plate or cover, is used with a tortuous movement to bring it closer up on the stand, which is also of glass. A drop of water is made to fall on the stand, the creature to be examined is brought up, and the two plates are twisted till both touch the drop. We might crush our specimen with the apparatus; but we carefully regulate the pressure so that no harm shall come to it while it is held fast in the same place. It struggles, beating with its wings, but all its exertions are in vain; it can not in the narrow space overcome the pressure that weighs upon its shell.

It is a wonderful view we get under the microscope of the fine muscular fibers crossing one another in the wings, now drawing together and now extending out, and we can follow the ramifications of the nerves and the vessels of the circulation. We perceive the motions of the mouth as it opens and shuts, the pharynx-head with the tongue, which is projected and withdrawn, the connections of the intestine; we see the heart beat, and can follow the current and eddies of water which are produced in the breathing-pores and certain secretory openings by the beating of innumerable cilia in their regular way. The animals are hermaphrodite. We can see the eggs and other products in the organs where they are generated and in the channels through which they are expelled. Only a few hours passed before the needle-butterflies and

their relatives could be seen laying eggs, with transparent shells, which resembled rosaries or long pods, in the spaces of which the eggs swam in a clear liquid. Do they lay these eggs because they are comfortable in the vessel, or in order to rid themselves of what is a burden in their straitened captivity? While this question is still unanswered, it is certain that such strings of eggs and pods are also found drifting in the open sea, that the eggs which are laid in captivity are usually fertilized, and that the development of the embryo can be followed under the microscope —at least, till the point when the larvæ, which go through many metamorphoses, leave the shells to swim in the sea. These do not resemble the parents, but the larvæ of creeping sea-mollusks, and swim by means of a ciliary apparatus which grows on the head, and afterward, when the wings have been formed, is repressed. The free larvæ have not been successfully raised any further in captivity. Probably they die of hunger, for it is impossible to feed them. But we can fish them out of the sea in a net, and can compare from the various forms found among them the succession of single steps in their growth to the adult state. This is, indeed, not always easy, for, on the one hand, the larvæ of different species are often very much alike, and, on the other hand, the currents do not always fetch what is wanted, so that many observers have to wait year after year to continue their observations and bring them to a conclusion.

Dealing with the pelagic animals that swim on the high sea is a delicate matter, and, despite the most careful researches, the

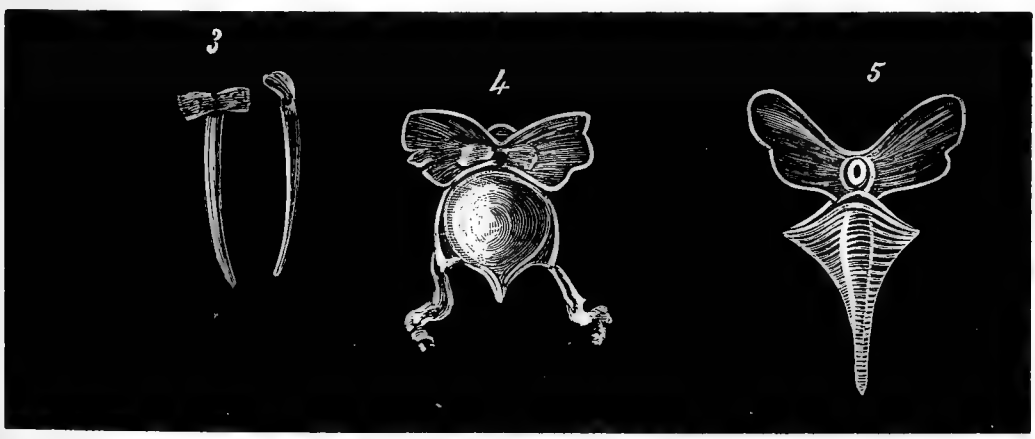

FIG. 3.—CRESEIS ACICULA. FIG. 4.—HYALEA TRIDENTATA. FIG. 5.—CLEODORA LANCEOLATA.

cause of their appearance and disappearance has never been ascertained. In the years from 1850 to 1852, which I spent in Nice, and when I fished with my fine net at least twice a week in the Bay of Villafranca, I only found a few species of needle-butterflies and related species. *Cymbuliæ*, which could not have escaped me then, I first found at a visit in the Easter vacation of 1867, when they were very numerous. Messina is the Mediterranean station

where the butterflies are brought in the largest number and most various forms from the stream of Charybdis. When I last spring asked my colleague there, Prof. Kleinenberg, to send me a few specimens of a naked shelless species (*Pneumodermon*), my courteous friend sent me a goodly number of other butterflies, and wrote: "I am sorry I can not send *Pneumodermon*. While it was formerly so abundant that one could hardly make a haul without having some in his net, there are now none here." The same Job's comfort came from the zoölogical station at Naples, which usually afforded remarkably fine sea-animals, and where I myself had obtained *Pneumodermon* two years before. I received a splendid lot of other butterflies, which were so well preserved that one could almost believe they were still alive; but *Pneumodermon* was not among them.

In Messina, however, is found the round butterfly, *Tiedemannia* (Fig. 2), of gigantic proportions when compared with the others, which somewhat resembles the mourning-cloak of the land-snails,

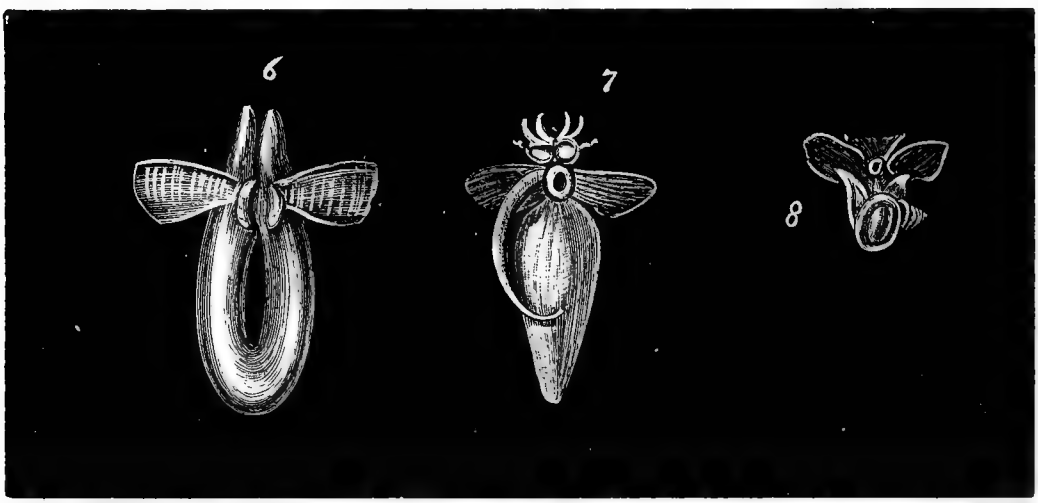

FIG. 6.—CLINOPSIS KROHNII. FIG. 7.—CLIONE BOREALIS. FIG. 8.—LIMACINA ARCTICA.

but is otherwise of like structure with the *Cymbuliæ*. It also has a water-clear shell, but much smaller and entirely smooth; its wings are united into a large disk, and its mouth is drawn out into a long, double-tipped snout, which the animal carries in swimming like a rakish mast between the wings.

All the sea-butterflies mentioned above are predatory, but I am inclined to believe that certain gorbellies, which are comparable to corpulent night-moths, and might be called thick butterflies (*Hyalœa*), are also, besides, plant-eaters. They tumble around clumsily at Messina and Naples, are occasionally driven to Villafranca, and are distinguished by their swollen, brownish shell, extending into a point behind, and having a narrow opening, out of which rise the short and massive three-lobed wings. They usually bear ragged or ribbon-like appendages of a brown or dark-

green color, which well adapt them to abiding among the sea-weeds. In the intestines of many specimens which I have examined for that purpose I have found among fine grains of sand and mold dubious remains of sea-plants and little shells of swimming mollusk-larvæ.

Many sea-butterflies are naked, having their spindle-like bodies, instead of shells, covered only by a sack-like skin. The laterally fixed wings are sometimes drawn back into pockets, and over them rises a roundish, somewhat depressed head-part, which is occasionally provided with appendages bearing hooks or suckers. To them belongs the above-mentioned violet-colored *Pneumodermon* of the Mediterranean Sea, which, when danger is impending, envelops itself in a white cloud of slime that is secreted in numerous glands, but is soon exhausted.

A species occurs in the northern seas which, together with a little butterfly, *Limacina arctica* (Fig. 8)—a species having a somewhat spiral, transparent shell—comes into remarkable direct relations with man. The little *Limacinas* appear in immense swarms in the polar seas, and the not less numerous naked Cliones, *Clione borealis* (Fig. 7), which are much larger and inflict grievous destruction upon them. In the Mediterranean Sea the Cliones are represented by the related genus, *Clinopsis Krohnii* (Fig. 6). The polar voyager, Captain Halböll, once tried to bring some living Cliones to Prof. Eschricht, in Copenhagen, for examination. Knowing that they were carnivorous, he fed them with reindeer-meat, which they ate greedily at first; but, although he changed the water frequently, he was not able to keep them alive more than eight days, and had to bring them preserved in alcohol. But Eschricht made a very satisfactory research upon them.

The Limacinas eat little crustaceans, the Cliones eat the Limacinas, and both are consumed by the ton by whales. The Greenland whale appears to live almost exclusively on the two species of sea-butterfly, which it has to swallow in immense quantities to fill its capacious maw. It eats also other pelagic small fry and crustaceans as side-dishes.

These are only indirect relations in which the sea-butterflies inhabiting all seas stand to man. But they are important enough. Without whale-food, no whales; without these, no blubber to grease sailors' water-proof boots and overalls; and without boots and southwesters, no sailors and high-sea fishermen; and without whales, no whalebone, no parasols and umbrellas and corsets, which were not worn by the beauties of ancient times, because they were limited to the productions of the Mediterranean Sea, where there are no Greenland whales. But chains of this kind can be found everywhere.

The older French naturalists—D'Orbigny, Péron, Lesueur—

who paid much more attention to the butterflies of the tropical seas than to those of the nearer Mediterranean, pronounced them nocturnal high-sea animals. They had never been seen near the coast, nor before sunset. They were not found at a less distance than about ten marine miles from the coast, and disappeared in the deep at daybreak. That may be correct for the tropical regions, where a dazzling sunlight is poured upon the highly heated surface of the sea; but it must not be forgotten that the sea-butterflies have no eyes, and their keeping away from the coast, where the water is highly warmed to a considerable depth, may indicate that temperature is more a determining factor in this behavior than light. The sea-butterflies behave differently in the Mediterranean. They are not wanting on sunny days, but are more numerous when the sky is clouded and in the night. In midsummer they are, like many other pelagic animals, extremely rare, and keep themselves in the great deeps. Prof. Chun, of Königsberg, who investigated this matter in the summer of 1886, fished larvæ of *Cymbulia* and *Tiedemannia* from as great depths as a thousand metres. Temperature may also be the decisive moment in this case; why should the animals not spend their summer vacation there? The sea-butterflies of the Mediterranean are not at all afraid of the coast. The Bay of Villafranca is hardly two kilometres wide, and they swim in the straits and harbor of Messina. I have caught multitudes of needle-butterflies in the daytime in that stream, close by the shore.

The case is somewhat different in the polar seas. We hunt the whale during the polar summer, when the sun does not set for months, and not in the polar nights, which are also months long, and when the ships would be frozen in the ice. If the Clliones and Limacinas were night animals they would not come to the surface during the whaling season, and would also not be known to sailors and hunters. They might, in fact, seek the deep in winter for the same reasons that they resort to it in summer in the Mediterranean—to escape extremes of temperature. Everything that lives depends on external conditions, and, as these are not everywhere the same, the behavior of the organisms subject to them must adapt itself to the local relations.—*Translated for the Popular Science Monthly from Land und Meer.*

THE fact that the enforcement of the legal requirements as to air-space in school-rooms fails of itself to secure a wholesome atmosphere, has been emphasized by Dr. George Reid's inspections of the schools of Stafford, England, where from 2·039 to 3·708 volumes of carbonic acid per 1,000 volumes of air were found to be present. With all the air that may be allowed, arrangements for some kind of circulation are still necessary.

FARM-LIFE IN CHINA.

By ADELE M. FIELDE.

THE number of persons that may subsist upon the products of an acre of land appears to have been practically determined by the Chinese. On ground that has been tilled for thousands of years they, by a skillful use of fertilizers and by attention to the welfare of each plant, raise crops that would honor a virgin soil.

In this Swatow region probably nine tenths of the men are engaged in agriculture. The farmers live in villages, isolated dwellings being uncommon. The villages are walled, contain no wasted space, and are densely peopled. The wide-spreading, flat fields, lying along the river-banks at the foot of the hills, may be made to yield here on the Tropic of Cancer a constant series of crops without interval on account of winter. Their chief productions are rice, sugar-cane, sweet potatoes, pulse, garden vegetables, peanuts, indigo, sesamum, ginger, the grass-cloth plant, tobacco, and wheat. Rice is the staple food of the people, and in the best years the local product just supplies the local demand. Sugar is the principal export. The cane requires less labor than any other crop, and will grow upon unwatered land, which is unsuitable for rice-culture. One crop of cane or two crops of other produce may be grown in the same year upon unwatered land. On the best rice-fields three crops are sometimes raised. The early rice is sowed in April and harvested in July; the late rice is sowed in August and harvested in November, and the field is then sometimes planted with garden vegetables, which are pulled in March. The expense of fertilizing the third crop is so nearly equal to its value that it is never reckoned as a source of profit to the cultivator.

The whole country belongs theoretically to its sovereign, and upon all land that can be tilled with profit a tax is paid into the imperial treasury. The sum due annually to the Government for the use of land is fixed for each field, amounts to from sixty cents to two dollars, and averages a dollar and a half upon each English acre.

When a father dies his land is divided equally among his sons, the eldest receiving an additional tenth on account of the extra expense to which he is put in worshiping the *manes* of the ancestor. The land is distributed very generally, though unequally, among the people, and is usually tilled by its peasant proprietor. Few own so much as two hundred acres; one who owns ten acres is reckoned wealthy, and he who owns one acre possesses a competence. Those who own from one tenth to one half an acre are

most numerous, and therefore there are many who till land for a share of the produce.

Land that is too sterile for profitable cultivation or for taxation sells for from six to sixty dollars an acre, while good farmland is valued at from three hundred to eight hundred dollars an acre. Rice-fields not in the vicinage of a city sell readily for six hundred dollars an acre, and are not always to be bought at that price, because those who own land find it the safest investment, and part with it only when under the stress of debt. The bursting of dikes, drought, and bad habits are the chief causes of the transfer of land, and the sale of a child often precedes that of the rice-field. Interest on money lent is from twelve to twenty per cent, according to agreement between lender and borrower.

The chief expense of tillage is in fertilizers, beans and sesamum-seeds from which the oil has been expressed being commonly used, at an outlay of from six to forty and an average of twenty-four dollars upon every acre of land. Besides this, potato-peelings, hair from shaven heads, and all other vegetable and animal refuse is carefully husbanded and methodically applied to the soil. The clods of the field are laid up into little ovens to retain and be enriched by the smoke of the stubble burned underneath them. Adobe houses, whose walls have for many years absorbed the fumes of a kitchen and the exhalations of human inmates, are pulverized and added to the ever-hungry earth. Each growing plant separately receives distinguished consideration, a scrap of tobacco-stalk being sometimes put beside its root to destroy underground grubs, while its leaves are frequently examined and sedulously freed from vermin. The rotation of crops is always practiced.

As no milk, butter, or cheese is used, the only quadruped seen on the farms is the water-buffalo, or the zebu, which assists in plowing and harrowing. Many farmers rear ducks, which are taken to the fields to devour the snails, crabs, and young frogs which thrive there at planting-time. Fowls often accompany the harvesters, picking up the last grains left among the stubble.

Few families are without the ubiquitous black hog, whose usual habitat is the door-step. Its food is the bran of the rice hulled and eaten in the house; its head is the chief offering set before the *lares* and *penates*, and its flesh is most highly esteemed among festive viands. It is reared at small expense, makes no disputed demand on space, furnishes the unctuous element in a satisfying bill of fare, and can always be sold at ten cents a pound.

The farming appliances are simple, and a complete outfit can be bought for forty dollars. A plow with two shares, a pair of harrows, and a fanning-mill each cost two dollars; a pump worked

by treadles in irrigating the fields, four dollars; a water-buffalo, twenty dollars; hoes, sickles, baskets, and sundries, nine dollars.

When land is leased, the owner pays the taxes, and the lessee furnishes all that is required in tillage. Payment to the landlord is always made in unhusked rice, and when the land is worked on shares this amounts to about one half the crop. The usual bargain for the use of land is a ton and a quarter of unhusked rice, worth about thirty dollars, for each acre. If the year be remarkably bad, the lessee may insist upon the landlord's taking one half the crop, though that be manifestly much less than the amount agreed upon as payment. If the year be good and the land excellent, the lessee may pay one third of his crop to the landlord, may have expended another third upon fertilizers, and may have the other third as net profit for his labor. As one man is unable to till more than one acre alone, the average yearly earnings of men who work land on shares is less than thirty dollars. One acre of good land produces on the average 3,648 pounds of clean rice.

A farmer may be hired by the year for from eight to fourteen dollars, with food, clothing, head-shaving, and tobacco. Those who work by the day receive from eight to ten cents, with a noonday meal. At the planting and harvesting of rice, wages are from ten to twenty cents a day, with five meals; or thirty cents a day without food. Few land-owners hire hands, except for a few days during the planting and harvesting of rice. Those who have more land than they and their sons can till, lease it to their neighbors.

Much land is held on leases given by ancient proprietors to clansmen whose descendants now till it, paying from seven to fourteen dollars' worth of rice annually for its use.

Food averages little more than a dollar a month for each member of a farmer's family. One who buys, cooks, and eats his meals alone, spends from one and a half to two dollars a month upon the raw material and fuel. Two pounds of rice, costing three and a half cents, with relishes of salt fish, pickled cabbage, cheap vegetables and fruits, costing a cent and a half, is the ordinary allowance to each laborer for each day. Abernethy's advice to a luxurious patient, "Live on sixpence a day and earn it," is followed by nearly every Chinaman. One or two dependent relatives frequently share with him the sixpence.

Five dollars, wisely spent, each year, will keep up a comfortable and even elegant outfit of clothing for a man or a woman. The clothing is usually woven in hand-looms in the farmer's house, from the fiber of the grass-cloth plant (*Boehmeria nivea*), or from imported cotton yarn. The average amount of clothing possessed by a farmer may be reckoned at four dollars in value.

A room may be comfortably furnished by an outlay of five

dollars, and such a room would usually be occupied by three or four persons. The house varies in value, from the twenty-dollar cabin of the poor to the thousand-dollar dwelling of the rich. The value of the land in the villages in which the agriculturists live is from six to eight hundred dollars an acre.

As the emigration of men is constant, and the smothering of female infants is common, it is probable that the land will support no more than its present population. One sixth of an acre to each mouth to be filled is commonly declared to be the least that will enable the cultivator to live upon his own land, even with the highest tillage and the utmost frugality. One acre, tilled by the peasant proprietor alone, will feed six persons—the peasant, his wife, his aged father and mother, and his two young children. It will yield rice, hulled in the house, and vegetables, raised between rice-crops, sufficient for food. The straw and stubble will serve as fuel, and the pig and fowls will supply meat. The clothing will be woven and made by the wife, while the old couple take care of the children. The aged and the young are thus provided for through the land which has been the property of the one and will be the inheritance of the other. If dirt, superstition, and mendacity were eliminated from such a home, its inmates would appear eminently fit to survive. A process of natural selection has doubtless adapted the Chinese to their environment.

Two brothers, aged thirty-one and thirty-two years, inherited from their father one acre of land, half of which is watered. Their house, with the ground on which it is built, is worth fifty, their furniture fifteen, their clothing twenty, and their farming appliances thirty dollars. They live as well as do their neighbors, have paid up a debt inherited with their land, and are now laying up money to invest in wives. Twenty years ago a wife could be betrothed for thirty dollars, whereas none can now be obtained for less than a hundred dollars, and the price is rapidly rising. Last year they got twenty-seven dollars' worth of rice from one half their farm, after having put on twelve dollars' worth of fertilizers. On the other half they planted sugar-cane, put on fifteen dollars' worth of manure, and sold the standing crop for forty dollars. The younger brother did nearly all the work.

Pong Hia lives in a village of three hundred persons, in which about thirty men are land-owners, having altogether forty-five acres of land. Pong Hia owns two acres, inherited from the father who adopted him. His land is worth one thousand dollars. His family consists of ten persons. He is himself forty-six years old, his wife is forty-one, his son is twenty-two, his son's wife is twenty-one, his four daughters are from ten to seventeen, and his two grandchildren are three and seven years old. He and his son till the land, hiring help at harvest-time, and weaving straw mats on

rainy days. The women-folk make the clothing, rear pigs and fowls, and do all the house-work. Their dwelling, with its site, is valued at a hundred and twenty dollars, their furniture at forty-four dollars, their clothing at forty dollars, their farming appliances at forty dollars. They have a water-buffalo, two hogs, thirty fowls, ten ducks, a pair of geese, a dog, and a cat. Last year Pong Hia sold twenty dollars' worth of rice from his farm, and paid $3.60 in taxes. He has two hundred dollars out at interest, at eighteen per cent.

At this rate of production and consumption, the arable land in the State of New York, with a reduction of one half its returns on account of its more northern latitude, would support the total population of the United States at the present time; and the occupied arable land of the United States, with its producing power diminished, on account of climate, to one half that of land at Swatow, would feed a population equal to that of the whole world, or over 1,400,000,000.

CHRISTIANITY AND AGNOSTICISM.

By Rev. Dr. HENRY WACE,
PRINCIPAL OF KING'S COLLEGE.

READERS who may be willing to look at this further reply on my part to Prof. Huxley need not be apprehensive of being entangled in any such obscure points of church history as those with which the professor has found it necessary to perplex them in support of his contentions; still less of being troubled with any personal explanations. The tone which Prof. Huxley has thought fit to adopt, not only toward myself, but toward English theologians in general, excuses me from taking further notice of any personal considerations in the matter. I endeavored to treat him with the respect due to his great scientific position, and he replies by sneering at "theologians who are mere counsel for creeds," saying that the serious question at issue "is whether theological men of science, or theological special pleaders, are to have the confidence of the general public," observing that Holland and Germany are "the only two countries in which, at the present time, professors of theology are to be found whose tenure of their posts does not depend upon the result to which their inquiries lead them," and thus insinuating that English theologians are debarred by selfish interests from candid inquiry. I shall presently have something to say on the grave misrepresentation of German theology which these insinuations involve; but for myself and for English theologians I shall not condescend to reply to them. I content myself with calling the reader's atten-

tion to the fact that, in this controversy, it is Prof. Huxley who finds it requisite for his argument to insinuate that his opponents are biased by sordid motives; and I shall for the future leave him and his sneers out of account, and simply consider his arguments for as much, or as little, as they may be worth. For a similar reason I shall confine myself as far as possible to the issue which I raised at the Church Congress, and for which I then made myself responsible. I do not care, nor would it be of any avail, to follow over the wide and sacred field of Christian evidences an antagonist who resorts to the imputation of mean motives, and who, as I shall show, will not face the witnesses to whom he himself appeals. The manner in which Prof. Huxley has met the particular issue he challenged will be a sufficient illustration to impartial minds of the value which is to be attached to any further assaults which he may make upon the Christian position.

Let me then briefly remind the reader of the simple question which is at issue between us. What I alleged was that "an agnosticism which knows nothing of the relation of man to God must not only refuse belief to our Lord's most undoubted teaching, but must deny the reality of the spiritual convictions in which he lived and died." As evidence of that teaching and of those convictions I appealed to three testimonies — the Sermon on the Mount, the Lord's Prayer, and the story of the Passion—and I urged that whatever critical opinion might be held respecting the origin and structure of the four Gospels, there could not be any reasonable doubt that those testimonies "afford a true account of our Lord's essential belief and cardinal teaching." In his original reply, instead of meeting this appeal to three specific testimonies, Prof. Huxley shifted the argument to the question of the general credibility of the Gospels, and appealed to "the main results of biblical criticism, as they are set forth in the works of Strauss, Baur, Reuss, and Volkmar." He referred to these supposed "results" in support of his assertion that we know "absolutely nothing" of the authorship or genuineness of the four Gospels, and he challenged my reference to Renan as a witness to the fact that criticism has established no such results. In answer, I quoted passage after passage from Renan and from Reuss showing that the results at which they had arrived were directly contradictory of Prof. Huxley's assertions. How does he meet this evidence? He simply says, in a foot-note, "For the present I must content myself with warning my readers against any reliance upon Dr. Wace's statements as to the results arrived at by modern criticism. They are as gravely as surprisingly erroneous." I might ask by what right Prof. Huxley thus presumes to pronounce, as it were *ex cathedra*, without adducing any evidence, that the statements of another writer are "surprisingly erroneous"? But I in

my turn content myself with pointing out that, if my quotations from Renan and Reuss had been incorrect, he could not only have said so, but could have produced the correct quotations. But he does not deny, as of course he can not, that Reuss, for example, really states, as the mature result of his investigations, what I quoted from him respecting St. Luke's Gospel, namely, that it was written by St. Luke and has reached us in its primitive form, and, further, that St. Luke used a book written by St. Mark, the disciple of St. Peter, and that this book in all probability comprised in its primitive form what we read in the present day from Mark i, 21, to xiii, 37. These are the results of modern criticism as stated by a biblical critic in whom Prof. Huxley expressed special confidence. It was not therefore my statements of the results of biblical criticism with which Prof. Huxley was confronted, but Reuss's statements; and, unless he can show that my quotation was a false one, he ought to have had the candor to acknowledge that Reuss, at least, is on these vital points dead against him. Instead of any such frank admission, he endeavors to explain away the force of his reference to Reuss. It may, he says, be well for him

> to observe that approbation of the manner in which a great biblical scholar—for instance, Reuss—does his work does not commit me to the adoption of all, or indeed of any, of his views; and, further, that the disagreements of a series of investigators do not in any way interfere with the fact that each of them has made important contributions to the body of truth ultimately established.

But I beg to observe that Prof. Huxley did not appeal to Reuss's methods, but to Reuss's results. He said that no retractation by M. Renan would sensibly affect "the *main results of biblical criticism as they are set forth in the works of* Strauss, Baur, Reuss, and Volkmar." I have given him the results as set forth by Reuss in Reuss's own words, and all he has to offer in reply is an *ipse dixit* in a foot-note and an evasion in the text of his article.

But, as I said, this general discussion respecting the authenticity and credibility of the Gospels was an evasion of my argument, which rested upon the specific testimony of the Sermon on the Mount, the Lord's Prayer, and the narrative of the Passion; and, accordingly, in his present rejoinder Prof. Huxley, with much protestation that he made no evasion, addressed himself to these three points. And what is his answer? I feel obliged to characterize it as another evasion, and in one particular an evasion of a flagrant kind. The main point of his argument is that from various circumstances, which I will presently notice more particularly, there is much reason to doubt whether the Sermon on the Mount was ever actually delivered in the form in which it

is recorded in St. Matthew. He notices, for instance, the combined similarity and difference between St. Matthew's Sermon on the Mount and St. Luke's so-called "Sermon on the Plain," and then he adds:

> I thought that all fairly attentive and intelligent students of the Gospels, to say nothing of theologians of reputation, knew these things. But how can any one who does know them have the conscience to ask whether there is "any reasonable doubt" that the Sermon on the Mount was preached by Jesus of Nazareth?

It is a pity that Prof. Huxley seems as incapable of accuracy in his quotations of an opponent's words as in his references to the authorities to whom he appeals. I did not ask "whether there is any reasonable doubt that the Sermon on the Mount was preached by Jesus of Nazareth," and I expressly observed, in the article to which Prof. Huxley is replying, that "Prof. Reuss thinks, as many good critics have thought, that the Sermon on the Mount combines various distinct utterances of our Lord." What I did ask, in words which Prof. Huxley quotes, and therefore had before his eyes, was "whether there is any reasonable doubt that the Lord's Prayer and the Sermon on the Mount afford a true account of our Lord's essential belief and cardinal teaching." That is an absolutely distinct question from the one which Prof. Huxley dissects, and a confusion of the two is peculiarly inexcusable in a person who holds that purely human view of the Gospel narratives which he represents. If a long report of a speech appears in the "Times" and a shortened report appears in the "Standard," every one knows that we are none the less made acquainted—perhaps made still better acquainted—with the essential purport and cardinal meaning of the speaker. On the supposition, similarly, that St. Matthew and St. Luke are simply giving two distinct accounts of the same address, with such omissions and variations of order as suited the purposes of their respective narratives, we are in at least as good a position for knowing what was the main burden of the address as if we had only one account, and perhaps in a better position, as we see what were the points which both reporters deemed essential. As Prof. Huxley himself observes, we have reports of speeches in ancient historians which are certainly not in the very words of the speakers; yet no one doubts that we know the main purport of the speeches of Pericles which Thucydides records.

This attempt, therefore, to answer my appeal to the substance of the teaching of the Sermon on the Mount is a palpable evasion, and it is aggravated by the manner in which Prof. Huxley quotes a high German authority in support of his contention. I am much obliged to him for appealing to Holtzmann; for, though Holtzmann's own conclusions respecting the books of the New

Testament seem to me often extravagantly skeptical and far-fetched, and though I can not, therefore, quite agree with Prof. Huxley that his "Lehrbuch" gives "a remarkably full and fair account of the present results of criticism," yet I agree that it gives on the whole a full and fair account of the course of criticism and of the opinions of its chief representatives. Instead, therefore, of imitating Prof. Huxley, and pronouncing an *ipse dixit* as to the state of criticism or the opinions of critics, I am very glad to be able to refer to a book of which the authority is recognized by him, and which will save both my readers and myself from embarking on the wide and waste ocean of the German criticism of the last fifty years. "Holtzmann, then," says Prof. Huxley in a note on page 489, "has no doubt that the Sermon on the Mount is a compilation, or, as he calls it in his recently published 'Lehrbuch' (p. 372), 'an artificial mosaic work.'" Now, let the reader attend to what Holtzmann really says in the passage referred to. His words are: "In the so-called Sermon on the Mount (Matt. v–vii) we find constructed, on the basis of a real discourse of fundamental significance, a skillfully articulated mosaic work."* The phrase was not so long a one that Prof. Huxley need have omitted the important words by which those he quotes are qualified. Holtzmann recognizes, as will be seen, that a real discourse of fundamental significance underlies the Sermon on the Mount. That is enough for my purpose; for no reasonable person will suppose that the fundamental significance of the real discourse has been entirely obliterated, especially as the main purport of the sermon in St. Luke is of the same character. But Prof. Huxley must know perfectly well, as every one else does, that he would be maintaining a paradox, in which every critic of repute, to say nothing of every man of common sense, would be against him, if he were to maintain that the Sermon on the Mount does not give a substantially correct idea of our Lord's teaching. But to admit this is to admit my point, so he rides off on a side issue as to the question of the precise form in which the sermon was delivered.

I must, however, take some notice of Prof. Huxley's argument on this irrelevant issue, as it affords a striking illustration of that superior method of ratiocination in these matters on which he prides himself. I need not trouble the reader much on the questions he raises as to the relations of the first three Gospels. Any one who cares to see a full and thorough discussion of that difficult question, conducted with a complete knowledge of foreign criticism on the subject, and at the same time marked by the greatest lucidity and interest, may be referred to the admirable

* "In der sog. Bergpredigt, Mt. 5–7, gibt sich eine, auf Grund einer wirklichen Rede von fundamentaler Bedeutung sich erhebende, kunstreich gegliederte Mosaikarbeit."

"Introduction to the New Testament," by Dr. Salmon, who, like Prof. Huxley, is a Fellow of the Royal Society, and who became eminent as one of the first mathematicians of Europe before he became similarly eminent as a theologian. I am content here to let Prof. Huxley's assumptions pass, as I am only concerned to illustrate the fallacious character of the reasoning he founds upon them. He tells us, then, that—

there is now no doubt that the three synoptic Gospels, so far from being the work of three independent writers, are closely interdependent, and that in one of two ways. Either all three contain, as their foundation, versions, to a large extent verbally identical, of one and the same tradition; or two of them are thus closely dependent on the third; and the opinion of the majority of the best critics has, of late years, more and more converged toward the conviction that our canonical second Gospel (the so-called "Mark's" Gospel) is that which most closely represents the primitive groundwork of the three. That I take to be one of the most valid results of New Testament criticism, of immeasurably greater importance than the discussion about dates and authorship. But if, as I believe to be the case beyond any rational doubt or dispute, the second Gospel is the nearest extant representative of the oldest tradition, whether written or oral, how comes it that it contains neither the "Sermon on the Mount" nor the "Lord's Prayer," those typical embodiments, according to Dr. Wace, of the "essential belief and cardinal teaching" of Jesus?

I have quoted every word of this passage because I am anxious for the reader to estimate the value of Prof. Huxley's own statement of his case. It is, as he says, the opinion of many critics of authority that a certain fixed tradition, written or oral, was used by the writers of the first three Gospels. In the first place, why this should prevent those three Gospels from being the work of "three independent writers" I am at a loss to conceive. If Mr. Froude, the late Prof. Brewer, and the late Mr. Green each use the Rolls Calendars of the reign of Henry VIII, I do not see that this abolishes their individuality. Any historian who describes the Peloponnesian War uses the memoirs of that war written by Thucydides; but Bishop Thirlwall and Mr. Grote were, I presume, independent writers. But to pass to a more important point, that which is assumed is that the alleged tradition, written or oral, was the groundwork of our first three Gospels, and it is, therefore, older than they are. Let it be granted, for the sake of argument. But how does this prove that the tradition in question is "the oldest," so that anything which was not in it is thereby discredited? It was, let us allow, an old tradition used by the writers of the first three Gospels. But how does this fact raise the slightest presumption against the probability that there were other traditions equally old which they might use with equal justification so far as their scope required? Prof. Huxley alleges, and I do not care to dispute the allegation, that the first three Gospels

embody a certain record older than themselves. But by what right does he ask me to accept this as evidence, or as affording even the slightest presumption, that there was no other? Between his allegation in one sentence that the second Gospel "most closely represents the primitive groundwork of the three," and his allegation, in the next sentence but one, that "the second Gospel is the nearest extant representative of the oldest tradition," there is an absolute and palpable *non sequitur*. It is a mere juggle of phrases, and upon this juggle the whole of his subsequent argument on this point depends. St. Mark's Gospel may very well represent the oldest tradition *relative to the common matter of the three*, without, therefore, necessarily representing "the oldest tradition" in such a sense as to be a touchstone for all other reports of our Lord's life. Prof. Huxley must know very well that from the time of Schleiermacher many critics have believed in the existence of another document containing a collection of our Lord's discourses. Holtzmann concludes ("Lehrbuch," page 376) that "under all the circumstances the hypothesis of two sources offers the most probable solution of the synoptical problem"; and it is surely incredible that no old traditions of our Lord's teaching should have existed beyond those which are common to the three Gospels. St. Luke, in fact, in that preface which Prof. Huxley has no hesitation in using for his own purposes, says that "many had taken in hand to set forth in order a declaration of those things which are most surely believed among us"; but Prof. Huxley asks us to assume that none of these records were old, and none trustworthy, but that particular one which furnishes a sort of skeleton to the first three Gospels. There is no evidence whatever, beyond Prof. Huxley's private judgment, for such an assumption. Nay, he himself tells us that, according to Holtzmann, it is at present a "burning question" among critics "whether the relatively primitive narration and the root of the other synoptic texts is contained in Matthew or in Mark."* Yet while his own authority tells him that this is a burning question, he treats it as settled in favor of St. Mark, "beyond any rational doubt or dispute," and employs this assumption as sufficiently solid ground on which to rest his doubts of the genuineness of the Sermon on the Mount and the Lord's Prayer!

But let us pass to another point in Prof. Huxley's mode of argument. Let us grant, again for the sake of argument, his *non sequitur* that the second Gospel is the nearest extant representative of the oldest tradition. "How comes it," he asks, "that it contains neither the Sermon on the Mount nor the Lord's Prayer?" Well, that is a very interesting inquiry, which has, in point of fact, often been considered by Christian divines; and various

* "Popular Science Monthly" for June, 1889, p. 169.

answers are conceivable, equally reasonable and sufficient. If it was St. Mark's object to record our Lord's acts rather than his teaching, what right has Prof. Huxley, from his purely human point of view, to find fault with him? If, from a Christian point of view, St. Mark was inspired by a divine guidance to present the most vivid, brief, and effective sketch possible of our Lord's action as a Saviour, and for that purpose to leave to another writer the description of our Lord as a teacher, the phenomenon is not less satisfactorily explained. St. Mark, according to that tradition of the Church which Prof. Huxley believes to be quite worthless, but which his authority Holtzmann does not, was in great measure the mouth-piece of St. Peter. Now, St. Peter is recorded in the Acts of the Apostles, in his address to Cornelius, as summing up our Lord's life in these words: "How God anointed Jesus of Nazareth with the Holy Ghost and with power, who went about doing good, and healing all who were oppressed of the devil; for God was with him"; and this is very much the point of view represented in St. Mark's Gospel. When, in fact, Prof. Huxley asks, in answer to Holtzmann, who is again unfavorable to his views, "What conceivable motive could Mark have for omitting it?"* the answers that arise are innumerable. Perhaps, as has been suggested, St. Mark was more concerned with acts than words; perhaps he wanted to be brief; perhaps he was writing for persons who wanted one kind of record and not another; and, above all, perhaps it was not so much a question of "omission" as of selection. It is really astonishing that this latter consideration never seems to cross the mind of Prof. Huxley and writers like him. The Gospels are among the briefest biographies in the world. I have sometimes thought that there is evidence of something superhuman about them in the mere fact that, while human biographers labor through volumes in order to give us some idea of their subject, every one of the Gospels, occupying no more than a chapter or two in length of an ordinary biography, nevertheless gives us an image of our Lord sufficiently vivid to have made him the living companion of all subsequent generations. But if "the gospel of Jesus Christ" was to be told within the compass of the sixteen chapters of St. Mark, some selection had to be made out of the mass of our Lord's words and deeds as recorded by the tradition of those "who from the beginning were eye-witnesses and ministers of the word." The very greatness and effectiveness of these four Gospels consist in this wonderful power of selection, like that by which a great artist depicts a character and a figure in half a dozen touches; and Prof. Huxley may, perhaps, to put the matter on its lowest level, find out a conceivable motive for St. Mark's omissions when he can produce such an effective narrative

* "Popular Science Monthly" for June, 1889, p. 171.

as St. Mark's. As St. John says at the end of his Gospel, "There are also many other things which Jesus did, the which, if they should be written every one, I suppose that even the world itself could not contain the books that should be written." So St. John, like St. Mark, had to make his selection, and selection involves omission.

But, after all, I venture to ask whether anything can be more preposterous than this supposition that because a certain tradition is the oldest authority, therefore every other authority is discredited? Boswell writes a life of Johnson; therefore every record of Johnson's acts or words which is not in Boswell is to be suspected. Carlyle writes a life of Sterling first, and Archdeacon Hare writes one afterward; therefore nothing in the archdeacon's life is to be trusted which was not also in Carlyle's. What seems to me so astonishing about Prof. Huxley's articles is not the wildness of their conclusions, but the rottenness of their ratiocination. To take another instance:

> Luke either knew the collection of loosely connected and aphoristic utterances which appear under the name of the "Sermon on the Mount" in "Matthew," or he did not. If he did not, he must have been ignorant of the existence of such a document as our canonical "Matthew," a fact which does not make for the genuineness or the authority of that book. If he did, he has shown that he does not care for its authority on a matter of fact of no small importance; and that does not permit us to conceive that he believed the first Gospel to be the work of an authority to whom he ought to defer, let alone that of an apostolic eye-witness.

I pass by the description of the Sermon on the Mount as a "collection of loosely connected utterances," though it is a kind of begging of a very important question. But supposing St. Luke to have been ignorant of the existence of St. Matthew's Gospel, how does this reflect on the genuineness of that book unless we know, as no one does, that St. Matthew's Gospel was written before St. Luke's, and sufficiently long before it to have become known to him? Or, if he did know it, where is the disrespect to its authority in his having given for his own purposes an abridgment of that which St. Matthew gave more fully? Prof. Huxley might almost seem dominated by the mechanical theory of inspiration which he denounces in his antagonists. He writes as if there were something absolutely sacred, neither to be altered nor added to, in the mere words of some old authority of which he conceives himself to be in possession. Dr. Abbott, with admirable labor, has had printed for him, in clear type, the words or bits of words which are common to the first three Gospels, and he seems immediately to adopt the anathema of the book of Revelation, and to proclaim to every man, evangelists and apostles included, "if any man shall add unto these things, . . . and if any man shall take away from the words" of this "common tradition" of Dr.

Abbott, he shall be forthwith scientifically excommunicated. I venture to submit, as a mere matter of common sense, that if three persons used one document, it is the height of rashness to conclude that it contained nothing but what they all three quote; that it is not only possible but probable that, while certain parts were used by all, each may have used some parts as suitable to his own purpose which the others did not find suitable to theirs; and, lastly, that the fact of there having been one such document in existence is so far from being evidence that there were no others, that it even creates some presumption that there were. In short, I must beg leave to represent, not so much that Prof. Huxley's conclusions are wrong, but that there is absolutely no validity in the reasoning by which he endeavors to support them. It is not, in fact, reasoning at all, but mere presumption and guess-work, inconsistent, moreover, with all experience and common sense.

Of course, if Prof. Huxley's quibbles against the Sermon on the Mount go to pieces, so do his cavils at the authenticity of the Lord's Prayer; and, indeed, on these two points I venture to think that the case for which I was contending is carried by the mere fact that it seems necessary to Prof. Huxley's position to dispute them. If he can not maintain his ground without pushing his agnosticism to such a length as to deny the substantial genuineness of the Sermon on the Mount and the Lord's Prayer, I think he will be found to have allowed enough to satisfy reasonable men that his case must be a bad one. I shall not, therefore, waste more time on these points, as I must say something on his strange treatment of the third point in the evangelical records to which I referred, the story of the Passion. It is really difficult to take seriously what he says on this subject. He says:

> I am not quite sure what Dr. Wace means by this—I am not aware that any one (with the exception of certain ancient heretics) has propounded doubts as to the reality of the crucifixion; and certainly I have no inclination to argue about the precise accuracy of every detail of that pathetic story of suffering and wrong. But if Dr. Wace means, as I suppose he does, that that which, according to the orthodox view, happened after the crucifixion, and which is, in a dogmatic sense, the most important part of the story, is founded on solid historical proofs, I must beg leave to express a diametrically opposite conviction.

Prof. Huxley is not quite sure what I mean by the story of the Passion, but supposes I mean the story of the resurrection! It is barely credible that he can have supposed anything of the kind; but by this gratuitous supposition he has again evaded the issue I proposed to him, and has shifted the argument to another topic which, however important in itself, is entirely irrelevant to the particular point in question. If he really supposed that when I said the Passion I meant the resurrection, it is only another proof of his incapacity for strict argument, at least on these subjects.

I not only used the expression "the story of the Passion," but I explicitly stated in my reply to him for what purpose I appealed to it. I said that "that story involves the most solemn attestation, again and again, of truths of which an agnostic coolly says he knows nothing"; and I mentioned particularly our Lord's final utterance, "Father, into thy hands I commend my spirit," as conveying our Lord's attestation in his death agony to his relation to God as his Father. That exclamation is recorded by St. Luke; but let me remind the reader of what is recorded by St. Mark, upon whom Prof. Huxley mainly relies. There we have the account of the agony in Gethsemane and of our Lord's prayer to his Father; we have the solemn challenge of the high priest, "Art thou the Christ, the son of the Blessed?" and our Lord's reply, "I am; and ye shall see the Son of man sitting on the right hand of power, and coming in the clouds of heaven," with his immediate condemnation, on the ground that in this statement he had spoken blasphemy. On the cross, moreover, St. Mark records his affecting appeal to his Father, "My God, my God, why hast thou forsaken me?" All this solemn evidence Prof. Huxley puts aside with the mere passing observation that he has "no inclination to argue about the precise accuracy of every detail of that pathetic story of suffering and wrong." But these prayers and declarations of our Lord are not mere details; they are of the very essence of the story of the Passion; and, whether Prof. Huxley is inclined to argue about them or not, he will find that all serious people will be influenced by them to the end of time, unless they can be shown to be unhistorical.

At all events, by refusing to consider their import, Prof. Huxley has again, in the most flagrant manner, evaded my challenge. I not only mentioned specifically "the story of the Passion," but I explained what I meant by it; and Prof. Huxley asks us to believe that he does not understand what I referred to; he refuses to face that story; and he raises an irrelevant issue about the resurrection. It is irrelevant, because the point specifically at issue between us is not the truth of the Christian creed, but the meaning of agnosticism, and the responsibilities which agnosticism involves. I say that whether agnosticism be justifiable or not, it involves a denial of the beliefs in which Jesus lived and died. It would equally involve a denial of them had he never risen; and if Prof. Huxley really thinks, therefore, that a denial of the resurrection affects the evidence afforded by the Passion, he must be incapable of distinguishing between two successive and entirely distinct occurrences.

But the manner in which Prof. Huxley has treated this irrelevant issue deserves perhaps a few words, for it is another characteristic specimen of his mode of argument. I note, by the way,

that, after referring to "the facts of the case as stated by the oldest extant narrative of them"—he means the story in St. Mark, though this is not a part of that common tradition of the three Gospels on which he relies; for, as he observes, the accounts in St. Matthew and St. Luke present marked variations from it—he adds:

> I do not see why any one should have a word to say against the inherent probability of that narrative; and, for my part, I am quite ready to accept it as an historical fact, that so much and no more is positively known of the end of Jesus of Nazareth.

We have, then, the important admission that Prof. Huxley has not a word to say against the historic credibility of the narrative in the fifteenth chapter of St. Mark, and accordingly he proceeds to quote its statements for the purpose of his argument. That argument, in brief, is that our Lord might very well have survived his crucifixion, have been removed still living to the tomb, have been taken out of it on the Friday or Saturday night by Joseph of Arimathea, and have recovered and found his way to Galilee. So much Prof. Huxley is prepared to believe, and he asks "on what grounds can a reasonable man be asked to believe any more?" But a prior question is on what grounds can a reasonable man be asked to believe as much as this? In the first place, if St. Mark's narrative is to be the basis of discussion, why does Prof. Huxley leave out of account the scourging, with the indication of weakness in our Lord's inability to bear his cross, and treat him as exposed to crucifixion in the condition simply of "temperate, strong men, such as the ordinary Galilean peasants were"? In the next place, I am informed by good medical authority that he is quite mistaken in saying that "no serious physical symptoms need at once arise from the wounds made by the nails in the hands and feet," and that, on the contrary, very grave symptoms would ordinarily arise in the course of no long time from such severe wounds, left to fester, with the nails in them, for six hours. In the third place, Prof. Huxley takes no account of the piercing of our Lord's side, and of the appearance of blood and water from the wound, which is solemnly attested by one witness. It is true that incident is not recorded by St. Mark; but Prof. Huxley must disprove the witness before he can leave it out of account. But, lastly, if Prof. Huxley's account of the matter be true, the first preaching of the church must have been founded on a deliberate fraud, of which some at least of our Lord's most intimate friends were guilty, or to which they were accessory; and I thought that supposition was practically out of account among reasonable men. Prof. Huxley argues as if he had only to deal with the further evidence of St. Paul. That, indeed, is evidence

of a far more momentous nature than he recognizes; but it is by no means the most important. It is beyond question that the Christian society, from the earliest moment of its existence, believed in our Lord's resurrection. Baur frankly says that there is no doubt about the church having been founded on this belief, though he can not explain how the belief arose. If the resurrection be a fact, the belief is explained; but it is certainly not explained by the supposition of a fraud on the part of Joseph of Arimathea. As to Prof. Huxley's assertion that the accounts in the three Gospels are "hopelessly discrepant," it is easily made and as easily denied; but it is out of all reason that Prof. Huxley's bare assertion on such a point should outweigh the opinions of some of the most learned judges of evidence, who have thought no such thing. It would be absurd to attempt to discuss that momentous story as a side issue in a review. It is enough to have pointed out that Prof. Huxley discusses it without even taking into account the statements of the very narrative on which he relies. The manner in which he sets aside St. Paul is equally reckless:

> According to his own showing, Paul, in the vigor of his manhood, with every means of becoming acquainted, at first hand, with the evidence of eye-witnesses, not merely refused to credit them, but "persecuted the Church of God and made havoc of it." . . . Yet this strange man, because he has a vision one day, at once, and with equally headlong zeal, flies to the opposite pole of opinion.

"A vision!" The whole question is, what vision? How can Prof. Huxley be sure that no vision could be of such a nature as to justify a man in acting on it? If, as we are told, our Lord personally appeared to St. Paul, spoke to him, and gave him specific commands, was he to disbelieve his own eyes and ears, as well as his own conscience, and go up to Jerusalem to cross-examine Peter and John and James? If the vision was a real one he was at once under orders, and had to obey our Lord's injunctions. It is, to say the least, rash, if not presumptuous, for Prof. Huxley to declare that such a vision as St. Paul had would not have convinced him; and, at all events, the question is not disposed of by calling the manisfestation "a vision." Two things are certain about St. Paul. One is that he was in the confidence of the Pharisees, and was their trusted agent in persecuting the Christians; and the other is that he was afterward in the confidence of the apostles, and knew all their side of the case. He holds, therefore, the unique position of having had equal access to all that would be alleged on both sides; and the result is that, being fully acquainted with all that the Pharisees could urge against the resurrection, he nevertheless gave up his whole life to attesting its truth, and threw in his lot, at the cost of martyrdom, with those whom he had formerly persecuted. Prof. Huxley reminds us that he did all this in the full vigor of manhood, and in

spite of strong and even violent prejudices. This is not a witness to be put aside in Prof. Huxley's off-hand manner.

But the strangest part of Prof. Huxley's article remains to be noticed; and, so far as the main point at issue between us is concerned, I need hardly have noticed anything else. He proceeds to a long and intricate discussion, quite needless, as I think, for his main object, respecting the relations between the Nazarenes, Ebionites, Jewish and Gentile Christians, first in the time of Justin Martyr and then of St. Paul. Into this discussion, in the course of which he makes assumptions which, as Holtzmann will tell him, are as much questioned by the German criticism on which he relies as by English theologians, it is unnecessary for me to follow him. The object of it is to establish a conclusion, which is all with which I am concerned. That conclusion is that "if the primitive Nazarenes of whom the Acts speak were orthodox Jews, what sort of probability can there be that Jesus was anything else?"* But what more is necessary for the purpose of my argument? To say, indeed, that this *a priori* probability places us "in a position to form a safe judgment of the limits within which the teaching of Jesus of Nazareth must have been confined," is to beg a great question, for it assumes that our Lord could not have transcended those limits unless his disciples transcended them simultaneously with him. But if our Lord's beliefs were those of an orthodox Jew, we certainly know enough of them to be quite sure that they involved a denial of Prof. Huxley's agnosticism. An orthodox Jew certainly believed in God, and in his responsibility to God, and in a divine revelation and a divine law. It is, says Prof. Huxley, "extremely probable" that he appealed "to those noble conceptions of religion which constituted the pith and kernel of the teaching of the great prophets of his nation seven hundred years earlier." But, if so, his first principles involved the assertion of religious realities which an agnostic refuses to acknowledge. Prof. Huxley has, in fact, dragged his readers through this thorny question of Jewish and Gentile Christianity in order to establish, at the end of it, and, as it seems, quite unconsciously, an essential part of the very allegation which I originally made. I said that a person who "knows nothing" of God asserts the belief of Jesus of Nazareth to have been unfounded, repudiates his example, and denies his authority. Prof. Huxley, in order to answer this contention, offers to prove, with great elaboration, that Jesus was an orthodox Jew, and consequently that his belief did involve what an agnostic rejects. How much beyond these elementary truths Jesus taught is a further and a distinct question. What I was concerned to maintain is that a man can not be an agnostic with

* "Popular Science Monthly" for June, 1889, p. 184.

respect to even the elementary truths of religion without rejecting the example and authority of Jesus Christ; and Prof. Huxley, though he still endeavors to avoid facing the fact, has established it by a roundabout method of his own.

I suppose I must also reply to Prof. Huxley's further challenge respecting my belief in the story of the Gadarene swine, though the difficulty of which he makes so much seems to me too trivial to deserve serious notice. He says "there are two stories, one in 'Mark' and 'Luke,' and the other in 'Matthew.' In the former there is one possessed man, in the latter there are two," and he asks me which I believe? My answer is that I believe both, and that the supposition of there being any inconsistency between them can only arise on that mechanical view of inspiration from which Prof. Huxley seems unable to shake himself free. Certainly "the most unabashed of reconcilers can not well say that one man is the same as two, or two as one"; but no one need be abashed to say that the greater number includes the less, and that if two men met our Lord, one certainly did. If I go into the operating theatre of King's College Hospital, and see an eminent surgeon perform a new or rare operation on one or two patients, and if I tell a friend afterward that I saw the surgeon perform such and such an operation on a patient, will he feel in any perplexity if he meets another spectator half an hour afterward who says he saw the operation performed on two patients? All that I should have been thinking of was the nature of the operation, which is as well described by reference to one patient as to half a dozen; and similarly St. Mark and St. Luke may have thought that the only important point was the nature of the miracle itself, and not the number of possessed men who were the subjects of it. It is quite unnecessary, therefore, for me to consider all the elaborate dilemmas in which Prof. Huxley would entangle me respecting the relative authority of the first three Gospels. As two includes one, and as both witnesses are in my judgment equally to be trusted, I adopt the supposition which includes the statements of both. It is a pure assumption that inspiration requires verbal accuracy in the reporting of every detail, and an assumption quite inconsistent with our usual tests of truth. Just as no miracle has saved the texts of the Scriptures from corruption in secondary points, so no miracle has been wrought to exclude the ordinary variations of truthful reporters in the Gospel narratives. But a miracle, in my belief, has been wrought in inspiring four men to give, within the compass of their brief narratives, such a picture of the life and work and teaching, of the death and resurrection, of the Son of man as to illuminate all human existence for the future, and to enable men "to believe that Jesus is the Christ, and believing to have life through his name."

It is with different feelings from those which Prof. Huxley provokes that I turn for a while to Mrs. Humphrey Ward's article on "The New Reformation." Since he adopts that article as a sufficient confutation of mine, I feel obliged to notice it, though I am sorry to appear in any position of antagonism to its author. Apart from other considerations, I am under much obligation to Mrs. Ward for the valuable series of articles which she contributed to the "Dictionary of Christian Biography" under my editorship, upon the obscure but interesting history of the Goths in Spain. I trust that, in her account of the effect upon Robert Elsmere and Merriman of absorption in that barbarian scene, she is not describing her own experience and the source of her own aberrations. But I feel especially bound to treat her argument with consideration, and to waive any opposition which can be avoided. I am sorry that she, too, questions the possibility in this country of "a scientific, that is to say, an unprejudiced, an unbiased study of theology, under present conditions," and I should have hoped that she would have had too much confidence in her colleagues in the important work to which I refer than to cast this slur upon them. Their labors have, in fact, been received with sufficient appreciation by German scholars of all schools to render their vindication unnecessary; and if Prof. Huxley can extend his study of German theological literature much beyond Zeller's "Vorträge" of "a quarter of a century ago," or Ritschl's writings of "nearly forty years ago," he will not find himself countenanced by church historians in Germany in his contempt for the recent contributions of English scholars to early church history. However, it is the more easy for me to waive all differences of this nature with Mrs. Ward, because it is unnecessary for me to look beyond her article for its own refutation. Her main contention, or that at least for which Prof. Huxley appeals to her, seems to be that it is a mistake to suppose that the rationalistic movement of Germany has been defeated in the sphere of New Testament criticism, and she selects more particularly for her protest a recent statement in the "Quarterly Review" that this criticism, and particularly the movement led by Baur, is "an attack which has failed." The Quarterly Reviewer may be left to take care of himself; but I would only ask what is the evidence which Mrs. Ward adduces to the contrary? It may be summed up in two words—a prophecy and a romance. She does not adduce any evidence that the Tübingen school, which is the one we are chiefly concerned with, did not fail to establish its specific contentions; on the contrary, she says that "history protested," and she goes on to prophesy the success of other speculations which arose from that protest, concluding with an imaginary sketch, like that with which "Robert Elsmere" ends, of a "new Reformation preparing,

struggling into utterance and being, all around us. . . . It is close upon us—it is prepared by all the forces of history and mind—its rise sooner or later is inevitable." This is prophesy, but it is not argument; and a little attention to Mrs. Ward's own statements will exhibit a very different picture. The Christian representative in her dialogue exclaims:

> What is the whole history of German criticism but a series of brilliant failures, from Strauss downward? One theorist follows another—now Mark is uppermost as the Ur-Evangelist, now Matthew—now the Synoptics are sacrificed to St. John, now St. John to the Synoptics. Baur relegates one after another of the Epistles to the second century because his theory can not do with them in the first. Harnack tells you that Baur's theory is all wrong, and that Thessalonians and Philippians must go back again. Volkmar sweeps together Gospels and Epistles in a heap toward the middle of the second century as the earliest date for almost all of them; and Dr. Abbott, who, as we are told, has absorbed all the learning of the Germans, puts Mark before 70 A. D., Matthew just about 70 A. D., and Luke about 80 A. D.; Strauss's mythical theory is dead and buried by common consent; Baur's tendency theory is much the same; Renan will have none of the Tübingen school; Volkmar is already antiquated; and Pfleiderer's fancies are now in the order of the day.

A better statement could hardly be wanted of what is meant by an attack having failed, and now let the reader observe how Merriman in the dialogue meets it. Does he deny any of those allegations? Not one. "Very well," he says, "let us leave the matter there for the present. Suppose we go to the Old Testament"; and then he proceeds to dwell on the concessions made to the newest critical school of Germany by a few distinguished English divines at the last Church Congress. I must, indeed, dispute her representation of that rather one-sided debate as amounting to "a collapse of English orthodoxy," or as justifying her statement that "the Church of England practically gives its verdict" in favor, for instance, of the school which regards the Pentateuch or the Hexateuch as "the peculiar product of that Jewish religious movement which, beginning with Josiah, . . . yields its final fruits long after the exile." Not only has the Church of England given no such verdict, but German criticism has as yet given no such verdict. For example, in the introduction to the Old Testament by one of the first Hebrew scholars of Germany, Prof. Hermann Strack, contained in the valuable "Hand-book of the Theological Sciences," edited, with the assistance of several distinguished scholars, by Prof. Zöchler, I find, at page 215 of the third edition, published this year, the following brief summary of what, in Dr. Strack's opinion, is the result of the controversy so far:

> The future results of further labors in the field of Pentateuch criticism can not, of course, be predicted in particulars. But, in spite of the great assent which the view of Graf and Wellhausen at present enjoys, we are nevertheless convinced that it will not permanently lead to any essential alteration in the conception which has

hitherto prevailed of the history of Israel, and in particular of the work of Moses. On the other hand, one result will certainly remain, that the Pentateuch was not composed by Moses himself, but was compiled by later editors from various original sources. . . . But the very variety of these sources may be applied in favor of the credibility of the Pentateuch.

In other words, it may be said that Dr. Strack regards it as established that "The Law of Moses" is a title of the same character as "The Psalms of David," the whole collection being denominated from its principal author. But he is convinced that the general conclusions of the prevalent school of Old Testament criticism, which involve an entire subversion of our present conceptions of Old Testament history, will not be maintained. In the face of this opinion, it does not seem presumptuous to express an apprehension that the younger school of Hebrew scholars in England, of whose concessions Mrs. Ward makes so much, have gone too far and too fast; and, at all events, it is clear from what Dr. Strack says—and I might quote also Delitzsch and Dillmann—that it is much too soon to assume that the school of whose conquests Mrs. Ward boasts is supreme. But, even supposing it were, what has this to do with the admitted and undoubted failures on the other side, in the field of New Testament criticism? If it be the fact, as Mrs. Ward does not deny, that not only Strauss's but Baur's theories and conclusions are now rejected; if it has been proved that Baur was entirely wrong in supposing the greater part of the New Testament books were late productions, written with a controversial purpose, what is the use of appealing to the alleged success of the German critics in another field? If Baur is confuted, he is confuted, and there is an end of his theories; though he may have been useful, as rash theorizers have often been, in stimulating investigation. In the same valuable hand-book of Dr. Zöchler's, already quoted, I find, under the "History of the Science of Introduction to the New Testament," the heading (page 15, vol. i, part 2), "Result of the controversy and end of the Tübingen school."

The Tübingen school (the writer concludes, p. 20) could not but fall as soon as its assumptions were recognized and given up. As Hilgenfeld confesses, "it went to an unjustifiable length, and inflicted too deep wounds on the Christian faith. . . . No enduring results in matters of substance have been produced by it."

Such is the judgment of an authoritative German hand-book on the writer to whom, in Merriman's opinion, "we owe all that we really *know* at the present moment about the New Testament," as though the Christian thought and life of eighteen hundred years had produced no knowledge on that subject!

In fact, Mrs. Ward's comparison seems to me to point in exactly the opposite direction:

I say to myself (says her spokesman, p. 466) it has taken some thirty years for German critical science to conquer English opinion in the matter of the Old Testament. . . . How much longer will it take before we feel the victory of the same science . . . with regard to the history of Christian origins?

Remembering that the main movement of New Testament criticism in Germany dates not thirty, but more than fifty years back, and that thirty years ago Baur's school enjoyed the same applause in Germany as that of Wellhausen does now, does it not seem more in conformity with experience and with probability to anticipate that, as the Germans themselves, with longer experience, find they had been too hasty in following Baur, so with an equally long experience they may find they have been similarly too hasty in accepting Wellhausen? The fever of revolutionary criticism on the New Testament was at its height after thirty years, and the science has subsided into comparative health after twenty more. The fever of the revolutionary criticism of the Old Testament is now at its height, but the parallel suggests a similar return to a more sober and common-sense state of mind. The most famous name, in short, of German New Testament criticism is now associated with exploded theories; and we are asked to shut our eyes to this undoubted fact because Mrs. Ward prophesies a different fate for the name now most famous in Old Testament criticism. I prefer the evidence of established fact to that of romantic prophecy.

But these observations suggest another consideration, which has a very important bearing on that general disparagement of English theology and theologians which Prof. Huxley expresses so offensively, and which Mrs. Ward encourages. She and Prof. Huxley talk as if German theology were all rationalistic and English theology alone conservative. Prof. Huxley invites his readers to study in Mrs. Ward's article

the results of critical investigation as it is carried out among those theologians who are men of science and not mere counsel for creeds;

and he appeals to

the works of scholars and theologians of the highest repute in the only two countries, Holland and Germany, in which, at the present time, professors of theology are to be found, whose tenure of their posts does not depend upon the results to which their inquiries lead them.

Well, passing over the insult to theologians in all other countries, what is the consequence of this freedom in Germany itself? Is it seen that all learned and distinguished theologians in that country are of the opinions of Prof. Huxley and Mrs. Ward? The quotations I have given will serve to illustrate the fact that the exact contrary is the case. If any one wants vigorous, learned, and satisfactory answers to Prof. Huxley and Mrs. Ward, Ger-

many is the best place to which he can go for them. The professors and theologians of Germany who adhere substantially to the old Christian faith are at least as numerous, as distinguished, as learned, as laborious, as those who adhere to skeptical opinions. What is, by general consent, the most valuable and comprehensive work on Christian theology and church history which the last two generations of German divines have produced? Herzog's "Real-Encyclopädie für protestantische Theologie und Kirche," of which the second edition, in eighteen large volumes, was completed about a year ago. But it is edited and written in harmony with the general belief of Protestant Christians. Who have done the chief exegetical work of the last two generations? On the rationalistic side, though not exclusively so, is the "Kurzgefasstes exegetisches Handbuch," in which, however, at the present time, Dillmann represents an opposition to the view of Wellhausen respecting the Pentateuch; but on the other side we have Meyer on the New Testament—almost the standard work on the subject—Keil and Delitzsch on the Old Testament and a great part of the New, Lange's immense "Bibelwerk," and the valuable "Kurzgefasster Kommentar" on the whole Scripture, including the Apocrypha, now in course of publication under the editorship of Profs. Strack and Zöckler. The Germans have more time for theoretical investigations than English theologians, who generally have a great deal of practical work to do; and German professors, in their numerous universities, in great measure live by them. But it was by German theologians that Baur was refuted; it is by German Hebraists like Strack that Wellhausen and Kuenen are now being best resisted. When Prof. Huxley and Mrs. Ward would leave an impression that, because German theological chairs are not shackled by articles like our own, therefore the best German thought and criticism is on the rationalistic side, they are conveying an entirely prejudiced representation of the facts. The effect of the German system is to make everything an open question; as though there were no such thing as a settled system of the spiritual universe, and no established facts in Christian history; and thus to enable any man of great ability with a skeptical turn to unsettle a generation and leave the edifice of belief to be built up again. But the edifice *is* built up again, and Germans take as large a part in rebuilding it as in undermining it. Because Prof. Huxley and Mrs. Ward can quote great German names on one side, let it not be forgotten that just as able German names can be quoted on the other side. Take, for instance, Harnack, to whom Mrs. Ward appeals, and whose "History of Dogmas" Prof. Huxley quotes. Harnack himself, in reviewing the history of his science, pays an honorable tribute to the late eminent divine, Thomasius, whose "History of Dogmas" has just

been republished after his death, and who wrote in the devoutest spirit of the Lutheran communion. Of course, Harnack regards his point of view as narrow and unsatisfactory; but he adds that, "equally great are the valuable qualities of this work in particular, in regard of its exemplarily clear exposition, its eminent learning, and the author's living comprehension of religious problems." A man who studies the history of Christian theology in Harnack without reference to Thomasius will do no justice to his subject.

But, says Mrs. Ward, there is no real historical apprehension in the orthodox writers, whether of Germany or England, and the whole problem is one of "historical translation." Every statement, every apparent miracle, everything different from daily experience, must be translated into the language of that experience, or else we have not got real history. But this, it will be observed, under an ingenious disguise, is only the old method of assuming that nothing really miraculous can have happened, and that therefore everything which seems supernatural must be explained away into the natural. In other words, it is once more begging the whole question at issue. Mrs. Ward accuses orthodox writers of this fallacy; but it is really her own. Merriman is represented as saying that he learned from his Oxford teachers that

> it was imperatively right to endeavor to disentangle miracle from history, the marvelous from the real, in a document of the fourth, or third, or second century; . . . but the contents of the New Testament, however marvelous and however apparently akin to what surrounds them on either side, were to be treated from an entirely different point of view. In the one case there must be a desire on the part of the historian to discover the historical under the miraculous, . . . in the other case there must be a desire, a strong "affection," on the part of the theologian, toward proving the miraculous to be historical.

Mrs. Ward has entirely mistaken the point of view of Christian science. Certainly if any occurrence anywhere can be explained by natural causes, there is a strong presumption that it ought to be so explained; for, though a natural effect may be due in a given case to supernatural action, it is a fixed rule of philosophizing, according to Newton, that we should not assume unknown causes when known ones suffice. But the whole case of the Christian reasoner is that the records of the New Testament defy any attempt to explain them by natural causes. The German critics Hase, Strauss, Baur, Hausrath, Keim, all have made the attempt, and each, in the opinion of the others, and finally of Pfleiderer, has offered an insufficient solution of the problem. The case of the Christian is not that the evidence ought not to be explained naturally and translated into every-day experience, but that it can not be. But it is Mrs. Ward who assumes beforehand

that simply because the "Life and Times of Jesus the Messiah," by that learned scholar and able writer, Dr. Edersheim, whose recent loss is so much to be deplored, does not "translate" all the Gospel narratives into natural occurrences, therefore it is essentially bad history. The story has been the same throughout. The whole German critical school, from the venerable Karl Hase —and, much as I differ from his conclusions, I can not mention without a tribute of respect and gratitude the name of that great scholar, the veteran of all these controversies, whose "Leben Jesu," published several years before Strauss was heard of, is still, perhaps, the most valuable book of reference on the subject —all, from that eminent man downward, have, by their own repeated confession, started from the assumption that the miraculous is impossible, and that the Gospels must, by some device or other, be so interpreted as to explain it away. "Affection" there is and ought to be in orthodox writers for venerable, profound, and consoling beliefs; but they start from no such invincible prejudice, and they are pledged by their principles to accept whatever interpretation may be really most consonant with the facts.

I have only one word to say, finally, in reply to Prof. Huxley. I am very glad to hear that he has always advocated the reading of the Bible and the diffusion of its study among the people; but I must say that he goes to work in a very strange way in order to promote this result. If he could succeed in persuading people that the Gospels are untrustworthy collections of legends, made by unknown authors, that St. Paul's epistles were the writings of "a strange man," who had no sound capacity for judging of evidence, or, with Mrs. Ward's friends, that the Pentateuch is a late forgery of Jewish scribes, I do not think the people at large would be likely to follow his well-meant exhortations. But I venture to remind him that the English Church has anticipated his anxiety in this matter. Three hundred years ago, by one of the greatest strokes of real government ever exhibited, the public reading of the whole Bible was imposed upon Englishmen; and by the public reading of the lessons on Sunday alone, the chief portions of the Bible, from first to last, have become stamped upon the minds of English-speaking people in a degree in which, as the Germans themselves acknowledge,* they are far behind us. He has too much reason for his lament over the melancholy spectacle presented by the intestine quarrels of churchmen over matters of mere ceremonial. But when he argues from this that the clergy of our day "can have but little sympathy with the old evangelical doctrine of the 'open Bible,'" he might have remembered that our own generation of English divines has, by the

* See the preface to Riehm's "Handwörterbuch."

labor of years, endeavored at all events, whether successfully or not, to place the most correct version possible of the Holy Scriptures in the hands of the English people. I agree with him most cordially in seeing in the wide diffusion and the unprejudiced study of that sacred volume the best security for "true religion and sound learning." It is in the open Bible of England, in the general familiarity of all classes of Englishmen and Englishwomen with it, that the chief obstacle has been found to the spread of the fantastic critical theories by which he is fascinated; and, instead of Englishmen translating the Bible into the language of their natural experiences, it will in the future, as in the past, translate them and their experiences into a higher and a supernatural region.—*Nineteenth Century.*

AN EXPLANATION TO PROF. HUXLEY.

By W. C. McGEE, Bishop of Peterborough.

IN the February number of this review Prof. Huxley put into the mouth of Mr. Frederic Harrison the following sentence: "In his [the agnostic's] place, as a sort of navvy leveling the ground and cleansing it of such poor stuff as Christianity, he is a useful creature who deserves patting on the back—on condition that he does not venture beyond his last." The construction which I put upon these words—and of which I still think them quite capable—was that the professor meant to represent Mr. Harrison and himself as agreed upon the proper work of the agnostic, and as differing only as to whether he might or might not "venture beyond" that. On this supposition, my inference that he had called Christianity "sorry," or, as I ought to have said, "poor stuff" (the terms are, of course, equivalent), would have been perfectly correct.

On re-reading the sentence in question, however, in connection with its context, I see that it may more correctly be regarded as altogether ironical; and this, from the professor's implied denial in his last article of the correctness of my version, I conclude that he intended it to be. I accordingly at once withdraw my statement, and express my regret for having made it. May I plead, however, as some excuse for my mistake, that this picture of himself when engaged in his agnostic labors is so wonderfully accurate and life-like that I might almost be pardoned for taking for a portrait what was only meant for a caricature, or for supposing that he had expressed in so many words the contempt which displays itself in so many of his utterances respecting the Christian faith?

Nevertheless I gladly admit that the particular expression I had ascribed to him is not to be reckoned among the already too numerous illustrations of what I had described as his "readiness to say unpleasant," and—after reading his last article—I must add, offensive, "things."

With this explanation and apology I take my leave of the professor and of our small personal dispute—small, indeed, beside the infinitely graver and greater issues raised in his reply to the unanswered arguments of Dr. Wace.

I do not care to distract the attention of the public from these to a fencing-match with foils between Prof. Huxley and myself. In sight of Gethsemane and Calvary such a fencing-match seems to me out of place.—*Nineteenth Century.*

FUNGI.

II.—MICROSCOPIC FORMS.*

By T. H. McBRIDE,

PROFESSOR OF BOTANY IN THE UNIVERSITY OF IOWA.

THE microscopic world is ever fair. In every department of research we revert to our instruments, certainly expecting to be charmed by beauty, whether of movement or mechanism. Rarely are we disappointed, certainly not in the realm of organic form. Here everything is beautiful, and, as the heavens to the astronomer, everything is clean. Even the rudest fungi offer no exception. In them the microscope finds no exception to the law of beauty. The simplicity of structure noted in the previous article runs through nearly all, only varied a thousand times; but whether mycelial thread or spores, one or other or both conjoined, the result, as we hope by illustration here to show, is always symmetry and elegance itself.

To begin, let us revert to the lilac-bush, whose whitened leaves may readily afford illustration of mycelial webs and threads. By September, if not sooner, the entire foliage will have taken on its peculiar whiteness as if thickly dusted with chalk or flour. On certain leaves, however, appear suspicious-looking dark-brown specks or grains, very small, but plainly visible to the naked eye. Removing some of these granules to the microscope, we find the field filled with tiny sculptured spheres ornamented with a profusion of long, interlocking filaments, starting out like so many extended radii of each sphere. A gentle pressure on the cover-glass breaks the sphere, and forthwith (Fig. 1) a dozen tiny sacs

* Illustrations from drawings by M. F. Linder and the author.

appear, each packed with transparent oval nucleated spores, just such spores and quite such sacs as appeared in the fruiting surface of the morel, and we are ready with the botanist to call the granules fruit. Who could have guessed the contents of that sphere? But look again at those radiating ornamental filaments. Trace to its distal end a single ray, and see the grapnels by which the fertile globule we have studied holds fast to the surface of its host through storm and flood. Notice the elegant curves, the symmetrical branching, fit model for the artist in arabesque or filigree! What more beautiful or more efficiently suggestive! (Fig. 2 *a*.)

Such is the lilac blight; but now that we have discoverd one such fungus, we may carry our inquiries to almost any extent. The neighboring cherry-tree will afford similar material for study and admiration. Here the appendages are simpler, and the fruit itself contains but a single sac with spores (Fig. 3 *a*). The poplars and the willows show spherules whose appendages are simple hooks, so that the fruit is a minute bur of the teazel sort, fit for fairy carding (Fig. 2 *b*). The oak-leaf and the hazel bear appendages simpler still, the appendages being straight and needle-shaped, ray-like, actinic; *Phyllactinia* Léveillé named it—leaf-ray—the needles starting like rays of light from some effulgent center (Fig. 3 *b*).

During the early days of autumn we can hardly go amiss for the appendaged fungi such as just described. In the woodland, the pastures, by the road-side, in shade and in sun, a thousand white-flecked leaves attract the appreciative and only the appreciative eye. Minuteness removes from ordinary ken—and the world goes on! Besides, these parasites are not especially harmful, at least in the phases described, to their presumably unwilling hosts. The pea-vine and the rose-bush may sometimes suffer, but generally the leaves attacked have pretty well done the season's work before the parasite attains its maximum, so that man's interest in the matter is not specially affected. There is, however, another and different set of leaf-fungi whose parasitism is decidedly more intimate, and consequently destructive of the host-plant, suicidal as such a policy would seem to be. These latter, as indeed all the fungi already cited, are known as blights, and as such some species are already famous. The potato murrain, which has its place in civil history, is a very pretty little transparent branching fungus, so delicate that a breath destroys it. First becoming notorious in 1845, and during the famines of 1846 and 1847, it has been found and studied in all parts of the world for the forty years succeeding. The lilac fungus is content to spread its mycelium over the surface of the lilac-leaves, absorbing its nourishment from the surface cells; but the potato mold,

the *Phytophthora infestans* of the books, seems to reach every cell and every tissue, so that a whole potato-field once infested will go down as if smitten by the frost of night. Kindred fungi are upon many of the plants about us. *Peronospora viticola* attacks the leaves of the grape. In wet seasons it is not uncommon to see the wild grape-vines along our western streams completely white with this overwhelming assailant, nor are our Concord vineyards ever quite exempt. The mycelial filaments thread the soft interior tissues while fruiting hyphæ come forth in delicate tufts or pencils through the open stomata on the under surface of the leaf. It is pleasant to think that weeds of various kinds suffer from similar fungal invasions. Thus goosefoot (*Chenopodium, sp.*) bears every spring upon its earlier leaves a tiny parasite, which seen under our lenses seems a miniature forest, while the fruit masses itself in violet tinted patches plainly to be seen by the naked eye.

Even the evergreens, the cone-bearers, that ancient race of hardy conservatives, are compelled to pay tithes and tribute to these all-assailing Vandals. I suppose the cedars of Lebanon are not exempt! At all events, who has not seen our native cedars bending after some warm shower in June with orange-colored fruit, beautiful, but to the cedar costly as it is fair? (Fig. 4 *a*.) Cedar-apples, men say, and they are not a few who would insist that the cedar is actually blooming and fruiting. Such fruit has actually been planted—vain expectation. Cedar-apples are but the excrescences caused by the persistent development of a fungus parasitic upon branch or leaf; they are receptacles from which the fungus throws out at a favorable moment gelatinous masses of orange-colored spores (Fig. 4 *b*). No fruit of the cedar are apples such as these, fruit rather of the cedar's malignant foe. Trees are sometimes seen whose crop of "apples" becomes so heavy that disaster almost to extinction marks successive years. Strange to say, the cedar does not bear its affliction alone. The hawthorn has a part in the matter, and on its leaves are borne fringed cups of fungal fruit supplemental to the cedar's parasite, just as the cluster-cups on the barberry-leaves are congeners of the rusts on fields of standing grain. In fact, with these microscopic forms parasitism is the rule, whether as affecting the vegetable world as we have seen, or in more insidious guise assailing the animal as well, when bacteria and bacilli in phantom myriads appear to baffle surgery and sanitary science. Here, as has been well said, is "the arrow that flieth by day; the pestilence that walketh at noonday." The discussions of a decade have rendered these organisms familiar, at least by name, to every reader. Every wise physician is an experimenter in the field. A new literature has grown up, to which the scientific world makes daily contri-

butions, and bacteriology is hailed the latest phase of biologic science. Nevertheless, the subject is as yet only touched upon. We have simply begun to find out how to study these minutest forms, some of which may yet be hiding beyond our utmost microscopic vision.

But the most remarkable group of fungoid organisms remains yet to be considered—remarkable alike because of the innate novelty and beauty of the objects themselves, and because of the difficulty which seems ever likely to attend any effort to fix exactly their place in classification. Among English writers the organisms in question are called slime-molds; in science they have received as a group different appellations. The slime-molds are sufficiently common in all the wooded regions of the globe, although receiving less attention on account of minuteness and unobtrusiveness. With most of the species it is a plain case of "*seek* and thou shalt find." Some, however, are quite large, as, for instance, one of the simplest appearing often in summer flowing up between the planks of our familiar board walks, for be it understood at the outset that the slime-molds are, in one stage at least, soft, protoplasmic bodies possessed of locomotive powers, changing form with protean incertitude, and position with nonchalance far from reassuring. The species in question appears then, in quantity, a patch of brownish, frothy-looking matter, not attractive. Scrape it away, and probably more will take its place, furnished forth from the moist, dark chambers underneath. Leave it a few hours, and you return to find a mass of purplish dust, overarched, perchance, by a porous crust of yellowish color and fragile structure. This dust is fruit, spores we may say, and we wonder what may be the destiny of spores formed in so strange a fashion. Place a few of these spores in a moist chamber, and in a short time each germinates and produces—a mycelial thread? Not at all; on the contrary, a protoplasmic particle, not to be distinguished from that other protoplasmic bit men call Amœba. When these Amœbæ, produced by the germinating spores, have for a time pursued each his individual way, all under favoring circumstances reassemble, coalesce, actually blending, in most

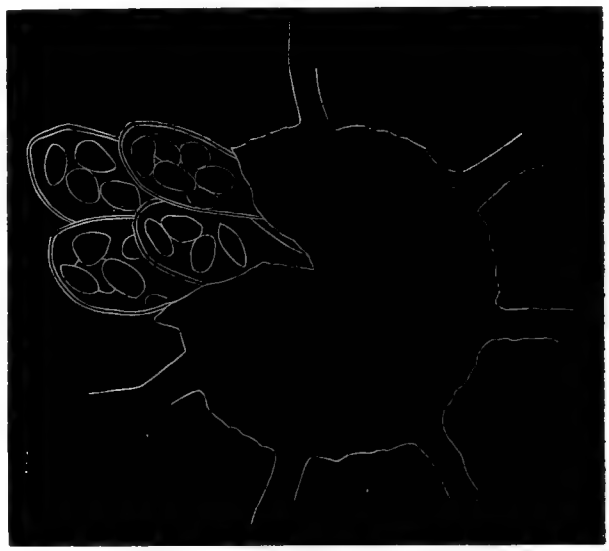

FIG. 1.—FRUIT OF LILAC BLIGHT, × 300.

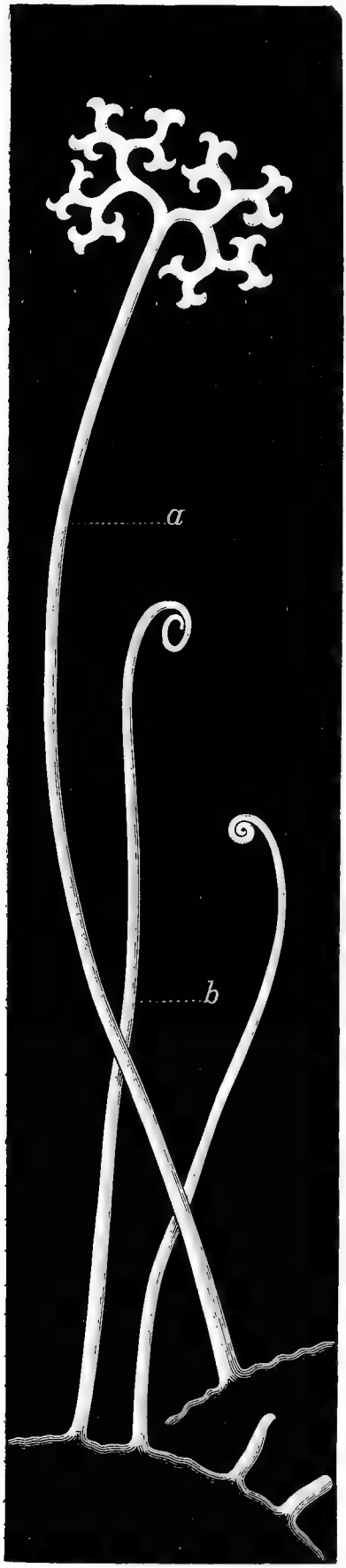

FIG. 2.

cases, to produce a new slime-mold in all respects comparable to its polymorphic ancestry, a new motile organism ready once more to break up into spores and fruit, and so continue its never-ending cycle of purposeless existence. I say purposeless, for there seems to be no outlet, no outlook toward anything better or higher. Its relations look backward, not forward, and we connect it with the lowest forms of animal life more easily than with anything else. Hence the difficulty of the systematist. Animals they can hardly be, for nowhere else in the kingdom are animals reproduced by spores, to say nothing of the forms of fruiting described later on. We call them for convenience fungi; yet, while some fungi are destitute of mycelium, and some produce swarm spores or motile naked amœboid spores, still in no instance do these behave as in the slime-mold.

It is interesting to notice the gingerly manner in which naturalists in their discussions approach these forms. Sachs throws in a chapter, nowhere in particular, a sort of addendum on *Myxomycetes*. De Bary, the lamented, gives us his masterpiece on fungi, "*including the Mycetozoa*," and in speaking of their relationship says, "For various reasons, which, according to the knowledge at hand, have from time to time been more or less closely worked out, I have, since 1858, placed the *Myxomycetes* (slime-molds) under the name *Mycetozoa* outside the vegetable kingdom, and this I still consider their proper place."* He does not call the organisms *animals*, be it observed. If a zoölogist chooses to do so, De Bary makes no objection. Meanwhile, Saville Kent, zoölogist, encouraged probably by De Bary's position, comes forward in

* De Bary, "Morphology and Biology of Fungi," p. 478.

his "Manual of Infusoria" and claims the whole series as animals; while Cooke, as representing the English botanists, says, in the introduction to "Myxomycetes of Great Britain," "It is unnecessary to attempt any controversion of the proposition once made, but soon ignored, that these organisms are more intimately related to animals than plants."* And Saccardo, in his great work now appearing, "Sylloge Fungorum," enumerates and describes the *Myxomycetes* with the rest.

But while systematists thus differ as to the place the slime-molds should have in classification, we need not hesitate to enjoy their beautiful forms. They *are*, whether we know *what* they are or not. The sidewalk species is very strange, and the transition from slime to dusty spores would be incredible did we not witness it. Stranger still, however, is the case of a species often brought in midsummer from the woods. Here, as the object comes from the forest, is a mass of yellowish slime without apparent structure or parts, "without form or comeliness." We lay it upon the laboratory table, shut it up in a box, if you choose, and a few days later examine to find no end of structure. Every particle appears to have passed into the composition of definite and elegant machinery. A perfect honey-comb now lies upon the bit of rotten wood, the original support, each cell capped with a filmy lid which seems all too fragile, and which, opening here and there, discloses a powdery, fluffy mass within. Brought to the microscope, the contents of each cell spread out in fruit, in spores and banded filaments, "elaters" called, to whose beauty our drawing (Fig. 5) pays but distant tribute. Golden is the color, sculptured

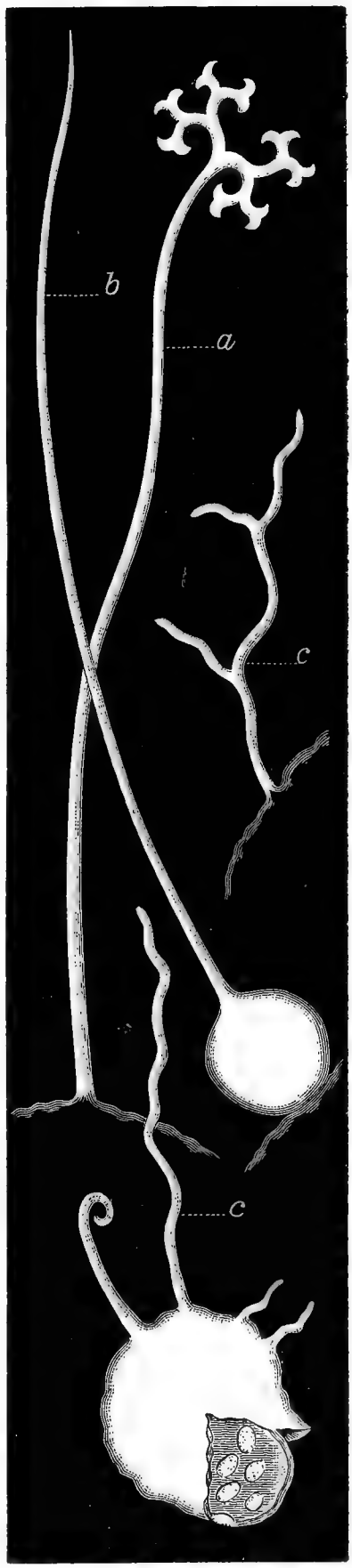

FIG. 3.

* Cooke's "Myxomycetes of Great Britain," introduction, p. iii.

are the spores, and twisted are the filaments with many a delicate spiral wound, the coils running transverse to certain finer striæ, as if the whole structure did but make appeal to some æsthetic eye. Slime-mold it was before, *Trichia chrysosperma* now, and, so far as may be seen, simple evaporation has wrought the change.

Fig. 6 illustrates the fruit of another slime-mold which, during the present year, has been extremely common in this vicinity. Abundant rains during the summer were, perchance, the stimulating cause. On oak-stumps of four or five years' standing there appeared glistening patches of the size of one's hand, by no means attractive to the casual observer; rather the reverse. Presently the entire mass heaped itself up, becoming, say, four tenths of an inch in depth; a thin film covered all, and desiccation began. Shortly the entire mass had been transformed. Hundreds of slender columnar receptacles, each mounted upon the most delicate little, black, shining pedicle or stalk, and crowded with spores, completely replaced that mass of slime, leaving scarcely a trace.

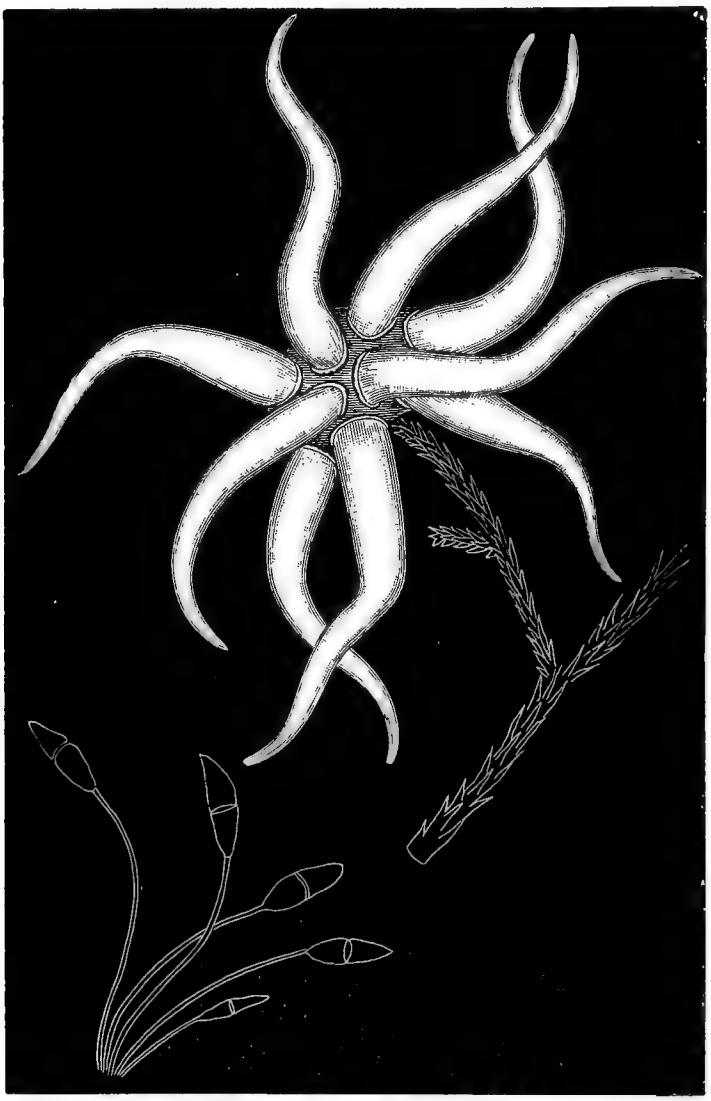

FIG. 4.—"CEDAR-APPLE" AND SPORES—the latter highly magnified.

The upper film breaks away, and a thousand delicate, plume-like structures wave a diminutive forest (Fig. 6). Each tiny stalked receptacle is a spore-case with lace-like walls of richest color, and is at first packed with unicellular sporules of the same deep tint. The entire fruit resembles somewhat a stamen, hence the name, *Stemonitis* (like a stamen). Other fungi, of the same type as

stemonitis, only more delicate still both in form and color, are not infrequent. They are everywhere in the woodland—on leaves and sticks that lie close upon the ground, upon a thousand humblest things. Such forms are the *Comatrichæ, Arcyriæ, Cribrariæ,* etc. The arcyrias form their spores and the net which contains them all in a delicate spherical or obconical receptacle.* At maturity the upper part breaks away and the elasticity of the contained structures forces them out as a most airy puff, from which the spores may be driven by the wind while the base of the original envelope remains as an empty cup. Sometimes the entire structure is mounted upon a slender, polished stalk of appreciable length, and the whole colony of sporangia stand as tiny salvers whose shadowy contents rise like incense-wreaths. To find a rosy field of *Arcyria puniceum,* to safely box it and lodge it in one's collection, is enough to give a man joy, even of the æsthetic sort, from Sunday to Sunday. The tints in all these fruits are just right: they are the grays, the olives, the brick-reds, the browns, and yellows.

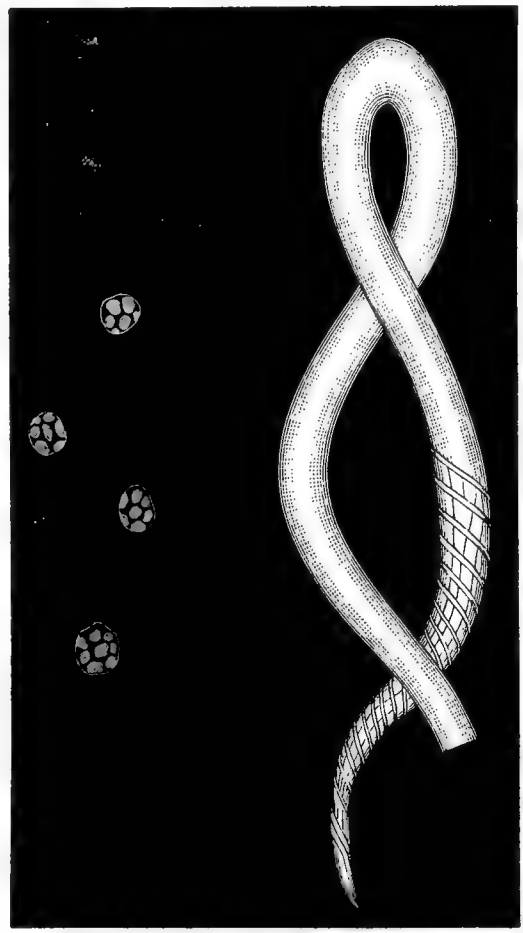

FIG. 5.—SPORES AND ELATERS OF TRICHIA CHRYSOSPERMA. Highly magnified.

Of these that produce their fruit thus in spherical or cup-shaped receptacles, some are giants among the rest. One, very common, imitates the *Lycoperdons,* or puff-balls, and that so closely as to have deceived the botanists themselves. It has been named *Lycoperdon* again and again, and even carried over the whole tribe with which it is related into the order *Gasteromycetes*—the puff-ball order. The student finds a row of little spheres, ashy or rosy in color, about as large as bullets, resting side by side on some bit of rotten stuff in the woods, and forthwith thinks about *Lycoperdon pusillum,* or possibly some new species, and not until after much investigation and groping, and probably some outside assistance, does he at length reach the "true inwardness" of *Lycogala.*

* *Stemonitis* also has at one time in its development a delicate peridium around each sporangium. This, however, soon vanishes.

The more we study these wonderful organisms, the more surprising it seems that two such very different phases should coexist in the same organism and succeed each other so abruptly. We no longer wonder at the perplexity of the systematists, and we can but admire the reckless courage of Saccardo, who discusses the slime-molds in his volume vii, "Sylloge Fungorum," along with other myceliumless forms, and says never so much as "By your leave."

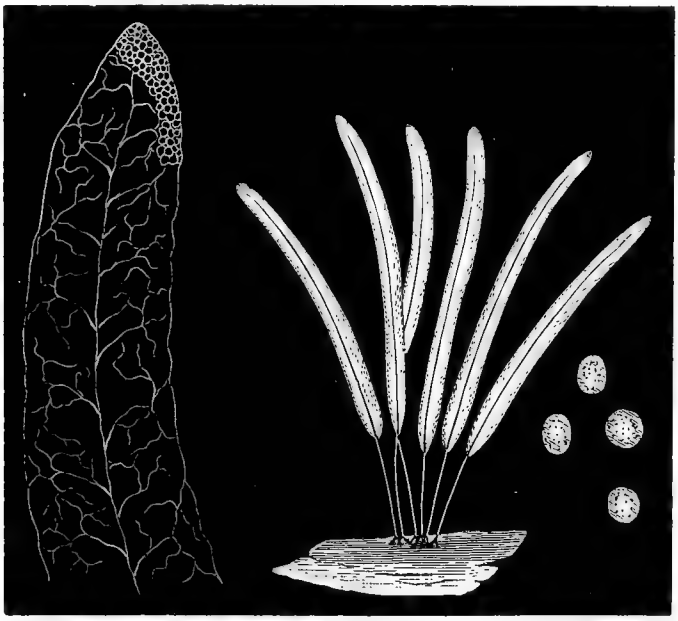

FIG. 6.—STEMONITIS FUSCA. Central figure × 2; detail and spores more highly magnified.

Before the vision of the biologist there rises ever more that weird limbo where "*men*" appear "as *trees* walking." Whether, as in that elder case, experience may bring clearer vision, time alone can tell. Plant and animal have doubtless somewhere a common starting-ground. Toward that common origin the *Myxomycetes* undoubtedly point. They are not it. They seem rather to represent an independent twig near the base of the great tree of life, a branchlet whose departure was absolute as ancient, developing with no respect to any other organic thing, and soon reaching the limit of that particular possibility. Perfect in themselves, we may look for nothing further in that direction. Nature herself has written, "No thoroughfare."

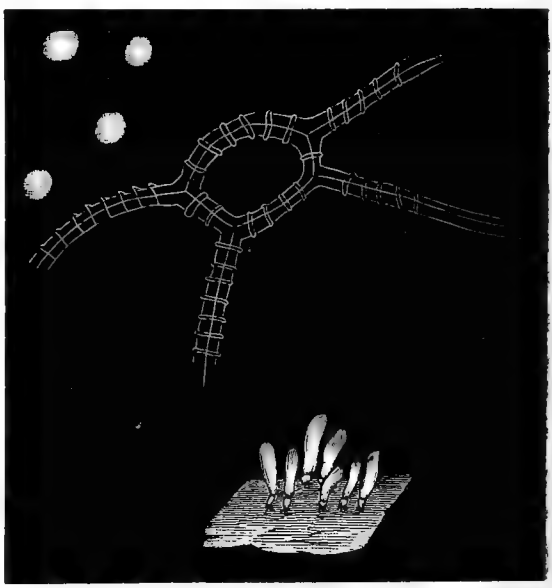

FIG. 7.—ARCYRIA PUNICEA. Detail and spores highly magnified.

In conclusion, we may notice the question of utility which doubtless rises in some minds. To what end are all these microscopic bits of stuff organic thus hidden from ordinary ken? To such a query no real answer can be given. Our systems of economics are nowhere sufficiently refined, our tests of value show no balances whose

delicacy trembles to a case like this. What know we of Nature's infinite equipoise? Such organisms are their own excuse for being, and, if by any chance they serve at length the æsthetic sense of some creature intellectual, his is the good fortune; their destiny waxes not nor wanes.

THE ARTIFICIAL PROPAGATION OF SEA-FISHES.

By Prof. W. K. BROOKS,
of Johns Hopkins University.

SOME years since the writer was much impressed by an article by Prof. Huxley, in "The Popular Science Monthly," on the artificial propagation of food-fishes, in which he recognizes the value of the economic results which have followed the culture of the fishes of inland waters, but gives very emphatic expression to his belief that man's influence, either for good or for bad, upon the infinite wealth of the ocean, is so very slight as to be absolutely without significance. He argues that an oceanic species which is rich enough in individuals to resist all the enemies which prey upon it can be in no danger from man. If, he says, it is able to hold its own in the fierce struggle with the natural conditions of its existence, the loss of the few individuals, which are all that the human fishermen are able to capture, can not possibly lead to its extermination, nor even exert any noteworthy influence upon its abundance; nor can man, he argues, by artificially fertilizing a few million eggs, and by rearing a few million young fishes, cause any appreciable increase in the abundance of a species which includes countless millions of adult fishes, each of which has the power to leave behind it millions of descendants.

As compared with the natural reproductive power of the cod-fishes upon the Grand Banks, the efforts of man to artificially increase the supply sink into absolute insignificance, and Huxley's statement of the case seemed to me at the time to be convincing; but I have recently been able to investigate the subject for myself, and I am now satisfied that his opinions are not beyond question. As I am well aware that their influence has been far-reaching, and has much to do with current views, I take this opportunity to state my reasons for the change in my own opinion, as I wish to call attention to what I now consider a serious fallacy in his argument. If man's destructive influence were similar in kind to that of the other enemies of marine food-fishes, it would undoubtedly be quite true that the numbers destroyed by him are as nothing when compared with those which are destroyed in other ways; but the danger which comes from man's

influence is fundamentally different from all the natural dangers to which sea-fishes are exposed, since it is modern or recent, and has, therefore, failed to be recognized and provided against during the evolution of these animals. In this sense man's influence is *unnatural*, while all other dangers are *natural*. The danger from man is not only modern, but also totally anomalous in the rapidity of its approach. It has not grown up gradually and imperceptibly, but has swept over the entire ocean with a speed which leaves no chance for the production of compensating adjustments by the slow process of selection. If it were to remain without change, or were to change very slowly, there can be no doubt that all the species which were not quickly destroyed would ultimately be brought into adjustment, and would from that time on be able to resist; but what animal can become adjusted to an enemy who is able, in less than a generation, to increase his power by such inventions as the steamboat, the electric light, and the dynamite bomb? To marine food-fishes man is a catastrophe, not a natural enemy, and the natural methods of maintaining the harmony between oceanic animals and the slow geologic changes of the ocean bottom are of no avail against him.

A study of the destructive forces of nature shows that man is peculiar in other all-essential particulars. It is a well-known fact that of all the marine animals which fall a prey to enemies, or become the victims of accidents and diseases, all but an infinitesimal percentage are destroyed during infancy or youth. As soon as the eggs of a fish are laid, the process of decimation begins, and it is initiated on a scale which would quickly sweep the species out of existence if it lasted long; but, fortunately, it does not, and each day in the life of a young fish brings with it an enormous increase in the chance for a long life.

During the early stages of development the young fish is totally defenseless, and at the mercy of enemies and accidents; and, although each pelagic fish lays enormous numbers of eggs, not a single one could escape if the embryonic period were long. Natural selection has been constantly acting for untold ages to shorten it, however, for in each generation those eggs which developed most rapidly have most frequently escaped destruction; and as the fishes which hatched from these precocious eggs have inherited a tendency to produce similar eggs, the embryonic life has gradually grown short, and most pelagic eggs now develop so rapidly that it is not unusual for them to hatch within twenty-four hours after they are fertilized. After they are hatched the transparency and activity of the little fishes add greatly to their safety, although each school of young fishes is constantly encompassed on all sides by a host of enemies. I have found, by watching for an hour from the end of a wharf a school of some eight

hundred or a thousand young fishes, that one of them fell a victim each minute to the enemies of the air or of the water. While the death-rate is vastly less than it was during embryonic life, it is great enough to put an end to the entire school in a single day, were it not for the fact that each time a bird swoops down upon the little fishes out of the air above, and each time that a predacious fish darts in among them out of the depths and carries off a victim, the survivors profit by the new experience, and become more alert and vigilant and better able to escape future danger. While it is not possible to give figures, there can be no doubt that the chance for long life increases by a high geometrical ratio with age. Among salt-water fishes the death-rate is enormous at first, but it grows less and less as the individuals grow older; and the natural death-rate of adult fishes is infinitesimal as compared with the death-rate of the young. A high birth-rate has its advantages, since it gives an opportunity for selection, and thus contributes to the maintenance and gradual evolution and improvement of the standard of the race. Each adult fish is a survivor, picked out or naturally selected from among thousands or even millions of less favored brothers and sisters; and while many of the accidents which overwhelm the eggs and young are of such a character that individual peculiarities count for nothing against them, we can not doubt that, on the whole, the alert and energetic and intelligent fishes are most likely to escape, and to grow up to maturity and to bear descendants. A high rate of increase does unquestionably aid evolution by selection, but the well-known fact that it is reduced in all species with low death-rates shows that its primary and most important purpose is to compensate for the loss from accidents and diseases and enemies, and to insure the perpetuation of the species.

A young fish with a million brothers and sisters must, before it reaches sexual maturity, be in imminent peril of life a million times before it is able to reproduce its kind; and the million perils are so grouped that most of them face it at the beginning of its life, and grow less and less frequent as it becomes older. The perils of a fish may be compared to a pyramid which tapers from a broad base in infancy to a pointed apex in mature life, and each species must be made up of individuals of all ages in a similar numerical ratio to each other. The perils of each individual fish seem to be accidental, but their average for the entire species conforms to exact numerical laws, and the number which die during the first day, the second day, and so on, of their lives, must be about the same, season after season. During the slow process of evolution the birth-rate of each species has been so regulated by selection that, after the natural mortality has been provided for, there shall be enough survivors in each generation to maintain

the species and to keep the area which it inhabits stocked with as many adults as it can support.

All the natural sources of mortality are thus provided for. As each species is slowly and gradually brought into harmonious adjustment to the conditions of its environment, its birth-rate, like all its other attributes, is regulated and adapted to meet all the natural demands upon it. Now what happens if, after each one of the natural enemies has claimed its victims, a new enemy not provided for by Nature suddenly attacks the few adult survivors which Nature has provided to perpetuate the species? What happens when the last drop falls into the brimming bucket? What happens when the proverbial last straw is put on the load? It may be quite true that, for each codfish which man catches, the natural enemies destroy a million. That has no bearing on the subject. Nature has provided for the destruction of the million. Before their birth they were destined to premature death. The one was reserved by Nature for another purpose.

If the destructive influence of man had been gradually brought to bear, and had kept pace with the evolution of the species, natural selection would have provided a remedy, and the birth-rate would have been correspondingly increased; but this has not been the case; and, while man might not be able to make any impression on the broad base of the pyramid, we must remember that he does not attack the base, but the pointed apex. The fact that sea-fishes are so enormously prolific is entirely irrelevant. Their high birth-rate is an adjustment to their natural environment, while the influence of man is a new factor which has not been provided against.

It is difficult to get statistical information regarding marine animals, but there is ample evidence that they may be exterminated by man. The Bahama sponge-fishermen complain that they are now compelled to make long voyages and to visit remote banks for sponges which in former years could be gathered in abundance near the seaports. It is well known that, just before the oil from the wells of Pennsylvania came into common use, the sperm-whales had become so scarce that they were in imminent danger of extermination. The scarcity and the high price of sea-fishes in the vicinity of large seaport towns are unquestionable; and the shore-fisheries of the New England coast, to which Cape Cod owes its name, have been so completely destroyed that, when the Cape Cod fishermen caught, a few months ago, in their nets some of the young codfishes which had been hatched in the Fish Commission laboratory at Wood's Holl, they brought them to the naturalists as specimens of a new and unknown species. The destruction of sea-fishes may require many years, but there is no animal on earth large enough to be valuable as human food which

can long survive the attacks of a new unnatural enemy armed with the energy, the resources, and the intelligence of civilized man. Fortunately, the qualities which render him the most resistless of enemies also enable him to become a producer as well as a destroyer; and, while the fear of him and the dread of him is upon every beast of the earth and upon every fowl of the air and upon all the fishes of the sea—while they are all delivered into his hands, and are powerless to resist him—he alone of all animals is able to make good the destruction caused by his ravages, and to increase, by agriculture, by domestication, by selection and improvement, and by artificial propagation, the animals and plants which he destroys.

Can these influences be brought to bear upon marine animals? Can human intelligence and skill and power over Nature be so employed as to make quickly, by artificial means, that slight adjustment in the birth-rate of food-fishes which would have been brought about more slowly by natural agencies if man had long occupied his present rank among their enemies?

Looked at in this way, the proposition certainly does not seem to be impracticable; and, while human efforts in this field are of too recent a date to furnish positive evidence, I believe that I have shown that there is no *a priori* impossibility and no logical basis for a negative answer to the question. The results which have already been reached by the artificial propagation of certain sea-fishes, like the shad, which make periodical visits to fresh water, are extremely interesting, as they furnish indirect evidence which is very conclusive. They prove that human influence produces very prompt and decidedly advantageous results in the case of these fishes, and thus give us every reason to hope that equally valuable results will follow—a little more slowly, perhaps—from our efforts to increase the supply of more strictly marine species.

In the year 1880 the fisheries census and special investigations which were carried on under the direction of the United States Fish Commission proved that there had been a most rapid and alarming decline in the value of the shad-fisheries in the rivers and bays and sounds of our Atlantic coast, and that there was every reason to fear that in a few years the shad would be utterly exterminated. The adult shad is an oceanic fish, but each spring it enters one of the inlets or bays and makes its way up to the fresh-water streams to reproduce its kind. The supply of shad for the market is caught during this spring migration, when the fishes enter our inland waters plump and fat after their winter's feast upon the abundant supply of food which they find in the ocean. As they spend the greater part of each year gathering up and converting into the substance of their own bodies the innumerable minute marine organisms which would be of no value whatever to

man without their aid, and as their natural instincts impel them to bring to our very doors this great addition to our food-supply, their economic value is very great, as they put at our service a vast area of the surface of the globe which would otherwise be entirely beyond our control. The extinction of the shad would, therefore, be a national calamity.

In 1880 the fishermen believed, apparently with good reason, that the rapid decline was due to improper methods of fishing—to the erection of pounds and weirs along the shores of the salt bays and sounds, where the fishes were captured in great numbers long before they had reached their spawning-grounds. It was urged that, if these obstructions were removed, and all the shad were permitted to reach fresh water before they were captured, enough eggs would be deposited each year to keep up the supply, but that the destruction of such great numbers in salt water must necessarily result in extermination. This seemed to be good logic, but in the spring of the year 1888 more shad were caught in salt water than were caught altogether in the year 1880 in both fresh and salt water; and yet the shad-fisheries are now increasing in value from year to year, while in 1880 they were in danger of destruction.

To what is this change due? In 1880 the United States Fish Commission began systematically and upon a large scale the work of collecting the eggs from the bodies of the shad which were captured for the market in the nets of the fishermen. These eggs were artificially fertilized and hatched; the young fishes were kept for a few days in captivity in glass jars; they were then set at liberty in the fresh-water streams, and the waste of eggs was thus prevented. This work has been prosecuted steadily for eight years, and the results are briefly summarized in the following table:

YEARS.	Shad captured in salt or brackish water.	Shad captured in fresh water.	Total.	Percentage of increase over 1880.
1880.....	2,549,544	1,591,424	4,140,968	..
1885.....	3,267,497	1,906,434	5,172,931	25
1886.....	3,048,768	2,485,000	5,584,368	34
1887.....	3,813,744	2,901,661	6,715,405	62
1888.....	5,010,101	2,650,373	7,660,474	85

The money value of the excess in 1888 over the total catch in 1880 is more than $700,000. The conditions are now more unfavorable than ever to natural reproduction, and there can be no doubt that, if no shad had been produced by man since 1880, and if all the other conditions had been as they are, the fisheries would now be valueless. The mature shad which run the gantlet of all the pounds and traps in the lower waters, and finally reach the mouths

of the rivers, are excluded by dams and other obstructions from all the streams which are of most value as feeding-grounds for the young; and the area which is now available for spawning is restricted to the lower waters of the rivers, which are so assiduously swept by drift-nets and seines that each fish is surely captured soon after its arrival, and before it has had an opportunity to deposit its eggs. The number of eggs which are naturally deposited is now very small indeed, for, while the take upon the spawning-grounds has increased from 1,600,000 in 1880 to 2,600,000 in 1888, the take in salt water has increased from 2,500,000 to 5,000,000, and the shores of our bays and sounds are now so thoroughly lined with both nets and pounds that the number of shad which reach the spawning-grounds at all is proportionately much less than it was eight years ago, and more shad are now taken each year in salt water, where spawning is impossible, than were taken altogether in 1880. The fact that, in spite of all this, the value of the fisheries has increased eighty-five per cent, seems to prove that the shad is now entirely an artificial product, like the crops of grain which are harvested on our farms.

If any one doubts whether this result is due to man's efforts, we have more conclusive evidence. Previously to 1870 no shad were found in the Pacific Ocean or in any of its tributaries. Between 1870 and 1875 the United States Fish Commission introduced a few young shad into the Sacramento River. The number was very small, but the little fishes made their way down to the Pacific to feed and grow large and fat, and to return at last to the fresh water to reproduce their kind. Some of them came back to the same river, but others, following the warm Pacific current, wandered farther north into other rivers, until now the shad is in some places sufficiently abundant to furnish profitable fisheries, and it is distributed along more than three thousand miles of the Pacific coast of North America, and is still spreading northward in such a way as to indicate that it will in a few years be found in the rivers of Asia, so that the descendants of the shad of the Chesapeake Bay will increase the food-supply of China. If such noteworthy and valuable results follow the artificial culture of a fish which spends the greater part of its life in the ocean, and there obtains its food, is there any reason why man should not also make good his destruction of species which are more strictly marine?

The great increase in the shad-fisheries during the last eight years has been effected by the use of means which, while effective, are very crude and primitive as compared with those of modern agriculture, for example, and we must look for great improvements and a vastly greater return in the future. A farmer who did nothing more than to save and sow wild seeds which would

otherwise be lost on sterile ground or killed by frost or damp or eaten by birds and insects, would no doubt effect a slight increase in the food-supply, but his efforts would be very far behind the requirements of modern agriculture. His harvest would be as nothing compared with that of the farmer who sows improved seed; cultivates, protects, and nourishes his seedlings, and thus increases many hundred-fold the bounty of nature. Can similar improved methods be applied to the harvest of the sea? The Superintendant of the United States Fish Commission, Prof. Marshall McDonald, is now trying on a large scale experiments which will furnish an answer to this question, and the result will be eagerly looked forward to by those who are interested in pure science, as well as by those who value nothing except economic results. The young shad which are reared from the artificially fertilized eggs are usually turned out into the streams soon after they are born to shift for themselves. Many of them perish from accidents and the attacks of enemies, while others are forced to struggle for an insufficient supply of food. All horticulturists and breeders of domesticated animals know that the size and vigor and vitality of a plant or animal depend to a great degree upon its treatment during its infancy and youth, and that a stunted or injured infant seldom becomes a valuable adult plant or animal. Last spring about half a million young shad were placed soon after hatching in a large pond in Washington, and were carefully tended and fed and protected from enemies during the whole of the period which the young shad spends in fresh water. The young fishes prospered and grew rapidly, and nearly all of them were still alive when the time for migrating to the ocean came in the fall. The gates of the pond were then opened one morning, and all day long the silver stream of young shad poured out through them and started on the long journey down to the sea. All naturalists will look forward with the greatest interest to the time when these fishes return, bringing back with them to the fishermen of the Potomac the wealth of food which they have gathered in the ocean. In the mean time we may indulge the hope that the strong constitutions which they have acquired during their carefully nurtured youth will enable them to excel their less favored brothers, and that when they reach our market they will have some of the excellence of our improved garden products.

But this is not all. These shad were reared from selected eggs. The adults which enter our waters first in the spring are most valuable to the fishermen, since they are put upon the market at a time when fresh fish are scarce and high priced. Our experience with garden vegetables justifies the expectation that the eggs of early shad shall themselves give birth to early shad. Now, all

the young fishes which were put into the Fish Commission pond were hatched from eggs taken from the earliest shad of the season, and, if this process of selection be pursued for a few years, we may feel confident that the Potomac River will soon abound in shad of extra quality at the time when fine shad are hardest to get and most valuable.

RAILWAY MALADJUSTMENTS.

By BENJAMIN REECE.

IT is a remarkable fact that in social and industrial concerns men never dream of restoring an equilibrium by withdrawing the forces which disturb it, but they invariably demand the exertion of new and opposite forces to neutralize the effect of those in operation which could more easily be removed. When the moving locomotive is to be brought to a stand, the engine-man shuts off the steam and applies the brakes; but the practical statesman, and indeed many economic students, never dream of this simple method in dealing with social problems; they almost always insist on bringing out another locomotive of equal weight and power to run counter to the one in motion and thereby neutralize its energy, and the forces generated in the two locomotives are thus lost in preserving an equilibrium which could have been more readily secured by closing the throttle-valve of the one which it was designed to stop. The railroad manager making such use of his motive power would be deemed insane, yet in our industrial concerns a similar application of social energy is declared to be the only practical method, and those who decry its folly are contemptuously termed impracticals.

The space devoted by the leading periodicals to the discussion and investigation of the causes which underlie the disordered and incongruous development of our railways, as well as the numerous remedies proposed, fully attest their state of utter instability, which, if not corrected, may ultimately lead to practical confiscation by means of legislation, or their purchase and control by Government. In whatever light we view the social and industrial relations of the railroads, we are confronted by that state of chaotic confusion which must ever result from a persistent transgression of natural law.

Yet, while railroad managers are pleading to be preserved by legislation from their reciprocal aggressions, while the railroads and the public are asking for laws to protect them from their mutual hostilities, while railroad companies and employés have vainly sought an equitable adjustment of their differences, and are each looking to legislation to define their rights and limit

their obligations, it is worthy of all attention that in the physical and mechanical phases of its development the railroad is a marvel of orderly design, a monument of human energy, organization, and skill, to the perfection of which every branch of scientific research has contributed and revealed to man the proper adaptation of means to ends.

In a recent article* it was pointed out that to increase the specific gravity of water would at once disturb its relations to every other form of matter, and that the equilibrium so destroyed could only be restored by a return to natural adjustments. Do not the disordered industrial relations of our railroads present a striking parallel ?—for, with regard to their social and economic relations, viz., to the investors who own them, to the employés who operate them, and to the public who employ them, their adjustments are non-adapted, and have thus far proved non-adaptable; for innumerable laws, intended to be remedial, have only served to increase the disorder and perplexity. Is it not time that we ceased our vain attempts to neutralize by balancing unmeasured, unweighed, and complicated forces, and turn our attention to the discovery of the original sources of disturbance, so that by shutting off the steam and applying the brakes the equilibrium of adjustments will be reinstated ?

In the examination of the many evils which it is sought to remedy, I will refer to articles in recent publications, contributed by gentlemen whose experience and intimate knowledge of details connected with railroad management enable them to speak with authority, and I can not but conclude that an analysis will show all the disturbances enumerated to have their origin in two groups of stimulating laws, and in their repeal will be found the only true and permanent remedy.

"The Political Control of Railways"† is a general argument against legislation which prescribes and enforces regulations for the administration of railroad proprerties. The author calls for the repeal of the Interstate Commerce Bill, and of adverse laws enacted by the States; but such enactments had their origin in an effort to restore the equilibrium between the railroads and the public, and they stand as the reactions of, and not as the active causes of, the original disorder. It is true the repeal of these laws might restore harmony between the railroads, but only by a further unbalancing of the relations between the railroad companies and the public. The argument is substantially this: that having built roads without regard to commercial necessities or demands, investors should be permitted to unite in pools, etc., to secure the

* "Law as a Disturber of Social Order," "Popular Science Monthly," March, 1889, p. 632.

† Appleton Morgan, "Popular Science Monthly," February, 1889.

maintenance of profitable rates, and the author insists that legislation aiming to prevent such unions or agreements or regulating rates is in the nature of confiscation. This seems plausible, for it is only a half-statement of the case; as the Western granger, who has granted a free right of way and voted aid for the construction of competing lines of railways, views such alliances as treachery and dishonesty, to be prevented and punished by legal penalties.

The author of "Legislative Injustice to Railways"* condemns attempts at State regulation, which from the very nature of things must more or less directly interfere with interstate commerce; but, upon the whole, he is disposed to look upon the Interstate Commerce Bill as a step in the right direction, and would only recommend certain modifications of the anti-pooling and the long and short haul clauses. But in the main this writer asks for legislation aimed directly at the inherent dishonesty of railroad management; viz., he wants laws compelling directors to publish truthful reports, and asks the appointment of public accountants to examine and attest all reports for publication. He asks a law making it incumbent upon railroads to elect at least one thoroughly trained and honest director, specially educated for the purpose. He also insists on legislation "to regulate the methods of construction companies," which, he says, "are probably doing more to demoralize the railroad system than any other factor," and he broadly intimates that these companies are nothing but organized schemes for the enrichment of thrifty directors at the expense of the stockholders.

"Bribery in Railway Elections"† is an argument to show that the many evils complained of are the result of systematic bribery employed in the election of the directors who control the management of railway properties. The writer asserts that the practice is neither business-like nor moral, "and requires some weapon more potent than argument," hence he demands enactments prescribing heavy penalties. But surely bribery within the railway company can not be the cause of demoralization, for it is but a symptom of a diseased organism, and proves the evil to rest in the constitution of the railway corporation itself, which is the creature of statute law. What could better indicate the operation of foreign and abnormal forces than this acknowledgment that our railroads are controlled by forces neither "business-like nor moral"? Is it not evident that such an organism is of artificial origin, and is unfitted to survive unless its business and moral qualities are developed on a plane with the importance and far-reaching influences of the properties controlled?

* Henry Clews, "North American Review," March, 1889.

† Isaac L. Rice, "The Forum," March, 1889.

In "The Prevention of Railroad Strikes,"* as the title indicates, the author confines himself to the want of harmony existing between railroad companies and their employés, and suggests a plan for improving their relations by bringing the officials of the roads into closer personal contact with the men.

An examination of the evils, as above given from various sources, proves them to be symptoms of a chronic disease, at once suggesting a complication of disorders arising from two forms of original stimulation, which, although more or less reciprocal in their operations, are susceptible of a tolerably distinct line of division: viz., (1) legislative stimulation of railway construction; (2) legislation tending to push capital into unnatural combinations. These two groups of laws give rise to evils independent of each other, although when coexisting they interact, and not unfrequently the one furnishes the means while the other affords the occasion for dishonesty, as the construction companies heretofore alluded to make plain; e. g., while our loose laws, encouraging the construction of new railroads, have afforded the opportunity or occasion for directors to insidiously absorb the profits of stockholders by the extension of systems, the laws which have united "unbusiness-like and immoral forces" for the control of railway properties have placed in the hands of designing men the tools and means of doing so dishonestly.

In this present article let us confine the inquiry to the evils arising from laws intended to induce the speedy construction of railroads, and we will leave to a future number the examination of those evils which have developed within the railway corporation itself, of which railroad wrecking, false reports, bribery in railway election, and railroad strikes are familiar phases.

The splendid opportunities which the railroad afforded for the development of a country's resources were very quickly recognized by society at large, and, being impatient of the reasonable caution exercised by capital before embarking into vast and costly enterprises, the people through their Legislatures enacted laws especially calculated to promote and hasten the construction of railroads, never imagining that any evils could arise therefrom. The Western and central States particularly enacted laws providing for State subsidies and local aid, while the General Government joined the States in the surrender of the public lands to railroads. Nearly all the States passed general railroad laws substantially granting railway charters to any one who followed the legal forms in making application for them. These various laws have all contributed to destroy the equilibrium between the normal wants of a developing commerce and the natural development of railway systems within prudential limits to meet the growing demand,

* Charles Francis Adams, "Scribner's Monthly," April, 1889.

and much of the present demoralization is due to the rash, impetuous folly of those who hoped to enjoy the pleasures of stimulated activity and still escape the reacting evils.

When legislative inducements were made to investors for the construction of new railroads, capitalists were pleased to be relieved of ordinary prudence in making their investments, and upon the strength of such legislation continued to build railroads in excess of commercial wants, expecting to so adjust the traffic rates as to insure to them good profits; but this was never the purpose of the shippers or of the legislators who represented them, for, by the construction of numerous lines, they expected to arouse a spirit of competition among the railroads which would lead to cut rates and reduced cost of service. Thus the original laws which stimulated the organization and construction of railroads polarized the interests of the investors and the shippers, and made mutually repellent forces which should have mutually attracted. Each was deluded by false hopes, for neither considered the rights or interests of the other, and all subsequent legislation which has aimed to preserve the benefits of unwise and premature railroad construction to the public has shifted all the evils and consequent losses upon the railroad companies, while the efforts of railway companies to avoid all competition, by a division of revenues would throw the entire burden of supporting useless roads upon the public; and it is this unbalanced condition of affairs which has led to aggressions upon the part of railroads, adverse verdicts by juries, and hostile legislation by the States, all of which are in the nature of reactions due to the disturbance caused by the original laws.

For example, between the cities of Toledo and Detroit there are two lines of railway passing through the same towns, and for the greater part of the distance running side by side, their rights of way abutting. These two roads, being branches of the Lake Shore and Canada Southern respectively, were originally independent and competing lines, but, as one could have carried the business brought to the two, it is evident that the conflict was only a question of the survival of the fittest. In this as in most other cases the new road ultimately fell into the hands of those who owned the original line, and, though under different managers, are operated under one controlling policy; rates were equalized, train schedules harmonized, and the business which with the small additional cost of a second track could be more cheaply performed by one line must now earn the fixed charges and pay dividends on the stock certificates of two, all of which extra expense must be paid by the people. So long as the roads were in competition, they were a source of loss to the owners; when they harmonized their differences, they became a burden to the public; and the class of

legislation which encouraged the construction of the second line, under the false pretext to the public that it would serve as a competing route, has really imposed upon the people the expense of supporting two railroads when their interests could be as well or better served by the support of one. The West Shore, Nickel Plate, and other lines were practically built for the purpose of sale to the old roads which they paralleled and threatened with ruinous competition, and, as in the first instance named, the people living along those lines are now compelled to pay for the maintenance of two railroads, while for all practical purposes they derive benefits from only one. Is it not evident that the construction of railroads in excess of commercial needs must entail a loss upon the investors or an additional cost to shippers; and so long as this unbalanced state exists the railroad companies can only be saved from losses by pooling with, purchasing, or gaining control of competing lines, and thereby throw the cost upon the people? Or if the latter, through legislation, the verdicts of their juries, and interpretations of their courts, can thwart such combinations, purchase, or control, then the full force of vicious legislation will be shifted to the railroads, and as investments those properties will be ruined.

The rights and obligations of railway companies and the public meet and harmonize at the point where, the facilities provided being ample for the business, the amount of traffic is sufficient to make a low cost of service remunerative to the investors; but this desideratum can not be attained by legislating to preserve railroad properties by restricting competition and legalizing pools, nor by anti-pooling clauses to foster competition; it will only come through the repeal of the disturbing laws which by stimulating the construction of railroads polarized interests which natural adjustments made identical; but normal adjustments are impossible so long as laws exist which offer advantages to the investor other than the natural and legitimate profits of the investment.

Let general railroad laws be repealed, and, before the legislative authority to exercise the right of eminent domain is extended to a railway company, let the public necessity for the construction of a railroad be fairly shown and affirmatively proved as required by the common law.

Is the present demoralization to be wondered at when, in most of the States, charters granted under general laws are deemed as *prima facie* evidence of the public necessity, although railroads so chartered may be projected side by side with those having facilities not half employed?

Not uncommonly it is claimed that the railroads have made the country what it is, but is it not equally true that the country has made its railroads what they are? The two statements com-

plement each other, and afford further proof that a stable adjustment is only possible when the development of a country's commerce and its means of transport and communication advance together.

The State of Iowa early passed sundry laws very favorable to the construction of railroads, and, as a consequence, induced the premature development of several systems. For convenience of illustration, let us watch the early settlers of Iowa distribute themselves along three lines of railroad when they could have been better accommodated at less cost for highways, schools, churches, policing, and the administration of township and county affairs along the line of one; but in addition to these incidental burdens they found themselves compelled to pay high rates for railway service in order to pay the fixed charges and dividends on the stock of three railroads doing the business of one. If the legislators had been endowed with the common sense of the locomotive-driver, they would have closed the throttle-valve and put on the brakes; but, instead of doing this, they allowed the disturbing laws to remain in force, and prescribed legal rates to be charged for railway services, hoping thereby to retain the benefits and still escape the evils of premature railroad extension, and from that day to this Iowa has vainly sought a satisfactory solution of the problem.

The evils to be corrected were those due to the premature or unnecessary construction of railroads: this could only be accomplished by deterring such construction; and in so far as the laws succeeded in so doing, the people were relieved of the evils but lost the advantages arising from the operations of the original law, and, in so far as the remedial laws failed to deter further construction, the evils as well as the supposed benefits of the original law remained in force.

As might be expected, the two classes of laws—the one stimulating direct, the other repressing railroad extensions by impairing their value as investments—did not operate to restore a stable equilibrium; for the adverse legislation was not aimed directly against premature and unnecessary construction, but it simply made the conditions of operating railroads more onerous.

Hence the influence of the two laws may be likened to a see-saw, and in their operations they have caused abrupt changes and violent oscillations. The first effect of adverse legislation tended to stop further building; but when populative increase caused the legal tariff rates to become remunerative to the railroads, the deterring laws became inoperative, the stimulating enactments once more hastened a development far in advance of the natural wants, and the pressure of adverse laws was again experienced; and so these spasmodic fluctuations have taken the place of the

steady, rhythmic development which results from the operation of natural laws and is ever indicative of genuine progress and stability.

The pernicious influence of such conflicting legislation has led capital to alternate its moods between the extremes of inexcusable recklessness and unwarranted timidity; whereas the repeal of laws encouraging construction would withdraw the incentive of the reckless, while a similar repeal of laws discouraging construction would quiet the fears of the timid, and a healthy growth and a stable development would result.

Laws which have led to the construction of parallel lines of railway have diverted capital from the improvement of the country's highways; and even in Illinois and adjoining States, during certain seasons of the year, a ton of freight can be shipped a thousand miles to the seaboard at less cost than it can be hauled a distance of ten miles to market; yet, in spite of this grotesque condition, laws encouraging further railroad extensions still deface their statute-books.

The Interstate Commerce Bill aims to correct the evil, but it will fail, for it does not touch the cause. It attempts to cure evils which have come from unnecessary and premature construction by regulating the operation of railroads. Its direct and immediate effects appear to be good, for men do not concern themselves with the necessary reactions which are the true adjustments by which any laws or systems of laws must be judged.

Here is our railroad system in a state of utter demoralization and confusion, and yet the "Railway Age" of April 12th presents a table in detail showing that six hundred and sixty-six new lines are in contemplation, with an aggregated mileage of over fifty-three thousand miles, of which nearly fifteen thousand miles are under construction or contract, nearly ten thousand miles are surveyed, and twenty-nine thousand miles incorporated only. Does this not suggest the probable direction which the reaction to the Interstate Commerce Bill will take, unless stimulating laws are repealed, viz., a separation of the men who build the railroads on speculation under the one class of laws and the *bona fide* investors who will be compelled to purchase and operate them under the other class of laws? Can any one imagine the bewildering complications which the new adjustment threatens?

The Interstate Commerce Bill gives fair warning to investors that, if they avail themselves of laws which encourage the construction of railroads, they must suffer the consequences of their rashness, for they will be permitted neither to combine in pools nor discriminate in rates. This would be fair and logical if the parties constructing railroads were also the ones who operate them; but, unfortunately, our laws are so devised as to give aid and en-

couragement to persons who construct railroads without regard to public wants for speculation merely, and then so manipulate them as to compel old companies to purchase and operate the new lines in order to save losses on the old, which can not be done without additional cost to the people.

If we would restore harmonious relations between the railroads, we must repeal the laws which are more favorable to those who build than to those who operate them; and by such repeal the construction of railroads for purposes of blackmail and speculation will be made impossible, and the occupation of dishonest construction companies will be gone.

Is it not evident that to prevent ruinous competition and adverse legislation of which the railroads complain, and to avoid the discrimination, pools, and combines of which the public complain, we must close the throttle-valve and apply the brakes, and, by repealing, arrest the operation of those laws which have led to undue and premature railway construction; and, as population increases, existing railway systems will be more fully employed, and new systems will be extended only on their merits? Under such conditions disturbances will become less and less marked, pulsations less and less severe, and a stable equilibrium will be speedily restored.

An analysis of the testimony presented to the United States Senate Committee on Interstate Commerce, which entered upon its investigation after the above article was in type, fully confirms the position assumed. Mr. Fink stated to the committee that there were too many roads, and that, if the Grand Trunk and a half-dozen other lines did not exist, the public would be as well served as now. It was generally acknowledged that the law was not fully observed, and Mr. Depew did not hesitate to state that it never would be unless pools were legalized.

With few exceptions the railroad managers asked for the abrogation or modification of the anti-pooling and long and short haul clauses, which led Mr. Herrick, of the New York Produce Exchange, to remark, that "it seemed as if the railroads wanted to abrogate just what the public demanded should be enforced." Mr. Depew admitted that the law has prevented the building of useless roads, and that the condition of the railroads had improved, but not so much as would have been the case had they been permitted to pool. He said, "The law has proved beneficent to the public at the expense of the railroads"; but with legalized pools the converse might be stated, for they would improve the position of the railroads at the expense of the public.

Mr. John D. Kenna, ex-railroad commissioner and attorney for the Produce Exchange, insisted that the Interstate Commerce

Act extended to the roads all the advantages which could be legitimately derived from a pool; and he very justly observed that, when recklessness had reached its length, the railroad presidents and bankers ordered their employés to obey the law and *stop building useless railroads.*

Mr. John Newell, President of the Lake Shore, declared that "for fifteen years they had fruitlessly sought a solution of the difficulty"; the cause of failure is not obscure, for railway pools, like legislation, sought to annul the unfavorable conditions induced by over-construction; but moderating the evil effects simply resulted in the unchecked persistency of the cause; hence new roads were built, expecting to enjoy the artificial profits derived through combination, and, if denied a connection with the pool, the new roads entered the lists as freebooters and disturbers until their claims were allowed.

Since the Interstate Commerce Law is neither fully respected nor enforced, what its effect will be is undetermined; but as it aims to lessen the evils due to excessive railroad-building, it will tend to increase the energy of the original disturbing cause, and will probably result in specializing the speculative constructor as distinct from the operator of railroad properties; and as the impinging forces are intermittent in operation, it is at once suggestive of the attempt to balance an egg upon its end. Railroad managers would scale up rates by combination, the people would scale them down by competition; in either case the gain of the one is predicated upon the loss of the other.

In the normal adjustment of means to ends, of supply to natural demand, no such conflict appears, for the public could be better served at lower cost, while the railroads could secure fair profits from a larger traffic at lower rates.

The strength of this position does not rest upon the fact that "existing railroads have all they want," but on what Senator Blair failed to comprehend, that the public are already provided with more railroads than the traffic at reasonable rates can sustain; hence no possible legislation can be invoked which can prevent either a loss to the railroads or added burdens upon the people.

THE existence of evidences of the Glacial period in the Altai Mountains was doubted by B. Van Cotta, who failed to find them. But Mr. E. Michaelis, in 1870, observed "undoubted traces of a mighty spreading of ancient glaciers" in the southern part of the range, where there are now some large glaciers and snow-covered ridges. Among them are deposits of bowlders, of various rocks, confusedly mingled, the smaller ones well rounded and the larger ones more angular, while the intervals between the stones are crammed with clay and sand. The relation of these deposits to the neighboring defiles is in most cases incomprehensible.

MUSCLE AND MIND.

By FRANCES EMILY WHITE, M. D.

THE fundamental characteristic of the animal world, as distinguished from the vegetable world, lies in its different relations to the energies of matter. Every animal is a mechanism for the liberation of energy previously stored up, in great part, in the tissues of plants which serve as food for these higher forms of life; and the quantity and kinds of energy liberated in any animal are determined mainly by the degree of development of the muscular and nervous systems, the other tissues and organs of the body being subservient to these two, which have been well styled the master tissues.

But the animal differs from the plant, not only in the power of liberating energy, and thus acting on the outside world; it is also differently affected by the outside world, the energies of which play upon its living tissues as the wind upon the strings of an Æolian harp; and the sensitive organism thrills under these influences with responsive sensations of greater or less diversity and intensity according to the variety and grade of development of its sensitive organs.

The muscular and the nervous tissues, upon which depend the distinctively animal functions of sensation and spontaneous movement, develop together, and their relations, both anatomical and physiological, are of the most intimate character.

Rudimentary nerve-threads are found in the *Hydra;* first recognized by Klinenberg, they were regarded by him as partly nervous and partly muscular; and the most primitive fibers positively identified as true nerves serve as pathways of communication from the sensitive surface to the rudimentary nerve-centers, and from these centers to the equally rudimentary muscles of the simple animals to which they belong. In short, the primitive nervous system is merely an immature apparatus for the production of sensations and the excitation of movements of the kind called "reflex," since they are excited by a stimulus transmitted from the surface of the body to the nerve-centers and thence reflected, as it were, to the muscles;* and a large proportion of the nerve-bundles which, with the centers, make up the nervous system of man, consists of fibers of communication between the muscles of the trunk and limbs and their stimulating centers in

* The term "reflex" is a misnomer, as the action of the nerve-center is not the mere reflection of an impulse received from the periphery. The word is used to indicate that the exciting cause of activity of the center arises outside itself, and not, as in so-called "automatic" action, within itself.

the brain; and since no muscle normally contracts except under the stimulus of a nervous impulse transmitted through a nerve-fiber from the central nervous system, my first thesis will be at once admitted, viz., that *exercise of muscles necessarily involves exercise of their associated regions in the central nervous system, and that voluntary movements at least require the activity of certain areas of the brain.*

It is admitted that the evolution of mind in the animal series and that of the bodily organs have kept pace with each other. The hemispheres of the brain increase in size and in complexity in the ascending zoölogical scale, the animal becoming mentalized in a direct ratio to the development of this part of the brain, which in man forms by far its largest subdivision. The doctrine, first definitely formulated by Fritsch and Hitzig, that the cortex of the brain contains special centers which govern definite groups of muscles,* is most significant in connection with this subject. They and their followers divide the brain cortex into two principal regions—one of sensory areas, which lie in the hinder part of the brain, and another of motor areas, which lie anteriorly; i. e., into a region engaged in receiving from the surface organs (the skin, the eye, etc.) impressions which excite the various sensations, and a region concerned in exciting and co-ordinating the movements of the body. The motor centers thus far definitely located are those which control the muscles of the face, arm, leg, and trunk. They lie on each side of one of the fissures of the brain,† in the order named from below upward—an arrangement which led Dr. Lauder-Brunton to suggest that it had occurred in accordance with the progressive evolution of the faculties, premising that the uppermost in position were the latest to be acquired and the highest functionally. Thus animals low in the scale seize their food with the mouth; the center for the face-muscles was therefore earliest in order of development, as it is lowest in situation. Animals of a somewhat higher grade grasp their food with the anterior limbs—the next higher centers being those devoted to the arm-movements. Animals still further advanced in development have the power of running after their prey, using the posterior to assist the anterior limbs in accordance with the higher level of the centers concerned. Later still, the trunk muscles come to the assistance of the arms and legs in the all-important work of securing food, the first necessity. Coincident with these observations is the fact that the higher the center the more it requires education in the human being. The new-born infant has control of the muscles of the mouth to

* Known as the doctrine of localization.

† The fissure of Rolando, anterior to the fissure of Sylvius which separates the motor from the sensory areas.

the extent of appropriating the food placed at its lips; yet, for the effective use of the arms and legs, months of training are necessary; while definite movements of the trunk, as in dancing, bowing, etc., are acquired much later in life. It is also a most significant fact that the center for the control of the various and complex movements concerned in speech is limited to the left side of the brain in *right-handed persons*—a few cases having been recorded in which disease of the corresponding locality on the right side of the brain has been followed by loss of speech in the *left-handed* *—implying that the more frequent and intelligent use of the muscles of the right hand and arm has had some connection with the development of the faculty of speech. This is corroborated by the fact that, among the lower animals, there is little if any difference in the use of the anterior limbs, as there is also absence of the faculty of speech—a factor of the highest importance in mental development.

Although the doctrine of localization has distinguished opponents, Prof. Goltz denying that either sensations or movements have any special centers in the brain, and the late George Henry Lewes opposing the idea to the extent of saying, "It is the whole man who feels and thinks," nevertheless the doctrine is gaining ground. At least two cases have been recorded of otherwise normal individuals in whom a congenital absence of the left hand and a part of the arm was accompanied by a rudimentary condition of the corresponding convolution on the right side of the brain, showing that the building up of these motor areas in the brain is largely dependent on muscular exercise during the period of growth. That the maintenance of their nutrition in the adult is also to some extent dependent on muscular exercise is made probable by the fact that wasting of the corresponding convolution has been found in a few instances after amputation of a limb. Removal of the brain, slice by slice, in the lower animals is followed by a corresponding reduction both of intelligence and of power of voluntary movements which disappear together in about an equal degree; and every observer knows that in many cases of brain disease intelligence and the power of voluntary movement alike suffer in proportion to the extent of degradation of brain substance. There is also no more conspicuous feature of idiocy than its accompanying feeble, irregular, and uncoördinated movements. Just what relations exist between the motor areas of the brain and general intelligence is not a matter for dogmatic assertion; but that these centers form a part of the intellectual machinery is undoubted, and the facts cited, without reference to theories, may be regarded as proving my second thesis, viz., that *the systematic and regular use of the voluntary muscles of the body*

* Küssmaul.

must have an important influence on the development of the brain, and hence also of the mind of which the brain is the organ.

Whatever differences of opinion may exist as to certain minor points in the physiology of the brain, all agree that it is organized on the same general plan as are the lower parts of the nervous system, and as are the entire nervous systems of those simple animals whose functions consist in feeble sensations which arouse equally feeble movements; and as there are no abrupt transitions either in the animal series or in individual development, so in the nervous system of man there is no abrupt introduction of mental conditions of a kind totally different from those which prevail at a lower plane of animal life, but rather the foundations of all mental processes are to be found in simple reflex actions. The mental building material is, therefore, derived from movements as well as from sensations; and a sensation and its associated movement may be said to constitute *the psychical unit of the whole mental life,* as a sensory and motor nerve with their connecting center constitute the structural unit of the entire nervous system.

It is argued by Prof. Bain* that it is by the experience of muscular exertion that we obtain our first real knowledge of the external world—a "not-me" as opposed to the "me" of passive sensation. Mr. Herbert Spencer also describes our fundamental conception of *matter* as of something which offers resistance.† The different degrees of resistance met with from the "not-me" calling out different degrees of muscular effort, there arises a sense of discrimination which is the beginning of knowledge.

The duration of a muscular act also leaves its impression as a distinct element of consciousness; and the continuance of the mental state which accompanies this duration becomes a measure of *time,* the idea of which is thus incorporated in our mental make-up from the very dawn of consciousness.

The origin of the perception of *space* is similarly traced, in part at least, to movements; especially the idea of linear extension, which is greater or less in any given case according to the degree of contraction involved in moving the limbs through space, taken in connection with the time occupied. It is, then, largely by these fundamental modes of what may be termed muscular discrimination that we acquire our ideas of matter, of time and of space—the classic triad of "innate ideas" of the intuitionists. These supposed innate ideas being, however, susceptible of a psycho-physical explanation, we are bound by the law of parsimony to accept it.‡

* See "The Senses and the Intellect," by Prof. Alexander Bain, M. A.

† See "First Principles."

‡ The view advocated by Prof. W. James (see "Mind," 1887), that all sensations have

It thus appears that the brain has a twofold connection with the muscular machinery of the body; that it not only supplies the stimulus required for the production of voluntary movements, necessitating a corresponding activity on its own part, but that it is stimulated in turn by the active muscles; since every contraction is a separate occasion for the return of responsive impulses to the brain, by means of which the corresponding centers there are informed of the degree of energy put forth, and the extent of the resulting movement. Voluntary movements are thus associated with three distinct kinds of consciousness: 1. That which accompanies the outgoing impulse from the brain—the so-called "sensation of innervation."* 2. That excited by contraction of muscles through impulses arising within the muscle itself and thence transmitted to the brain—the true muscular sensation in which the muscle acts the part of a special sense-organ. 3. That produced by the resulting movement, also due to impulses sent to the brain—perhaps from the surfaces of the bones as they move against each other at the joints, or from the stretched and compressed tissues, especially the tendons in which many "Pacinian corpuscles" are found.

The brain is thus infused with a knowledge of the work done by the muscles, and hence of the external world of matter upon which the body acts by means of its muscles. These *muscular tuitions*—so-called intuitions—become permanent constituents of the mental life; and my third thesis is to the effect that *the muscles play a rôle in the development of mind similar to that which belongs to the other special sense-organs—the eye, the ear, etc.*

The dependence of intellect upon sensation was recognized by Aristotle in his famous dictum, "Nothing in the intellect not first in the senses";† and whatever the differences of view which divide the schools of psychology or individual psychologists as to the origin of our ideas of matter, time, and space, and whatever the real nature of the so-called "muscle-sense," all agree that the special sense-organs are the chief avenues of approach to the

an underived spatial element, though opposed to that of the exclusively muscular origin of the space idea, does not conflict with the general scope of my argument, since, as will appear later, the more important special sense-organs involve a muscular element.

* Not a true sensation, since it starts from the center. These sensations are described by Prof. Meynert as dependent on the memory of originally reflex movements. See "Psychiatry," by Theodor Meynert, M. D.

† Said by Schwegler to be falsely attributed to Aristotle; the following citations, however, from Grote's account of the psychology of Aristotle show that this aphorism is in harmony with his philosophy: "Without the visible phantasm of objects seen and touched, or the audible phantasm of words heard and remembered, the '*nous*' [intellect] in human beings would be a nullity."—"The fundamenta of intellect are sense and hearing." Many other excerpts of similar purport might be given.

brain, and that the sensations excited through these organs constitute the raw material of the mental life—touch, hearing and sight being recognized as *par excellence* intellectual senses. Now, it is a most significant fact, from the point of view of my third thesis, that the activities of these three senses in particular involve muscular co-operation as an essential accessory; and the profound relations which exist between many of the mental processes and muscular action are at least adumbrated in certain experimental observations by Wundt upon the eye. He has shown, for example, that vertical distances appear greater than equal horizontal distances in the proportion of 4·8 to 4, and that the same proportion exists between the muscular forces which move the eye vertically and those which move it horizontally; that the minimum of movement of the eye capable of exciting consciousness of contraction and the smallest perceptible distance are in exact agreement, both answering to an angle of one sixtieth of a degree; that we are able to distinguish a difference in length of two lines if it amount to one fiftieth of the entire length of the shorter one—the difference in movement of the eyes in this case being also one fiftieth of their entire linear movement.*

These relations can not be mere coincidences. Ideas of the size and distance of objects are also attributable in part to the degree of muscular action involved; for the nearer an object to the eye, the greater the muscular exertion required in converging the axes of the balls upon the object, and the greater the tax upon the muscles of accommodation; and it is not the visual sensation alone which gives the idea of distance, although the degree of distinctness, no doubt, has a marked influence, but the muscular sensations excited by the movements of accommodation and convergence must also contribute to the result. A mere allusion to the immense importance of visual perceptions in our mental furnishings will sufficiently indicate the bearings of these facts on the relations of muscular activity to mental activity and growth. To the significance of the muscles as organs of the muscular sense must then be added that which is due to the existence of a muscular element in other sense-organs.

Since movements, no less than sensations, play a conspicuous part in the acquisition of knowledge of the external world, it follows that ideas are a revival of ideal movements as well as of ideal sensations. My fourth thesis is, therefore, that *ideas have no special separate centers in the brain, but result from the excitation of those areas which have taken part in the original acquisition of ideas, viz., the sensory and motor centers.* These two kinds of centers, with the inhibitory centers and numerous connecting

* See "German Psychology of To-day," Ribot.

fibers, make up the convolutions of the brain and constitute the physical basis of the mental life.*

The voluntary or spontaneous excitation of ideas is thus to be attributed to the activity of the psycho-motor centers, while the inhibitory centers, since they play an important part in attention and concentration of thought, are the seat of the higher faculties; and intellectual power probably bears a direct ratio to the development of these centers. By observations and experiments similar to those employed in localizing the sensory and motor areas, the inhibitory centers have been localized in the frontal lobes of the brain. The development of these lobes, as compared with other parts of the brain, is conspicuous in man; as a rule, also, great intellectual power is associated with great frontal development.†

The biological doctrine that automatism is a property of protoplasm supports the theory of the originally spontaneous character of the so-called voluntary movements, leading up to the view that volition is an underived quality of mind; but it is a biological fact that muscles and nerves appear on the stage of animal life together in the form of a reflex apparatus, and that the primordial movements executed by these specialized forms of protoplasm are reflex; my fifth thesis is, therefore, that *the germs of volition are to be found in movements; that volition, so far from providing an original stimulus to the muscular activities, has itself grown out of these activities—the voluntary movements developing secondarily from reflex ones.*

Movements in themselves excite agreeable sensations which prompt to repetition; such as prove injurious, however, become a source of pain which tends to their suppression—that is, to inhibition; volition, therefore, develops under the stimulus of pleasure combined with the repressive influence of pain, both of which result from the action of muscles. The will is thus disciplined and directed to such activities as are useful to the organism.

Prof. Meynert describes volitional impulses as due to the [revived] perception or memory of sensations of innervation. By means of association these memories acquire sufficient intensity themselves to excite movements which thus starting from the brain appear to be spontaneous; their character will, however, depend on what has been previously registered in the motor centers.‡ Although the brain-centers concerned in the exercise of voluntary restraint (the inhibitory centers), primarily stimulated to activity by the pain resulting from injurious movements, do not

* "Thought consists of a certain elaboration of sensory and motor presentations, and has no content apart from them." Article "Psychology," "Encyclopædia Britannica," Mr. James Ward.

† See "Functions of the Brain," by David Ferrier, M. D., F. R. S. ‡ *Op. cit.*

expend their influence directly upon muscles, they may, nevertheless, be regarded as a part of the motor machinery, since they act on other centers which are motor; and, by the associated action of these two kinds of centers, the will gradually acquires a real though limited control over the voluntary muscles.

Volition, whatever its origin, involves a state of excitation of the brain and stimulation of body and mind. Opposition only serves to increase its energy (as the load in "the nerve-muscle preparation"* augments the force of the contraction), and under excitement intellectual as well as muscular work is more easily done. Emotional excitement, if not of too absorbing a nature, promotes intellectual activity, but the latter is itself accompanied by a peculiar exaltation of feeling which is a source of the keenest psychical satisfaction.

Stimulation, then, either sensory or volitional, is a necessary antecedent of activity—in common parlance, its cause. Prof. Bain advocates the idea that stimulation is the sole cause of pleasure, the nutritive functions by keeping up the vital energy enabling stimulation to be carried to certain lengths before degenerating into pain. If we fall short of the pain limit, we fail of the satisfactions which flow from the conscious expenditure of energy to the full degree of which the organism is capable. If we exceed this limit, we pay the penalty of physical degeneracy and resulting mental decrepitude with the accompanying falling off of activity, and hence of pleasure. Degeneration also follows from disuse—that is, the neglect of stimulation, and consequent inaction.

Sir William Hamilton, following Aristotle, defines pleasure as "the reflex of the spontaneous and unimpeded exertion of power of whose energy we are conscious." But exercise of power occurs as a result of stimulation. The larger statement of Prof. Bain, therefore, includes that of Hamilton; and, since the spontaneous exertion of power with the accompanying state of consciousness depends on excitation of motor centers, both these statements are involved in my sixth thesis, viz., that *movements are the primary source of pleasure and pain which, in the experience school of psychology, are recognized as the basis of the entire mental life.*

Mr. James Ward† regards the reflex movements immediately expressive of pleasure and pain as primordial, the voluntary movements being elaborated out of these. But movements occur presumably below the plane of consciousness—e. g., in vegetable protoplasm. We may therefore conclude that, in the developing animal series, the lowest members of which are indistinguishable

* The calf-muscle, with its nerves, taken from the leg of a frog. Within certain limits, the heavier the weight attached to the muscle the more powerfully it contracts when the nerve is stimulated.

† *Loc. cit.*

from plants, pleasure and pain gradually arose out of movements, thus leading to the development of volition.

Lucretius says:* "It is delightful to stand on the sea-shore in a high wind and watch the dangers of those who are on the deep; it is equally pleasant to behold from an elevated station a battle raging in the plains below, because it is naturally agreeable to witness those misfortunes from which yourself are free; but far more pleasant still is it to occupy wisdom's heights, and from thence to look down on others groping and wandering in search of the true light."† Although the want of sympathetic feeling shown in this poetic flight is shocking to the altruism of the nineteenth century, the idea is nevertheless in entire harmony with Hamilton's definition of pleasure, since consciousness of power naturally belongs to a position of superiority; and the feeling here disclosed undoubtedly constitutes an important element in human satisfactions. It is not always necessary that superiority should be demonstrated in order to the securing of its legitimate effects; a powerful mastiff scorns to use his strength against an inferior antagonist; the mere consciousness of ability to exterminate the puppy with a single shake satisfies the demands of his nature.

Pleasure, originating in physical activity and reaching a far higher phase in the doing of intellectual work, culminates in the supreme consciousness of power which attends the moral actions. As pointed out by Mr. Stanton Coit,‡ "The conscious fulfillment of duty is attended by a feeling of happiness which sometimes takes the form of deep inward peace, and sometimes of gladness and exultation, like that of a victor." Thus the ancient heathen poet and the modern moralist, although separated by the vast ocean of sympathy which lies between the opposite poles of egoism and altruism, meet nevertheless on the common soil of a common human nature.

Activity, then, carries with it its own reward; it is in itself an end; and education, once almost exclusively directed to the immediate cultivation of the mind, is gradually extending to all the activities of the complex human being—the physical and moral as well as the intellectual. The general methods by which the full measure of development of which human nature is susceptible may be secured are, I believe, indicated in the psycho-physiological facts and principles of which I have here attempted a brief outline.

* Quoted by B. Cattell in "Are Animals mentally happy?" "Nineteenth Century," August, 1886.

† It was one of the teachings of a certain system of theology, now happily nearly obsolete, that the spectacle of the tortures of the damned would constitute one of the elements of heavenly bliss.

‡ See "Mind," No. xliii, "The Final Aim of Moral Action."

Experimental proofs of the efficiency of these methods are also forthcoming. Among them, perhaps, none are more convincing

FIG. 1.—AGE, SIX MONTHS.

FIG. 2.—AGE, EIGHTEEN MONTHS.

than the results secured in the modern training schools for idiots, in which difficult field the late Dr. Edward Séguin, of New York, distinguished himself not only as an investigator of remarkable insight and originality, but as a humanitarian of a high order.

FIG. 3.—AGE, SEVEN YEARS.

At the meeting of the British Association in 1879, Dr. Séguin read a paper entitled "The Training of an Idiotic Hand,"* in which are given the details of his developmental method of teaching in the case of an idiot boy. The training described was applied mainly to the hands, over which the feeble will of the child had almost no control. He was unable to put either his fingers or hands in any given required attitude, although movements of great rapidity and considerable force were involuntarily executed, mainly from the wrist. The sense of touch was also almost wholly want-

* See "Archives of Medicine," October, 1879.

ing. After a year's training (the detailed account of which is most instructive) he is described as having learned to help and amuse himself, and to refrain from biting himself, and from striking his friends, although the hands are still subject, at times, to involuntary movements. The sense of touch has developed to the degree of recognizing about one hundred objects by their shape and texture alone, without the aid of sight. He has also acquired consciousness of the ordinary variations of temperature of water, food, etc. He has been taught to recognize the typical geometrical forms, and to cut them out of paper. He has visited the florists daily, and learned to know and name about sixty different kinds of flowers, all fragrant, thus appealing to the brain through still another sense. This development of the special senses and of volition was accompanied by a marked decline, not only of uncontrolled movements but of outbursts of temper, which had been conspicuous.

At the end of a year's training, concentrated mainly on the hands, the special training of the eyes was begun, the history of which is given in a second paper.*

There was a lack of control over the movements of the eyes quite comparable to that which had existed in the case of the

FIG. 4.—AGE, EIGHT YEARS.

FIG. 5.—AGE, NINE YEARS.

hands. The boy was unable voluntarily either to hold his eyes still or to direct them toward any particular object—rapid oscillations alternating with periods of fixation upward and to one side. In the training of these refractory organs the improved hands were made to give most effective assistance. "What words can not do," says Dr. Séguin, "the hand can; viz., it can present objects to the eye at the proper distance, at the proper opportunity, and with the proper degree of insistence and pertinacity, even fol-

* See "Archives of Medicine," December, 1880.

lowing the eye in its wanderings till it has captured and captivated the regard, . . . keeping the eye at bay, or leading it away from its empty fixedness."

At the end of the second year of training, "the vibrations of the eyes have diminished, his voluntary look has become more steady, and his automatic one less riveted." From the study of objects and movements this no longer idiotic boy was led on to the acquirement of language. At the beginning of training he could repeat only the last word of what was said to him; at the end of the second year he had acquired an accurate though limited vocabulary. Five portraits of the child accompany the reports of this experiment—the first (Fig. 1) taken at six months of age, showing normal development; the second (Fig. 2) at eighteen months (after convulsions), in which idiocy is apparent;* the third (Fig. 3) at seven years, in which the characteristics of idiocy are well marked; the fourth (Fig. 4) at the end of a year's training of the hands, and the fifth (Fig. 5) after a year's training of the eyes. These portraits testify, in a language far more forcible than that of words, to the efficiency of Dr. Séguin's method. The improvement—physical, mental, and moral—as reflected in the last portrait, is most remarkable.† The entire history of this experiment is a history of the triumph of the physiological method of education‡—the only rational method, and as applicable to the sound as to the unsound body and brain. To the physiologist, at least, it must have the value of a complete demonstration of the supreme importance of physical culture in both mental and moral development.

Corroborative testimony of equal or even greater importance may be found in a recent report of the New York State Reformatory at Elmira, to whose resident physician, Dr. Hamilton D. Wey, belongs the distinction of having proposed and carried out the details of an experiment# for testing the effects of physical culture on the mental and moral capacities of an inferior order of adult criminals. Dr. Wey selected for this experiment twelve men ranging from nineteen to twenty-nine years of age, five of whom had been convicted of burglary, four of grand larceny, and three of crimes against the person.

* The fact that idiocy often follows convulsions has a significant bearing on the subject of this paper, since the convulsions of childhood are generally the result of reflex overstimulation of the motor centers of the brain from excessive irritation of the sensory centers brought about by some severe disturbance at the periphery, as in the convulsions of teething.

† We are indebted to the kindness of the Messrs. Putnam for permission to reproduce these portraits.

‡ This includes all that comes under the head of *manual training*.

See Annual Report of Board of Managers of the New York State Reformatory, January, 1887.

Three of them had been total-abstinence men; eight had indulged in alcoholic drinks occasionally, and one habitually. Several of them confessed to intemperate parents; one had an insane and one an epileptic mother. Many of these men had faces indicative of criminal tendencies; the heads of two were suggestive of idiocy; and among the entire number there was not a face which did not express either mental hebetude or moral obliquity, or both combined.

During the previous two years these men had made no appreciable progress in school-work, seeming incapable of prolonged mental efforts. One of them could neither read nor write; another found great difficulty in doing either; and, although four of them understood the steps necessary for working out a problem in long division, they could never obtain a correct answer, while the remaining eight were "stranded upon the shoals of rudimentary arithmetic from notation to simple division." Some of them were unable even to name the State or country from which they had come. It will be admitted that the proposed test of the value of physical culture was of the severest possible kind.

The physical discipline to which they were subjected consisted in (1) hot baths—three weekly, the Turkish and common bath alternating; (2) massage—kneading of the muscles, passive motions of the joints, and friction of the entire surface; (3) physical exercise—manual drill, free gymnastics and exercise with dumbbells ranging progressively from three to eight pounds in weight; (4) the substitution of a special dietary for the regular prison fare. The experiment was continued during five months—long enough to demonstrate the value of the method, but not to determine the full measure of success probably attainable by these means. At the end of this period, nine of the eleven men then living had risen from the third or refractory to the intermediate grade, the remaining two having merely maintained their original standing in this grade.

During the six months immediately preceding the experiment, the average marking for shop-work, school-work, and conduct had been forty-six per cent. During the experiment, the average for school-work, previously lowest of all, rose to seventy-four per cent, the conduct improving at about an equal rate. Shop-work was discontinued, as the special training was thought to secure enough muscular exercise. During the six months following the term of the experiment, the average marking of the men in the three departments of shop-work, school-work, and conduct rose to seventy-one per cent as compared with forty-six per cent for the six months preceding the experiment. At the end of this period Dr. Wey reported* that "although the men had been remanded to

* See "Science," June 17, 1887.

the former routine of prison life, mental development was still going on; six of the number had reached the first grade in school-work, and two of the remaining five had every prospect of soon doing so."

Physical improvement was marked; their skins had acquired the softness and smoothness of childhood (several having had some form of skin-disease), and their biceps muscles had become worthy of the traditional blacksmith. Their former stooping attitude, slow movements, and shuffling gait had given place to an appearance of alertness and vigor; their faces also had developed an expression of comparative brightness and intelligence. In manual labor the advance was not so pronounced as in other directions, though improvement in this department was marked; but the stride in mental and moral development was almost beyond belief. Dr. Wey, in closing his account of this most interesting test of a new method in prison discipline, says, "I regard my experiment in physical culture as showing that something more than mere brawn can be accomplished by muscular exercise, properly directed."

Inquiries extending over a period of forty years, made of about three hundred members of the Cambridge and Oxford University crews, instituted by Dr. Maclaren, director of the University Gymnasium at Oxford, have elicited facts which may be accepted as experimental evidence of the value of physical training in a class of cases in which the conditions of life are most favorable, hence affording a test from which practically every element except the purely muscular one is eliminated. The benefits experienced by the members of these crews are stated to be an increase of stamina, of energy, enterprise, and executive power, and of fortitude in endurance of trials, privations, and disappointments—"a goodly list of benefits bearing on the mental and moral as conspicuously as on the physical side of the question," says Dr. Maclaren, "for, in the struggle for existence, failure is more likely to result from inability to endure trials and disappointments than from merely physical weakness—the statistics of suicide bearing out this statement." *

The testimony obtained from this source shows that the advantages of physical training are not limited to the idiotic, the ignorant, and the criminal classes, the conditions of whose lives have been especially unfavorable to a normal symmetrical development, but that they belong alike to all; and these widely different experiments, considered together, are calculated to convince the most skeptical mind of the soundness of the several foregoing theses based on certain facts of the development and physiology of the muscular and nervous systems, and on certain principles of

* See Dr. Maclaren's work on training.

psycho-physics and psychology, to which reference has been made. This experimental evidence, having been drawn from observations on the extremes of human capacity and character (exemplified in the young idiot, the adult criminal, and the university student, during the intermediate developmental period), may be accepted as virtually covering the entire ground of human nature in its various phases, and therefore as conclusive of the *universal applicability of systematic physical culture in education.* The cases cited show that in the processes of mental and moral development the muscles, as well as the purely sensory mechanisms, play a conspicuous part; and, while the period of growth is undoubtedly most favorable to this work, Dr. Wey's experiment shows that *even the adult brain and mind may be improved by the various procedures included under the head of physical culture.*

That health has an important bearing upon morals is undoubted.* Count Tolstoï, through the lips of one of his dramatic impersonations, says, "I must have some physical exercise or my character will entirely spoil";† and it is probable that not even the finest examples of human development have attained a height so great, either intellectual or moral, as to be beyond betterment by these means. Descartes testified to the importance of attention to the physical nature in saying, "If it be possible to perfect the human race, it is in medicine that we must seek the means"—employing the term "medicine" in its broad sense as a science devoted to the care of the body. The curative value of physical exercise has long been recognized. Boerhaave said that most of our fashionable diseases might be cured mechanically instead of chemically, by climbing a bitter-wood tree or by chopping it down, rather than by swallowing a disgusting decoction of its leaves and bark. Asclepiades was accustomed to prescribing a course of gymnastics for nearly every form of bodily ailment. Tolstoï also proposes to enrich medicine with a new term, "labor-cure," as a sovereign specific for nervous affections.‡

We have found that activity is in itself an end. The excitement which attends voluntary muscular exercise is a natural stimulant in which all can afford to indulge, since, unlike the artificial stimulants, it adds to the stock by promoting the nutrition of the entire body. Voluntary exercise also tends to develop the general power of volition (including that of self-restraint), which, as we have seen, first appears on the stage of animal life in connection with movements.

But emotions and thoughts as well as movements may be inhibited and brought under control; and it is in this region of

* See author's article, "Hygiene as a Basis of Morals," "Popular Science Monthly," May, 1887.

† See "Anna Karénina."

‡ *Loc. cit.*

mentality that volition reaches its highest phase. Whosoever has attained those "shining table-lands" of human character where force, courage, endurance, and a due degree of altruism perennially abide is in his own person an apotheosis of power, the power whose beginnings we have traced to the muscular activities.

It then appears that in the twofold nature of man the physical and the psychical exist not merely in the relation of simple contiguity, but rather as involved in "the one and indivisible whole" of human existence, and that the psychical—the so-called spiritual—qualities are developed through the physical agents known as the bodily organs, by means of the activities which constitute the functions of those organs.

Said the great Spinoza, whose far-reaching vision penetrated depths beyond the ken of the common mind: "*We do not desire or strive after anything because we think it good; we think it good because we are moved to strive after and desire it.*"

KINSHIP IN POLYNESIA.*

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IN Polynesia, the distinct classes constitute a similar state of things to the family group in the peoples of Asia, since they form an exclusive organization, holding property in common. It is not very clear how these classes arose, but we may assume that they are connected with an earlier distribution into clans, so that the chief represents the eldest line of the posterity of their common ancestor. In some cases this ancestor is supposed to be of divine origin; but we lay no stress on such a supposition, since it probably arose after the chief's position was established. The people are usually in possession of small plots of ground, either as comparatively independent proprietors, or as serfs; the nobles are owners or rulers of small districts, and the king is ruler of the whole. The conditions are in many respects confused and indefinite, yet the type is undoubtedly that of the joint family, or village community.

The classes differ from clans in a natural way. The nobles of different clans belong to one class, and while the clan is usually exogamous, the class always tends to become endogamous. In Polynesia, the definition of the class depends upon the line of kinship, and the classes are not isolated with the exclusiveness of

* From "The Primitive Family," by Dr. C. N. Starcke, "International Scientific Series," vol. lxv, just published by D. Appleton & Co.

castes in India: marriages between the different classes are not absolutely forbidden.

The position of a child born from a marriage between persons of unequal rank may be decided in several ways. The child may either be always assigned to the superior or inferior class, or always either to the father or mother. Polynesia offers us examples of all kinds.

If the father or mother alone belongs to the ruling class, the child is, in the Caroline Isles, assigned to that class.* In the Tonga Isles, the highest class—the Egi, or nobles—inherits rank and property through the mother; the children of the common people (Mataboulas and Tuas) inherit from the father, but belong to the mother's class.† In Otaheite, the children of a marriage between a noble (Hui-Arii) and a woman of a lower class are set aside, unless numerous ceremonies are performed in the temple at the time of the wedding, so as to raise the rank of the inferior person.‡ Both among the nobles and in the intermediate class of landowners the father abdicates in favor of his new-born son, because the son has an additional ancestor, and is therefore of higher rank than his father.#

Marriages are dissolved in the Sandwich Isles at the wish of either party; only in the case of the chiefs there is no divorce, but they form a connection with other women, and their wives take other lovers. These are usually of inferior rank, and the children begotten of such marriages are almost always put to death, probably by the kinsfolk of the higher class, in order that their own importance may not suffer from intermixture with an inferior rank.‖ When we are told that in Hawaii the dignity of chief is inherited through the mother, it must be understood that preference is given to those of the chief's children whose mother is of the highest rank.^ "The wife does not share her husband's rank. The rank of the child is decided by certain definite laws, generally by that of its mother, but also in some cases by that of the father. A woman of noble family who marries one of the common people loses her rank in the event of bearing children to him, in which case she and her children are degraded to her husband's class. The right of inheritance is not decided by priority of birth, but by the fact that the mother is of higher rank than the other wives."◊

This is also the case at King's Mill and in New Zealand.‡ In

* Chamisso, vol. ii, p. 241.

† Martin, vol. ii, p. 101. Rienzi, vol. iii, p. 45. Morgan, "Systems," p. 559.

‡ Ellis, vol. iii, p. 98.

Ibid., vol. iii, p. 100. Cook, vol. i. Hawkesworth, vol. ii, p. 243.

‖ Ellis, vol. i, p. 256; vol. iv, p. 411.

^ Varigny, p. 14.

◊ Chamisso, vol. ii, p. 275.

‡ Wilkes, vol. v, p. 85. Rienzi, vol. iii, p. 142.

the latter country, the man who marries into another tribe or clan takes up his abode in it, and is thenceforward reckoned with his wife's family. It is also usual for the wife to raise her husband to her own rank, while this is not done by the husband.* This fact has been regarded as a survival of a clearly established female line, and a sign of the earlier pre-eminence of the wife; but it seems to me to imply precisely the opposite. Only the prevalent custom of ascribing the child to its father would induce the kinsfolk of a woman of high rank to adopt her husband, in order not to lose their hold upon the children. If the female line were about to disappear, the growing claims of the husband would lead to the adoption of his wife by his own family.

It has been supposed that the strongest proof of the female line is to be found among the Fiji Islanders, but here also the spirit of mature criticism is wanting. We are told that the king is succeeded by his brother, and by his eldest son only in the event of his leaving no surviving brother. The mother's rank and some other circumstances may, however, cause this rule to be violated, so that the younger is preferred to the elder brother.† The chief's practice of extensive polygamy makes it desirable to establish the child's rank by a reference to its mother.‡ The female line can not be deduced from these customs, but a stronger proof is afforded by the institution of the Vasu, which is described as follows: "Most prominent among the public notorieties of Fiji is the *Vasu.* The word means a nephew or niece, but becomes a title of office in the case of the male, who, in some localities, has the extraordinary privilege of appropriating whatever he chooses belonging to his uncle, or those under his uncle's power. Vasus are of three kinds: the *Vasu taukei,* the *Vasu levu,* and the *Vasu;* the last is a common name, belonging to any nephew whatever. *Vasu taukei* is a term applied to any Vasu whose mother is a lady of the land in which he is born. The fact of Mbau being at the head of Fijian rank gives the Queen of Mbau a pre-eminence over all Fijian ladies, and her son a place nominally above all Vasus. No material difference exists between the power of a *Vasu taukei* and that of a *Vasu levu,* which latter title is given to every Vasu born of a woman of rank, and having a first-class chief for his father. *Vasu taukei* can claim anything belonging to a native of his mother's land, excepting the wives, home, and land of a chief. . . . However high a chief may rank, however powerful a king may be, if he has a nephew he has a master, one who will not be content with the name, but who will exercise his prerogative to the full,

* Thompson, vol. i, p. 176. Brown, p. 34.

† Williams and Calvert, p. 18. Appendix xxvi. Rienzi, vol. iii, p. 286. Morgan, "Systems," p. 582; "Ancient Societies," p. 375.

‡ Williams and Calvert, p. 26. Appendix xxvii.

seizing whatever may take his fancy, regardless of its value or the owner's inconvenience in its loss. Resistance is not thought of, and objection only offered in extreme cases. Thokonauto, a Rewa chief, during a quarrel with an uncle, used the right of Vasu, and actually supplied himself with ammunition from his enemy's stores."*

It can not be denied that this great power of the sister's son is very remarkable, and at the first glance it seems only possible to explain it by assuming that there was a peculiar sanctity in the tie of kinship between the man and his sister's son. The extent of the claim is astonishing—a claim which no son would venture to put forward; and this is the more remarkable since the sister's son is not the uncle's heir. In all other cases in which the female line divides father and son, in order to tighten the bond between the mother's brother and sister's son, the analogy with the male line is maintained; that is, the uncle exerts his authority over the sister's son, whereas in this instance their positions are reversed. This arouses a suspicion that ideas unconnected with the female line may have produced the Vasu rights.

On examining more closely the whole institution of the Vasu, we are first struck by the fact that no legitimate rights belong to the common Vasu. These claims can only be made by the Vasu whose mother's brother possesses people and land. It may be assumed that the power of the Vasu in its extreme development was first directed against the mother's brother after it had become an integral part of the political machinery of Fiji, since we are told that the Vasu right becomes an instrument in the king's hand for ruthlessly plundering the land. The king makes use of the Vasu, and shares the plunder with him.† There can be no doubt that the institution of Vasu arose out of the natural reverence with which the subjects regarded the king's sister's son when he visited his uncle. They honored the king through his kinsfolk. The king and his sons ruled after no gentle fashion, and the ruler was entitled to commit all sorts of acts of violence. In this way the honor paid to the king's sister's son enabled him to rob the people freely. The Vasu right was gradually transformed into a fundamental institution, and that which was at first serviceable to the king was now turned against him. It certainly affords no indications of a mystical and religious belief in any special sacred bond between the mother's brother and sister's son.

THE Russian observers of the solar eclipse of August 19, 1887, have expressed the conclusion that the corona has a real existence, and is not merely an optical phenomenon; it having maintained its shape during the whole of the eclipse at each spot where it was observed, and also at spots as far as six thousand miles apart.

* Williams and Calvert, p. 27. † Ibid., p. 27. Appendix xxviii.

SOME OF THE LIMITATIONS OF MEDICINE.*

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IT is a trait peculiar to some minds to believe too much and to others to believe too little. Between these extremes, however, there are many who, though keenly alive to the limitations of medicine, are, at the same time, able to appreciate the great boon it is to mankind. There may be those who would resent the idea of circumscribing our art, but "truth can never be really injurious, whatever phantoms apprehensive ignorance may conjure up around it."

The questions have often presented themselves to me why, after so many years of familiarity with disease, is there such a wide difference of opinion regarding its management? Why is it possible that there are two large schools of medicine opposed in theory if not in practice? Why the endless and surprising consumption of patent remedies? It would seem that more or less superstition still prevails in reference to disease, as well as much ignorance respecting its natural history. I am not well convinced that illness is a necessary concomitant of human existence; and to believe that it is unavoidable is to paralyze all legitimate efforts for its prevention. That it will, at any time, be wholly eradicated is too much to hope, and as Utopian as to expect that a high order of knowledge will ever be universal; nevertheless, great mental attainments and perfect physical health have been realized, and therefore must be accepted as a standard for approximation. Nor is such a realization fortuitous. Long years before our era a wise philosopher of Greece declared that *chance* was nothing more than *cause* unperceived by human reasoning. Now, the welfare of the human race suffers in proportion to the survival of a belief that chance and not some ascertainable cause underlies the evils that endanger it. We are prone to shift the responsibility for our misfortunes upon others, and slow to take the blame on ourselves, where it commonly belongs. Life is certainly a desirable thing under favorable circumstances, and oftentimes we are the makers, or, at least, the modifiers of our environment. As a rule, bad health is the foundation of the greater part of the unhappiness of man. And yet nothing is more positive than that the preservation of good health depends upon a strict observance of the laws of being, which include those of inheritance. Many

* Read before the Clinical Society of the New York Post-Graduate Medical School and Hospital, January 19, 1889.

of these precepts are well understood, but they are by no means generally heeded; for, though life is undoubtedly shortened by ignorance, it is also curtailed by a disregard of what is known—a failure to profit by the understanding. All infringements of the rules of health entail suffering upon the individual, his contemporaries, or his descendants. It is the inability to appreciate that man is but a molecular vibration in the great molar pulsation of life, that allows him to hope that action will ever be not followed by reaction. Furthermore, Nature is never cognizant of extenuating circumstances. Whatever a man's motive, he is equally a victim of a neglect to preserve his bodily well-being, whether his intentions be good or bad. We see death prematurely and with impartiality destroy the just and the unjust. We know that life bears many an old sinner to its utmost limit, and, contrariwise, that goodness is not incompatible with extreme old age. Seeing and knowing these things, are we to shut our eyes and be oblivious to such truths, or are we to awaken to a just appreciation of the invariable relation of cause and effect, however far removed one from the other?

Life has been defined as "the continuous adjustment of internal relations to external relations." Hence, a partial failure of the inner man to meet the successive changes that are going on about him, means incomplete life or disease, and a complete failure of a similar adjustment signifies death. The transmission and the development of characters known as inheritance are made clear by the hypothesis of *pangenesis,* which, therefore, with your permission, let me give: "Every unit or cell of the body throws off gemmules or undeveloped atoms, which are transmitted to the offspring of both sexes, and are multiplied by self-division. They may remain undeveloped during the early years of life or during successive generations; and their development into units or cells, like those from which they are derived, depends on their affinity for and union with other units or cells previously developed in the due order of growth." Here we find an explanation of the manner in which predispositions to disease are probably transmitted, and, what is more, the particular form of inheritance known as *atavism,* or the recurrence of certain features after one or two generations of immunity. I dwell upon this matter of inheritance in order to show how futile the attempt to construct a perfect being out of imperfect material. No amount of therapeutic skill will ever be able to atone for the fatal mistake of unwise parentage. The laws of generation are as applicable to man as to the lower animals. It seems unfair that the child should suffer for the shortcomings of the parent, but the offspring is a continuation of his progenitors, the product of those who have gone before, *plus* his own individuality. Hence, what affects

the child in some degree affects the parent. Indeed, the suffering of a parent over the misfortunes of the child is often greater than that of the child itself. It is important that man should understand the great power that inheritance exerts upon the race for good and for evil, so that he may make a wise departure in the right direction; and that he should know that his daily life so regulates his habits of mind and body that each succeeding day is the sum total of the days that have gone before in its influence upon his future health and movements.

Confucius says: "When you know a thing, to hold that you know it; and when you do not know a thing, to allow that you do not know it—this is knowledge." The laity are of necessity more or less ignorant of the nature of disease. And it would seem that their ignorance is shared by no inconsiderable number of our profession. Every malady pursues a definite course, and ends in restoration, incomplete recovery, or in death. Now, I believe that those medical men who are familiar with the natural history of disease will admit that the milder forms of most acute affections will pass through their various stages and end in recovery without the assistance of a single drug. Moreover, I think they will be obliged to acknowledge that, under the most favorable circumstances and most skilled treatment, many persons die overpowered by the virulence of a malady. The daily record of vital statistics would seem to prove as much. And the pathologists will bear testimony to the fact that where disease, either acute or chronic, has invaded a vital organ, just so much of the tissue as is destroyed remains destroyed and is never reproduced. Have we a broken-down lung? The best that can happen is that the process shall be stopped. Are portions of the kidneys degenerated? We can but save the remainder. Has the liver begun to retrograde into fibrous tissue? We can at best but check the retrogression.

The probable reason that treatment does not keep pace with the rapid advance of pathology is that therapeutics has gone astray, since the only possible solution for some of these difficulties is to seek out the cause and obviate it. A great deal of time and talent have been wasted in a fruitless search for specific remedies for disease, like unto the metaphysicians who have been asking unanswerable questions for hundreds of years about the unknowable.

While it is possible to imagine a community so intelligent as to exist free from the ravages of disease, it is too much for the most sanguine to hope for in the near future. But, notwithstanding this, the history of the recent past assures us that already great strides are being made in the proper direction. Devastating epidemics are less common, because stupidity and superstition

are being overcome by intelligence and a more general recognition of the sequence of cause and effect.

We have many useful drugs, some that are indispensable, but they are mostly double-edged tools to be handled only by trained hands. The man unfamiliar with disease who ventures to administer these drugs because he happens to be acquainted with their names, is very much like the literary aspirant who resorted to opium in the vain hope of becoming a De Quincey.

Whenever the germs of disease gain admission to the body, Nature makes strenuous efforts to throw them off, and, although it takes its own time, it is often successful. For example, fever, by destroying the morbid products that produce it, serves a most useful *rôle* in the restoration of the patient to health. And, as part of nature, the skillful physician stands by in readiness to do his share in furthering the process already initiated. By an intimate acquaintance with the phenomena of disease and the means by which they are manifested, he is enabled to do the right thing at the proper moment, and thus frequently turn the scale toward recovery, when without his intelligent interference the balance might fall in the wrong direction. But the meddlesome interposition of the ill-informed is often productive of great harm. A burning desire to do some impossible thing leads the unwary practitioner into many fatal extravagances. To have the knowledge when not to act, and the moral courage to forbear and give Nature a reasonable chance, are indeed combinations of gifts as desirable as they are rare. From this it follows that the man who recognizes the limitations of medicine is by far the safest adviser. There are no real specifics for disease; and to believe that somewhere in the animal, vegetable, or mineral kingdoms, hidden from the eye of man, there are to be found by diligent search a cure, at least, for each of the many ills that flesh brings upon itself, seems much less rational than to consider all these troubles as induced by violations of laws, known or discoverable, which must be obeyed and can not be evaded. In the scheme of Nature it would have been much simpler to eliminate all pain and disease than to provide occult remedial agents for each, were either alternative within the scope of creation.

No; disease is avoidable to a very considerable extent, if not entirely. And this is possible just in proportion to our knowledge and our will to act thereon. But, because of our ignorance and of our failure to live up to what is known, we are yet far removed from perfect health.

Let us now glance at what we can do. To begin with, we are able to give much instruction regarding the avoidance of disease. We can relieve functional troubles first by the simpler means of rest, food, or exercise, as the conditions demand. We

can quell undue pain. But we can not continue to supply medicines that will take the place of proper living. The man who neglects his own health, and expects the medical profession to make up for his negligence, is somewhat like a person careless of fire in his own house because there happens to be an efficient fire department in town. The flames sometimes get extinguished if the alarm is sounded in time. We can assist Nature in her endeavor to cast out morbid products by various therapeutical expedients. We can remove some of the exciting causes of disease, or else take the patient beyond their reach. We can place him under the most favorable circumstances for Nature to do her work, and at critical moments stimulate the flagging powers and thus bridge over a yawning gulf. We can palliate many of the distressing symptoms of disease, but we can not atone for all the outrageous infringements of Nature's inexorable laws by dosing with drugs, and, moreover, it is not likely that we shall ever be able to do so.

It is possible that we are upon the threshold of a new era in the treatment of infectious and miasmatic diseases, in which new reasons will be found for the survival of old remedies, and many useful additions will be made to our pharmacopœia. The wonderful discoveries of Pasteur in France and of Koch in Germany, and the splendid achievements of the former in his applications of them, seem very fruitful of promise. But, notwithstanding all this, it is much safer to be cautious about mad dogs than to run any undue risks because Pasteur has evolved a means of lessening the terrors of rabies.

And now, in conclusion, I would venture to claim that the answer to my three questions at the beginning of this paper is found in the fact that there is a natural cycle to many diseases wherein there is a tendency toward recovery that, to be sure, is favored or retarded by a multitude of circumstances, but which often takes place irrespective of medication. And this fact is the substratum of all those differences of opinion that are continually arising among superficial observers; is a reason for the survival of many absurd therapeutical theories; is the explanation of the existence of the vagaries of faith and of mind-cures; and, what is perhaps the most lamentable of all, makes it possible for the designing to trade upon the credulity of the public with their oft-times harmful nostrums.

DESCARTES supposed, in 1668, that the displacement of the rocks and the elevations of the surface might be caused by the earth's contraction. Newton expressed a similar thought in 1681, in a letter respecting Dr. Burnet's "Sacred Theory of the Earth," but was careful to add to his hypothesis, "I have not set down anything I have well considered, or will undertake to defend."

SKETCH OF HENRY CARVILL LEWIS.

ALTHOUGH Prof. Lewis died at an age when men usually have hardly more than begun to produce matured work, his name had already become associated with the solution of a most important geological question, and he was recognized as one who had led the science another step forward.

HENRY CARVILL LEWIS was born in Philadelphia, November 16, 1853, and died in Manchester, England, July 21, 1888. He was descended from an ancient patrician family, the Ludewigs, of the free imperial city of Hall, in Swabia, who are mentioned as having occupied as early as the fourteenth century responsible positions as military and civil officers in their city and in the Holy Roman Empire. In the beginning of the eighteenth century, the sons of his ancestor, Johann Peter Ludewig, appear as distinguished in arms and letters. One of them, Johann Peter von Ludewig, besides having other dignities, was a learned jurist and historiographer and poet laureate of the empire, and the author of many historical and legal works. His own ancestor of this generation, Johann David Ludewig, was connected with military and court life. His great-grandfather removed to America in 1784 and anglicized his name to Lewis. His grandfather, John F. Lewis, and his father, F. Mortimer Lewis, were engaged in the East India trade. The latter, since retiring from business, has been actively engaged in various philanthropies in connection with hospitals and benevolent institutions, and is now President of the Pennsylvania Institution for the Deaf and Dumb and of the Children's Hospital of Philadelphia. An incident that occurred when Henry Lewis was little more than an infant is mentioned by his biographer as showing an early inclination toward geological studies. He was found, while on a visit to the country, digging in the gravel-walk with a spoon, and, when asked why he was doing it, replied that he "wanted to see what was underneath." This may have been only a manifestation of childish activity which under other circumstances might not have been noticed and have passed without influence upon his career; but his father and his maternal grandfather, Mr. Henry Carvill, were quick to observe the direction of the dawning intelligence of the boy, and to cultivate whatever profitable tastes he might show. The generous interest taken by his father in fostering the bent of his son's mind toward research deserves, in fact, special recognition and acknowledgment. As soon as his son displayed earnest leanings in this direction, Mr. Lewis provided every facility for helping him in his favorite studies. Instead of attempting, as too

many parents might mistakenly have done, to divert him from this to a more "practical" line of pursuits, he fitted up for him a well-furnished chemical laboratory and workshop; and this laboratory was through all his life a favorite retreat of Carvill Lewis's, to which it was his delight to introduce his scientific friends. His interest in mineralogy and geology assumed a more definite and controlling shape when he was about twelve years old, when Dr. Isaac Lea gave him some specimens as the foundation of a collection, and stimulated him to go on studying them. A year later he and some playmates formed a scientific society, which continued in existence and of which he remained a member till 1875, when it disbanded. Having been graduated from the University of Pennsylvania in 1873 with the highest honors in the classical course, he took a post-graduate course of three years in the natural sciences. For several years after his graduation he divided his time almost equally between geology and astronomy. Twenty-nine communications by him are recorded in the "Proceedings of the Mineralogical and Geological Section of the Academy of Natural Sciences of Philadelphia," from 1877 to 1879. He gave to the American Association in 1877 a description of an aurora and of the zodiacal light as observed by him in May of that year, and notes by him on the zodiacal light were published in the "Proceedings of the American Association" and in the "American Journal of Science" in 1880. In 1879 he joined the Geological Survey of Pennsylvania as a volunteer member, and continued associated with it till 1884. In connection with this work he investigated the surface geology of the southern part of the State, and began the tracing of the great terminal glacial moraine with which his name is most closely associated, determining its course through the northern part of Pennsylvania. In all these researches, as well as his studies in mineralogy and petrology—notably in those relating to the diamond and to the archæan rocks—he was moved by an earnest spirit of independent inquiry, and afforded a living illustration of the force and application of his motto, "Truth for authority, not authority for truth." The controlling force of this principle in his life-work is emphasized in the simple record on his tombstone in Walmsley church-yard, Bolton, "He loved the truth."

In 1880 Mr. Lewis was elected Professor of Mineralogy in the Academy of Natural Sciences, Philadelphia; and in 1883, Professor of Geology in Haverford College. He held both of these positions at the time of his death. From 1885 to 1887 he was occupied during the winters in petrologic studies in Heidelberg with Prof. Rosenbusch, and during the summers in field-work on the glacial geology of England, Wales, Ireland, Switzerland, and northern Germany. The winter and spring of 1887–'88 were

spent in this country, partly in visiting the places in the Southern States where diamonds have been found, in continuance of his investigations on the origin of that gem. He had read papers on the subject at the meetings of the British Association in 1886 and 1887, and was planning to present his further results at the next meeting of that body; after which he hoped to carry on his glacial studies in Norway and other parts of Europe.

He sailed, with Mrs. Lewis, for Europe, on the 3d of July, 1888. He was affected during the latter part of his voyage with symptoms of illness, which developed, after he reached Manchester, England, into typhoid fever. From this he died on the 21st of July. Prof. G. F. Wright, author of "The Ice Age in North America" (New York, D. Appleton & Co., 1889), who was associated with him in the investigation of the terminal glacial moraine, has furnished the estimate which follows, of the general value of his work. The more particularized review of his glacial investigations with which this paper continues, has been furnished us by Mr. Warren Upham, who was also the author of a sketch of Lewis in the "American Geologist."

"It is impossible," says Prof. Wright, "to overestimate the value to the world of such a career as Lewis set before him, and already at his early death had largely realized. His vigor of body and mind, pleasing address, liberal education, high social position, and abundant means, insured to him flattering success in almost any direction. He could easily have attained eminence in the politics of his State and nation. He could have entered upon a business career with fair prospect of becoming a millionaire. Or he could have settled down, as the majority of those thus situated do, to the seductive pleasures of society, and have been one of its chief ornaments. Instead of this, he threw all the resources of his nature and of his position into the most laudable work of enlarging the stock of the world's knowledge.

"The leisure hours of his boyhood were spent in his laboratory and in roaming over the hills in the vicinity of Philadelphia in search of facts to explain their origin. After graduating from the university, he offered himself as an assistant to the Geological Survey of the State, and for one or two seasons accompanied the surveyors in the dull routine of their work. He afterward was commissioned to prosecute independently investigations into the nature of the gravel deposits of the rivers entering the Atlantic between New York and Norfolk, Va. It was with the results of these youthful investigations that he came to the meeting of the American Association for the Advancement of Science at Boston, in 1880, with two or three papers which at once attracted the attention both of that body and of the wider audience reached by the printed reports. Lewis was specially delighted on that occa-

sion by the approval of his work which was given by the venerable Prof. W. B. Rogers, then at the head of the Massachusetts Institute of Technology, and for so long a time connected with the Geological Survey of Pennsylvania and the adjoining Appalachian region.

"During all his earnest search for the truths of Nature, Lewis was stimulated by the thought that man does not live by bread alone, but that he who ministers to the mental wants of the race by discovering truth and bringing it within reach of the general apprehension is as truly a philanthropist as he who ministers to their bodily comfort. In all these aims it is gratifying to know that his wife most heartily coincided. A great truth of Nature, like the wonderful history of the Glacial period, when it finds its way into the school-books of the children and into works of general literature, is of incalculable utility in the intellectual development of mankind."

"Prof. Lewis first became specially interested," writes Mr. Upham, "in the glacial drift and its terminal moraine during the latter part of the year 1880, when, in company with Prof. G. F. Wright, he studied the remarkable osars of Andover, Mass., the gravel of Trenton, N. J., containing palæolithic implements, the drift deposits of the vicinity of New Haven, Conn., under the guidance of Prof. Dana, and finally the terminal moraine in eastern Pennsylvania between the Delaware and Lehigh Rivers. The following year Profs. Lewis and Wright traversed together the southern border of the drift through Pennsylvania from Belvidere, on the Delaware, west-northwesterly more than two hundred miles across the ridges of the Alleghanies, to Little Valley, near Salamanca, N. Y., and thence southwesterly one hundred and thirty miles to the line dividing Pennsylvania and Ohio, which it crosses about fifteen miles north of the Ohio River. The report of this survey of the terminal moraine was published in 1884, forming Volume Z of the reports of progress of the Second Geological Survey of Pennsylvania.

"With the similar exploration of other portions of this great moraine done a few years earlier by Prof. Chamberlin in Wisconsin, Profs. Cook and Smock in New Jersey, and Mr. Warren Upham in Long Island, thence eastward to Nantucket and Cape Cod, and also in Minnesota, it completed the demonstration of the formation of the North American drift by the agency of land-ice.

"The observations of the moraine in Pennsylvania, detailed in this volume, are summarized by Prof. Lewis as follows: 'The line separating the glaciated from the non-glaciated regions is defined by a remarkable accumulation of unstratified drift material and bowlders, which, heaped up into irregular hills and

hollows over a strip of ground nearly a mile in width, forms a continuous line of drift-hills (more or less marked) extending completely across the State. These hills vary in height from a few feet up to one hundred or two hundred feet, and, while in some places they are marked merely by an unusual collection of large transported bowlders, at other places an immense accumulation forms a noteworthy feature of the landscape. When typically developed this accumulation is characterized by peculiar contours of its own—a series of *hummocks*, or low, conical hills, alternate short, straight ridges, and inclosed shallow basin-shaped depressions, which, like inverted *hummocks* in shape, are known as *kettle-holes*. Large bowlders are scattered over the surface, and the unstratified *till* which composes the deposit is filled with glacier-scratched bowlders and fragments of all sizes and shapes.'

"From its lowest point in Pennsylvania, where it crosses the Delaware, 250 feet above the sea-level, this terminal moraine extends indiscriminately across hills, mountains, and valleys, rising over 2,000 feet above the sea in crossing the Alleghanies, and attaining the maximum of 2,580 feet on the high table-land farther west, being there 'finely shown at an elevation higher than anywhere else in the United States.'

"Preliminary outlines of Prof. Lewis's work on the glacial drift of England, Wales, and Ireland are given by his papers in the reports of the British Association for 1886 and 1887; and the first of these also appeared in the 'American Naturalist' for November, and the 'American Journal of Science' for December, 1886. Their most important new contribution to knowledge consists in the recognition of the terminal moraines formed by the British ice-sheet, which Lewis traced across southern Ireland from Tralee on the west to the Wicklow Mountains and Bray Head, southeast of Dublin; through the western, southern, and southeastern portions of Wales; northward by Manchester and along the Pennine chain to the southeast edge of Westmoreland; thence southeast to York, and again northward nearly to the mouth of the Tees; and thence southeastward along the high coast of the North Sea to Flamborough Head and the mouth of the Humber. It is a just cause for national pride that two geologists of the United States—Lewis in Great Britain in 1886, and Salisbury the next year in Germany—have been the first to discover the terminal moraines of the ice-sheets of Europe. Like the great moraines of the interior of the United States, those of both England and Germany lie far north of the southern limit of the drift.

"Another very important announcement by Prof. Lewis relates to the marine shells, mostly in fragments and often worn and stri-

ated, found in morainic deposits and associated kames 1,100 to 1,350 feet above the sea, on Three Rock Mountain, near Dublin, on Moel Tryfan in northern Wales, and near Macclesfield in Cheshire, which have been generally considered by British geologists as proof of marine submergence to the depth of at least 1,350 feet. These shells and fragments of shells, as Lewis has shown, were transported to their present position by the currents of the confluent ice-sheet, which flowed southward from Scotland and northern Ireland, passing over the bottom of the Irish Sea, there plowing up its marine deposits and shells, and carrying them upward as glacial drift to these elevations, so that they afford no testimony of the former subsidence of the land. The ample descriptions of the shelly drift of these and other localities of high level, and of the lowlands of Cheshire and Lancashire, recorded by English geologists, agree perfectly with the explanation given by Lewis, which indeed had been before suggested, so long ago as in 1874, by Belt and Goodchild. This removes one of the most perplexing questions which geologists have encountered, for nowhere else in the British Isles is there proof of any such submergence during or since the Glacial period, the maximum known being 510 feet, near Airdrie, in Lanarkshire, Scotland. At the same time the submergence on the southern coast of England was only from ten to sixty feet, while no traces of raised beaches or of Pleistocene marine formations above the present sea-level are found in the Orkney and Shetland Islands. The work and writings of Prof. Lewis emphasize the principle that glacially transported marine shells and fragments of shells, which occur in both the till or bowlder-clay and the modified drift in various parts of Great Britain, are not to be confounded with shells imbedded where they were living, or in raised beaches, for only these prove the former presence of the sea.

"The drift deposits of England south of the terminal moraines traced by Lewis were regarded by him as due to floating ice upon a great fresh-water lake, held on the north by the barrier of the ice-sheet which covered Scotland, northern England, and the area of the North Sea, and on the southeast by a land-barrier where the Strait of Dover has since been eroded. Under this view he attributed the formation of the Chalky bowlder-clay in East Anglia and of the purple and Hessle bowlder-clays in Lincolnshire and much of Yorkshire to lacustrine deposition, and believed that there was only one advance and recession of the ice-sheet. But shortly after the British Association meeting in 1887 his observations on Frankley Hill in Worcestershire and thence westward led him to accept the conclusion, so thoroughly worked out by other glacialists both in America and Great Britain, that there were two principal epochs of glaciation, divided by an intergla-

cial epoch when the ice-sheet was mostly melted away. There can be little doubt that the continuation of Lewis's study of the drift in England, if he had lived, would have soon convinced him of the correctness of the opinions of Searles V. Wood, Jr., Mr. Skertchly, and James Geikie, that land-ice during the earlier Glacial epoch overspread all the area of the Chalky bowlder-clay, extending south to the Thames. Small portions of northern England, however, escaped glaciation both then and during the later cold epoch when the terminal moraines mapped by Lewis were accumulated; and these tracts of the high moorlands in eastern Yorkshire and of the eastern flank of the Pennine chain are similar to the driftless area of southwestern Wisconsin.

"Comparison of the drift in the United States and Great Britain enabled Prof. Lewis to refer the British modified drift, both that often intercalated between deposits of till and that spread upon the surface in knolly and hilly kames and more evenly in plains and along valleys, to deposition from streams supplied by the glacial melting, the material being washed out of the ice-sheet. These beds, however, are to be carefully distinguished from those of interglacial and post-glacial age. It is greatly to be regretted that this sagacious observer was not spared for the fulfillment of his plan of yet more extended study of European glacial deposits in the light of his wide knowledge of the terminal moraine and other drift formations in this country."

Prof. Lewis was a member of the American and the British Associations; of the American Philosophical Society, the Academy of Natural Sciences, and the Franklin Institute, in Philadelphia; of the Geological Society of Liverpool; and a Fellow of the Geological Societies of London and Germany.

He was married in 1882 to a daughter of the late William Parker Foulke, of Philadelphia, who, with a daughter, survives him, and will transfer his unfinished papers, for completion, to the distinguished geologists who have generously offered their assistance. He possessed a strong Christian faith, and was an active member of St. Michael's Protestant Episcopal Church, Philadelphia, of whose Sunday school he was for many years a teacher, and for a long time superintendent. He had the happy faculty of imparting knowledge to those whom he taught, and in making his instructions interesting and agreeable. With a high character, a pure standard of manhood, fine mental and physical powers, a wide range of scholarship, a happy, genial, and enthusiastic temperament, rare perseverance and industry, and a lofty devotion to the interest not only of science but of mankind, his life seemed to promise the widest usefulness and honor.

The following list of Prof. Lewis's published papers is abbreviated from the "American Geologist":

1876. "On Strontianite and Associated Minerals in Mifflin County, Pennsylvania."

1877–'79. Twenty-nine communications to the Mineralogical and Geological Section of the Academy of Sciences of Philadelphia.

1880. "Note on the Zodiacal Light: The Aurora and Zodiacal Light of May 2, 1877."

1880. "The Antiquity of Man in Eastern America, geologically considered."

1880. "The Iron Ores of the Brandon Period."

1881. "The Antiquity and Origin of the Trenton Gravel."

1882. Fifteen communications to the Academy of Natural Sciences of Philadelphia.

1882. "Volcanic Dust from Krakatoa."

1882. "The Great Terminal Moraine across Pennsylvania."

1882. "Note on the Aurora of April 16 and 17, 1882."

1882. "Map of the Terminal Moraine."

1883. Eight communications to the Academy of Natural Sciences of Philadelphia.

1883. "The Great Ice Age in Pennsylvania."

1883. "The Geology of Philadelphia."

1884. "Report on the Terminal Moraine in Pennsylvania and Western New York. Illustrated by a Map of Pennsylvania, showing the Glaciated Region, etc."

1884. "A Phosphorescent Variety of Limestone."

1884. "Supposed Glaciation in Pennsylvania south of the Terminal Moraine."

1884. "Marginal Kames."

1884. "An Interesting Mineral (Cacoclasite) from Canada."

1885. "On a New Substance resembling Dopplerite, from a Peat Bog at Scranton."

1885. "A Great Trap Dike across Southeastern Pennsylvania."

1885. "Erythrite, Genthite, and Cuprite from near Philadelphia."

1885. "The Direction of Glaciation as ascertained by the Form of the Striæ."

1885. "Some Examples of Pressure Fluxion in Pennsylvania."

1886. "Comparative Studies upon the Glaciation of North America."

1886. "On a Diamantiferous Peridotite and the Genesis of the Diamond."

1887. "The Terminal Moraines of the Great Glaciers of England."

1887. "On Some Important Extra-Morainic Lakes in Central England, North America, and elsewhere, during the Period of Maximum Glaciation, and on the Origin of Extra-Morainic Bowlder-Clay."

1887. "The Matrix of the Diamond."

1887. "On the Terminal Moraine near Manchester."

1887. "Accounts of Some so-called 'Spiritualistic' Séances."

1888. "Diamonds in Meteorites."

CORRESPONDENCE.

AWAKENING THOUGHT.

Editor Popular Science Monthly:

YOUR article upon "Learning to think," in the April number of your magazine, treats upon a great need.

To make it yet more helpful to those who wish to know how to ask questions, either to awaken thought or to elicit information from others, will you kindly suggest, in a future number, some leading "questions arranged under certain categories," for further instruction by way of example?

In behalf, I believe, of many educators,

A MOTHER.

WORCESTER, MASS., *May* 1, 1889.

ANIMAL ALTRUISM.

Editor Popular Science Monthly:

IN G. J. Romanes's chart of the "Derivative Origin of the Human Mind"* he marks "Sympathy" in the scale on the level or line 24 with "communication of ideas," on which level or line is also placed "Hymenoptera."

The writer has not studied Mr. Romanes enough to understand his chart, and therefore can not see why the *Hymenoptera* are there placed, except it be that in that class of insects the communication of ideas is earliest seen. He does not note altruism in the chart.

It seems to me altruism is allied to "sympathy," and to the maternal faculty of affection. At first thought it seemed as if altruism might be the outgrowth of maternal love and regard. But two instances of its manifestation in members of a colony of domestic fowls appear to be adverse to that conclusion. These may be described in detail.

A relative of the writer, Mrs. R——, of Stockton, was occupied in 1881 with the care and study of several dozen chickens. One day she was feeding them meat cut in small pieces, and most of her feathered family gathered around and fed from her hand. But one little white pullet was too timid to come up and get her portion. A strong gray chicken, nearly full grown, and which sustained no family kinship to the other, seemed to observe and take in the forlorn situation of the one standing back, began to fight, and tried to drive away the cluster, as if to make room for the lagging associate. But it did not stir or move toward the feeding group. The gray, failing in that effort, boldly came forward, took a fragment of meat, carried it to the hungry chicken and dropped it at its feet, and then moved away, as if it had done a useful and friendly act.

On another and subsequent occasion, Mrs. R—— was again feeding her poultry from her hand. As she appeared, they hurried out from under a sheltered retreat, and with natural eagerness each swallowed its coveted portion. But one Black Spanish member timidly remained behind under cover, though in sight. After devouring a few pieces of meat, a vigorous brown Leghorn seized a good-sized piece, ran to a corner, and hid it. She then went to the retreat and induced the backward party to go out. They two went to the place of concealed store, when the Leghorn brought forth the reserved morsel of meat and dropped it before her companion, which at once accepted the gift.

Here are two examples of the altruistic faculty developed in members of the body politic of domestic fowls. As these instances are found in young individuals wherein the maternal faculty of love and regard for offspring has never been called in action, must we not conclude that altruism in them is an outgrowth of energies remote from the maternal characteristic? The immediate mother of those chickens was the incubator.

It is of interest to determine how early in the growth of mind altruism can be perceived.

A. S. HUDSON, M. D.

STOCKTON, CAL., *April* 1, 1889.

* "Popular Science Monthly," April, 1889.

DO CATTLE COUNT?

Editor Popular Science Monthly:

READING, not long ago, a sketch in our local paper, entitled "Can Animals count?" said to have been taken from "The Popular Science Monthly," recalls to my mind an incident that I have heard my father relate.

My grandfather Butterfield kept a hotel on the Green Mountains, five miles from Manchester, Vermont, more than a hundred years ago. It was his custom to salt his cattle every Sunday morning.

After vegetation started in the spring he would turn his young stock into the forest to get their living, being short of cleared pasturage.

These cattle would remain away a week, but would invariably come to the barn every Sunday for their salt, and after eating it would return to the woods again.

Now, if this does not prove that animals can count, it proves that they are creatures of very regular habits.

SUSAN M. B. STAPLIN.

MANNSVILLE, JEFFERSON COUNTY, N. Y.

EDITOR'S TABLE.

THE STIMULATION OF THOUGHT.

ON another page we print a letter from "A Mother," whom we are happy to find interested in the subject of our recent editorial article, "Learning to think." We are not sure that we can fully meet our correspondent's demand for a series of "questions arranged under certain categories" for the purpose of drawing out thought, seeing that the questions would necessarily vary to a great extent with the subject. As we pointed out before, however, what is of chief importance is to keep alive a sense of relation between the particular thing that occupies attention for the moment and other things. A vast number of practical errors lie in neglecting the category of *cause*. The question Why? is one that can hardly be asked too often, provided only it is asked with a sincere desire for information and not in a spirit of evasion or obstruction. Children often ask Why? simply to gain their own ends, not with any intention of yielding to the reasons given. This spirit, of course, has to be repressed as far as possible, but too much encouragement can not be given to an observing, inquiring disposition.

Whatever the intellectual task in hand, we should adjust ourselves to it, with the intention of seeing the subject, as far as may be, in its true proportions and complete bearings. We know what it is to sit opposite an object so as to get a good, fair, and square view of it. So with our intellectual tasks: we should shift our position till we feel that we are so situated as to take in all that we can take in of them. Instead of this, however, how common a thing it is for people, old and young, to take but a hasty, *angular* glance, so to speak, at what they have to deal with, and so fail to see its most important and really conspicuous features! Before questions can be asked to any good purpose, there has to be careful observation; and before there can be careful observation, the object must be placed in the center of the field of vision. Whatever we see we should try to realize first in its entirety, as consisting of such and such related and convergent parts; and afterward we should examine it analytically, in order to obtain a better knowledge of the parts, from which may flow a better insight into their relations. It is one thing to know that a key fits a lock, and another to be able to figure to ourselves the wards or compartments in the lock that exactly answer to the pattern of the key. It is one thing to know that a certain action is predicated of a certain subject, and another to understand that the predicated action was a natural product of the attendant circumstances. The habit of classification is one that can be taught with comparative ease to the young; and it is one that gives rise to many useful questions. It continually raises the question, "What is it?" and teaches the habit of going behind first appearances. We can not ask in regard to anything: To what class does it belong? without also asking: What is it like? What is it unlike? Then, when the class is recognized, there arise questions of relation to other classes, etc., questions of origin, of function, of cause and effect, of purpose, of significance, and many others. To develop our theme fully would be to write an essay on pedagogics. To sum up, we may say that the great desideratum is to establish a healthy action and reaction between the mind and the environing world. Some minds set up this action and reaction, this interchange of impressions and conceptions, for themselves; others need

more or less help, and that help can best take the form of placing them, as we have expressed it, fairly opposite successive objects of study, and leading them to ask, one by one, the questions necessary to draw out all the information obtainable in regard to these. The educator who makes all education practical—that is to say, who keeps the idea of rational *purpose* ever in the foreground — will certainly accomplish better results, in the way of developing thought, than one who teaches with only an occasional reference to purpose. We can not say more on this subject at present; but, as it is one of great importance, and seems to be of special interest to not a few of our readers, we may attempt further elucidations at a future day.

THE WORK OF PRESIDENT BARNARD.

THE death of ex-President Barnard, of Columbia College, has removed from among us one of the most successful and far-sighted of American teachers. Dr. Barnard was a leader in advancing educational movements; among the foremost in steps to enlarge the scope and improve the methods of academic instruction. His early training and associations might have been expected to make him a conservative; but they did not. While prizing and keeping what was good in the old theories and forms, he was a pioneer in the movement that has liberalized the courses of university studies and given them greater flexibility and adaptation. During the very years previous to 1860, when he was closely associated with institutions which seem to have been crystallized in the formality of the ancient traditions, and with men wedded to them, he was maturing those views which, foreshadowed in his papers and reports on "College Government," "Collegiate Education," "Art Culture," "The Improvements practicable in American Colleges," "The Relations of University Education to Common Schools," and "University Education," he carried out in the latter part of his career.

Notwithstanding its advantages of age and endowment, Columbia College, when Dr. Barnard was called to its presidency in 1865, was not occupying a conspicuous position. His accession to the presidency was nearly coincident with the removal of the college to its present location and the establishment of the School of Mines. These were fortunate events which contributed their share to the growth of the college. But the prosperity of the School of Mines itself, which has become one of the foremost American scientific schools, is largely accredited to his executive ability, conjoined with the fidelity of the Board of Instructors who were happily associated with him. While always urging the giving of increased prominence to scientific studies, he did not lose sight of the value of the other departments. He rather sought and secured a symmetrical development all around; so that, as one of the most temperate summaries that we have noticed of the result of his work records, "under his administration Columbia has made steady progress, until he was able in his last years to foresee a future in which the institution shall grow into the dignity of a university worthy of the metropolis." During the last year of his active service Columbia is said to have had the highest enrollment of any college in the country.

President Barnard was successful because he was an original and independent thinker and a prompt executor; because he was quick to discern what was good and ready to accept it. He was neither too strongly attached to the old and established, nor so radical as to grasp at visions and try to force changes. Regarding education as something that must grow and be developed, he looked constantly forward, judged everything by its merits, and seized and made the best of whatever he found that was good.

The avowal of principles and acceptance of innovations that flew in the face of the custom of the ages often demanded much courage, but he never lacked it; and the wisdom of his course was usually justified in the event.

The opening of the School of Mines gave an opportunity to enlarge the plan of studies in favor of science, and to encourage the preference of students who desired to give it predominant attention. Similar liberality toward other departments facilitated the ultimate adoption of elective studies. This is a factor that is changing the whole aspect of college life. Columbia College is not alone in the movement toward flexibility in the curriculum; but it is most largely due to President Barnard that it is in it at all, and has been able to turn it to advantage. It can not be doubted that his positive attitude and example have been influential in promoting its extension and its advance elsewhere. The truth of the remark with which our "sketch" of Dr. Barnard in May, 1877, opened—that few men among the promoters of science and liberal culture in our time had labored more efficiently and successfully than he—was made more and more plain during the succeeding years of his life, and was never more evident than on the day when he resigned the presidency of Columbia College.

LITERARY NOTICES.

THE AMERICAN COMMONWEALTH. By JAMES BRYCE, M. P. London and New York: Macmillan & Co. Two Volumes. Price, $6.

THE comprehensiveness and importance of Mr. Bryce's book place it with Von Holst's great work in the first rank of treatises on the political institutions of America. It is not a history, though its statements are elucidated here and there by historical material; it is not a treatise on constitutional law, though the general character and notable features of the Federal and the several State Constitutions are pointed out; its fifteen hundred pages comprise an account of the present condition of the American nation. In the words of the author, "There are three main things that one wishes to know about a national commonwealth, viz., its framework and constitutional machinery, the methods by which it is worked, the forces which move it and direct its course." These three things it has been his task to tell about the United States. Part I deals with the three divisions of the Federal Government—the executive, the legislative, and the judicial. It describes the relations of the national power to the several States. It discusses the nature of the Constitution and shows how this stable instrument has been in a few points expressly, in many others tacitly and half-unconsciously, modified. Part II deals similarly with the State governments. There is also given some account of the systems of rural and city government which have been created in the various States. Mr. Bryce commends our rural governments, but condemns the government of our cities as "the one conspicuous failure of the United States." Part III contains a sketch of the party system and of the men who "run" it. The author is conscious of especial difficulties in making such a sketch, because the system is so different from what a study of the Constitution would suggest, because there are no existing authorities on the subject, and knowledge must be gleaned from newspaper articles, conversation, and a variety of occurrences, which together constitute a floating and uneven basis for the work. But what Mr. Bryce deems the most difficult and most vital part of his task is to describe public opinion in America, and this subject forms Part IV. Public opinion, he says, "stands above the parties, being cooler and larger-minded than they are; it awes party leaders and holds in check party organizations. No one openly ventures to resist it. It determines the direction and the character of national policy. It is the product of a greater number of minds than in any other country, and it is more indisputably sovereign." In order to illustrate the statements made in treating of parties and public opinion, the author gives in Part V accounts of the Tweed Ring, the Philadelphia Gas Ring, and Kearneyism. He follows these with discussions of territorial extension, the *laissez-faire* doctrine, and women's suffrage,

and then passes to an estimate of the strength and weakness of democratic government as it exists in the United States, and a comparison of the facts with European speculation about democracy in general. Part VI is of a somewhat different character from the preceding portions of the work, dealing with the social institutions of the United States, but these, as the author says, "count for so much in the total life of the country, in the total impression which it makes and the hopes for the future which it raises, that they can not be left unnoticed." In footnotes and appendixes to both volumes much matter illustrative of the text is supplied. Among these materials are an account of "the lobby," and a newspaper description of a scene in a presidential nominating convention. Mr. Bryce is not inclined to credit so much influence to democracy in making America what it is as preceding writers have done, or as Americans are fond of doing. "A close analysis of social and political phenomena," he says, "often shows us that causes are more complex than had at first appeared." He finds many things to condemn in our political system, as any honest critic must, but he is not pessimistic in regard to our future. He is convinced of "the existence in the American people of a reserve of force and patriotism more than sufficient to sweep away all the evils which are now tolerated, and to make the politics of the country worthy of its material grandeur and of the private virtues of its inhabitants. America excites an admiration which must be felt upon the spot to be understood. The hopefulness of her people communicates itself to one who moves among them, and makes him perceive that the graver faults of politics may be far less dangerous there than they would be in Europe. A hundred times in writing this book have I been disheartened by the facts I was stating; a hundred times has the recollection of the abounding strength and vitality of the nation chased away these tremors." If there is not much in these volumes that the well-informed American is not aware of, there is a great deal in them that Americans do not sufficiently think of, while to the English reader it furnishes a broad, truthful, appreciative view of the great republic of the New World.

THE HISTORY OF ANCIENT CIVILIZATION. Edited by Rev. J. VERSCHOYLE. New York: D. Appleton & Co. Pp. 295. Price, $1.75.

THIS hand-book is intended to give a comprehensive view of ancient civilization in Egypt, Mesopotamia, and other quarters of "the East," as well as in Greece and Rome, in order to bring them out in their relations with one another and show the chain of dependence, without an understanding of which their succession and development can not be adequately comprehended. The civilization of Rome, "which was the outcome of corporate action," was most largely influenced by that of Greece, which was "the outcome of individual thought," and this runs back into the various civilizations of the East. The precise nature and extent of the influence of these civilizations upon Grecian development have not been defined, but are at this moment more than ever before the subject of active study. The author does not attempt to measure them, but gives comprehensive though succinct descriptions of the civilizations so far as they have been made out, beginning with "the beginnings of civilization," and bringing under review in succession, "The Monuments and Art of Egypt," "The Babylonians and Assyrians," "The Religion and Social State of the Jews," "Phœnician Commerce," and "The Civilization of the Aryans, Hindoos, and Persians." Greek civilization is treated under the heads of "Religion," "Politics," "Literature and Art," and "The Diffusion of Greek Genius"; "The Roman World" under those of "The Republic," "The Conquests of Rome—Transformation of the Republic," "Roman Society under the Empire," and "Latin Literature and Art." The work is based on M. Ducoudray's "Histoire sommaire de la Civilisation"; but, while a translation was made by an experienced hand, it can not, in its present form, be called a translation, for a large part of it has been rewritten.

HOW TO STUDY GEOGRAPHY. By FRANCIS W. PARKER. International Education Series, Vol. X. New York: D. Appleton & Co. Pp. 400. Price, $1.50.

THE equipment of the teacher must include both an understanding of educational theory and an acquaintance with educational practice. The present volume, as indicated by its title, is designed to contribute to the

latter of these qualifications. It consists of plain and detailed directions for teaching a knowledge of the earth's surface. The general forms of river basins are first taught with the aid of diagrams. The structure of each of the continents is then shown in the same way. Next, attention is drawn to a large number of points which together give a view of the world as a whole, among these being the relative positions of the continents, relations of continents to oceans, distribution of heat, ocean currents, winds, distribution of moisture, of vegetation, of animals, of races of men, and of minerals, and political divisions. A brief outline of a course of study is given, and this is followed by a chapter of general suggestions and directions. One direction which the author ranks above all others is that the pupil should form the habit of "locating every place, natural feature and country, mentioned in reading and study," the best chance for this being found in the study of history. He indorses the use of relief maps, after considering the objections to them, and recommends map-drawing. He maintains that "in the art of questioning is concentrated the art of teaching," hence the "Notes on the Course of Study," which occupy about half of the volume, largely consist of questions. These may be used as they stand by the teacher in giving lessons, and should also serve the higher purpose of a model from which the teacher may learn the art of original questioning. The course of study is marked out in grades, and the "Notes" are followed by a list of books and maps suitable for supplementary reading and reference in each grade. Essays on "Spring Studies in Nature," "Weather Observations," "The Study of Geography," and "Relief Maps and their Construction," by various writers, are appended. This book can not fail to be an important aid to the teacher in changing geography lessons from a mere drudgery for the memory to a real study of the earth's surface.

THE MIND OF THE CHILD, PART II. THE DEVELOPMENT OF THE INTELLECT. By W. PREYER. Translated from the German by H. W. Brown. New York: D. Appleton & Co. "International Education Series." Pp. 317. Price, $1.50.

THE former volume of the relation of Prof. Preyer's investigations on the mind of the child contained those parts devoted to the development of the senses and of the will. The present volume contains a third part, which treats of the development of the intellect. Three appendixes are added, containing supplementary matter. The author, considering that the development of the power of using language is the most prominent index to the unfolding of the intellect, devotes the greater part of the volume to that branch of the subject. The question whether there can be thought without words, which Max Müller has made a living one, holds a first place in the discussion. The author's opinion on this subject is clear and expressed without reserve, and is opposed to the view which Dr. Müller maintains. The thinker, who has long since forgotten the time when he himself learned to speak, can not give a decided answer to the question; for he can not admit that he has been thinking without words, "not even when he has caught himself arriving at a logical result without a continuity in his expressed thought. . . . But the child not yet acquainted with verbal language, who has not been prematurely artificialized by training and by suppression of his own attempts to express his states of mind, who learns of *himself* to *think*, just as he learns of himself to see and hear—such a child shows plainly to the attentive observer that long before knowledge of the word as a means of understanding among men, and long before the first successful attempt to express himself in articulate words—nay, long before learning the pronunciation of a single word, he combines ideas in a logical manner—i. e., he *thinks*." This position is sustained by numerous illustrations and citations of incidents; and the case of uneducated deaf-mutes is regarded as demonstrating that thought-activity exists without words, and without signs for words. In our own only half-remembered experiences, the author says, "it was not language that generated the intellect; it is the intellect that formerly invented language; and even now the new-born human being brings with him into the world far more intellect than talent for language." The acquisition of speech belongs to the unsolved physiological problems. As a help to the investigation, a parallel is drawn between the child that does not yet speak and the diseased adult who

no longer has command of language, in the light of which the organic conditions of learning to speak are considered, with important physiological results. The development of speech in the child during the first three years is described from observations on the author's own infant. The growth of the feeling of self, or the "I" feeling, is examined in a like manner; and the results are summarized, particularly as they bear upon the theory of the formation of concepts without language. In the appendixes are given "Comparative Observations concerning the Acquirement of Speech by German and Foreign Children"; "Notes concerning Lacking, Defective, and Arrested Mental Development in the First Years of Life"; and reports of several cases illustrating the process of learning to see, on the part of persons born blind, but acquiring sight through surgical treatment. A full conspectus, showing the results of Prof. Preyer's observations in a chronological order, arranged by months, is added by the translator, and very greatly augments the value of the book.

POPULAR LECTURES AND ADDRESSES. By Sir WILLIAM THOMSON. In Three Volumes. Vol. I. CONSTITUTION OF MATTER. With Illustrations. London and New York: Macmillan & Co. Pp. 460. Price, $2.

THE first lecture included in this volume deals with capillary attraction, explaining with the aid of diagrams the action of the forces which produce capillary phenomena. There are two lectures on electrical measurements: one describing how the units in present use have been arrived at and pointing out certain things in relation to them which should be advanced and perfected; the other dealing mainly with the construction of electrometers. The collection contains an extended discussion of the size of atoms, and an address entitled "Steps toward a Kinetic Theory of Matter." The most popular address in the volume is entitled "The Six Gateways of Knowledge," and deals with the senses, including among them the temperature-sense. Prof. Thomson says there is no evidence for the existence of a magnetic sense. Another attractive paper to the general reader is a lecture on the wave theory of light, delivered in Philadelphia. There are two lectures on the sun's heat, one of which considers the probable limits to the periods of time past and future during which the sun can be reckoned on as a source of heat and light. The second volume of this series will include subjects connected with geology, and the third will be chiefly concerned with phenomena of the ocean and with maritime affairs.

SEVENTH ANNUAL REPORT OF THE UNITED STATES GEOLOGICAL SURVEY TO THE SECRETARY OF THE INTERIOR—1885–'86. By J. W. POWELL, Director. Washington: Government Printing-Office. Pp. 656, with Plates.

THE report begins with an explanation of the purposes of the geographic division of the survey and the object of the topographic maps and methods of preparing them. In the geologic division the adoption of a scheme of taxonomic representation that shall be comprehensive and susceptible of extension as new features come to light is shown to be important. The perfection of the work of the survey has made necessary the establishment of accessory divisions of paleontology, chemistry, microscopic petrography, statistics and technology, forestry, and illustrations; and, in order that needed facilities may be provided for the consultation of the results obtained by other geologists, a library of 17,255 books, 19,600 pamphlets, and 9,000 maps, has been collected. Topographic surveys were carried on during the year over 81,829 square miles, at an average cost of about $2.75 per square mile. In the distribution of the work, the investigation of the archæan rocks has been conducted under the direction of Prof. Raphael Pumpelly; investigations of the Atlantic coast, including changes of level, by Prof. Shaler; in the Appalachian region, by Mr. G. K. Gilbert; in the Lake Superior region, by Prof. R. D. Irving; in Glacial Geology, by Prof. T. C. Chamberlin; in Montana, Yellowstone Park, Colorado, California, Volcanic Geology, the Lower Mississippi region (iron and other ores, sulphur and salt deposits, etc.), Potomac River and the head of Chesapeake Bay, by Dr. Hayden, Arnold Hague, S. F. Emmons, G. F. Becker, Captain Dutton, L. C. Johnson, and W J McGee, respectively. In other branches of the studies, the surveys have been continued under the several specialists who have had them in charge in pre-

vious years. The special papers contained in this volume—fruits of the division surveys already named—are: "The Rock-Scorings of the Great Ice Invasion," by T. C. Chamberlin; "Obsidian Cliff, Yellowstone National Park," by J. P. Iddings; "Geology of Martha's Vineyard," by Prof. Shaler; "Classification of the Early Cambrian and Pre-Cambrian Formations," by R. D. Irving; "Structure of the Triassic Formation of the Connecticut Valley," by W. M. Davis; "Salt-making Processes in the United States," by T. M. Chatard; and "Geology of the Head of Chesapeake Bay," by W J McGee.

PROFIT-SHARING BETWEEN EMPLOYER AND EMPLOYEE. By NICHOLAS P. GILMAN. Boston: Houghton, Mifflin & Co. Pp. 460. Price, $1.75.

THE wide extent which labor troubles have reached in the past few years, and the great loss and misery which they have caused, give importance to a scheme which promises to be in any measure a remedy for them. The present volume, which is the only recent work giving a comprehensive account of its subject, is devoted chiefly to a history of profit-sharing. Accounts of experience with the system in business houses of continental Europe occupy three chapters, the first of which is a sketch of "the father of profit-sharing," M. Leclaire, and his house. In the other two chapters the operation of the system in paper-making, typographical industries, cotton and woolen factories, iron, brass, and steel works, insurance, banking, and transportation companies, retail establishments, agriculture, and various other industries is described. A chapter is devoted to profit-sharing in England, and another to American experience with the system. Cases in which the system has been abandoned are grouped in another chapter, the reasons for abandonment being given in each case. The author has prefixed to this history an exposition of the present standing of profit-sharing, a brief introduction, a chapter on product-sharing, which is concerned with the conduct of agriculture, fisheries, and mining "on shares," and another on such aspects of the wages system as concern his theme. In two concluding chapters he gives a summary and analysis of the results which have been so far attained, and follows this with a statement of the argument for profit-sharing. The essence of his argument is thus stated: "Profit-sharing advances the prosperity of an establishment by increasing the quantity of the product, by improving its quality, by promoting care of implements and economy of materials, and by diminishing labor difficulties and the cost of superintendence." A bibliography of the subject is appended.

THE COMPLETE WORKS OF ROWLAND G. HAZARD. Edited by his Granddaughter, CAROLINE HAZARD. Boston and New York: Houghton, Mifflin & Co. Four Vols. Pp. 416, 410, 380, 504. Price, $2 a volume.

MR. HAZARD was a man engaged busily in manufactures and commerce, who found time to think of questions of political economy and metaphysics, and wrote well and vigorously upon them. While his discussions usually went back to fundamental principles and were rather abstract, those on economical subjects at least were practical enough to be applicable to questions of the day; and it is mentioned by Prof. G. P. Fisher that in the financial exigencies that arose during the civil war his observations were more than once influential upon the proceedings of Secretaries of the Treasury. He was born, of Quaker descent, in 1801, and lived, excepting thirteen years spent in Pennsylvania, at Peacedale, in Rhode Island, where he was engaged in the woolen manufacture. For ten consecutive years he traveled in the South, in the interest of his business. In the course of these journeys he took up the cause of Northern colored men who were detained at New Orleans in the chain-gang; and, having resolved to secure their release, may be said to have bearded the slave-power in its den and fought it victoriously in its own courts. It is illustrative of the condition of American thought and feeling at the time, that it was deemed expedient, when this matter was referred to several years afterward, to suppress the name of the chief actor, in order that he might not come too directly under public reproach. But Mr. Hazard regarded the episode as the greatest effort of his life. He died June 24, 1888, carrying his taste for the discussion of abstruse questions of metaphysics into the last hours of his life. Mr. Hazard's papers, which were first published as public addresses, in

periodicals, or in book-form—while some of them have never before been published—are grouped in these four volumes in as many sets, each having its distinctive character. In the volume containing the portrait and "Biographical Preface," the most important paper is on "Language," the first essay which the author produced, and one which, as he averred, contained the germs of all his writings. It attracted the attention of Dr. Channing, and was the origin of a lasting friendship between the two. Of the other papers the most notable are those on "The Adaptation of the Universe to the Cultivation of the Mind"; "The Bible," now for the first time published; "Intemperance"; "The Public Schools"; and "The Duty of Individuals to support Science and Literature." A second volume of "Economics and Politics" contains papers on public questions. The first of them, on the "Decline of Political Morality," is as good reading and as pertinent now as when it was spoken immediately after the election of the elder Harrison in 1840. The others were related to questions of their time, such as the "Fugitive-Slave Law"; matters concerning railroads and their charges; "The Tariff"; "Bribery;" "Hours of Labor"; and questions of finance and policy that arose during the war or have arisen since. A third volume comprises the book "Freedom of Mind in Willing," which was first published by D. Appleton & Co. in 1864. It was prepared at the suggestion of Dr. Channing, as an answer to the position of Edwards, and is preceded by an analysis by Prof. G. P. Fisher of the author's philosophical writings. The fourth volume contains the letters on "Causation and Free Will," which were addressed to John Stuart Mill, with their appendixes, the "Existence of Matter" and "Our Notions of Infinite Space"; "Animals not Automata," which first appeared in this magazine, and discourses on "Man a Creative First Cause."

SOME CHAPTERS ON JUDAISM AND THE SCIENCE OF RELIGION. By Rabbi LOUIS GROSSMANN, D. D. New York: G. P. Putnam's Sons. Pp. 190. Price, $1.50.

THE author attempts to sketch in this volume a few agreements which he discerns as already noticeable between historical Judaism and the present science of religion, leading up to the thought that the science of religion is the science of Judaism—or, as he otherwise expresses himself, that the results of the science of religion and the doctrines of Judaism overlap each other. He first aims to show that religion is intuitive, or that the religious feeling is native and common to all men; that it is spontaneous, by which is meant that the feeling, having been suggested by intuition, is made active and manifests itself in some form of personification. In the chapter on "The Universal Religion and the Sects," religion is treated as in some sort a growth and an adaptation. A distinction is drawn between religion and theology: "Religion is a child of our heart, theology is a creation of our mind. . . . Religion is eternal; theology a make-shift, which the exigencies of time and the compelling agents of Providence may throw into a useless heap." The relations of prophecy and the value of religious books are considered. The standard of morality, theories of ethics, and the relations of religion and knowledge, are discussed. The relations of Judaism are treated of under the headings of its history and the foreign elements in Judaism. The book is full of suggestion, but the peculiarities of its thought and style make very careful reading essential to the proper appreciation of it.

THE INDIANS: THEIR MANNERS AND CUSTOMS. By JOHN MCLEAN. With Eighteen Illustrations. Toronto: William Briggs. Pp. 351.

THE information embodied in this book is based upon a nine years' residence of the author as a missionary among the Blood Indians of the Canadian Northwest, and some facts of a historical nature have been obtained from other sources. Finding that many of the books about the Indians are of a sensational character, he has endeavored to write an account that should be reliable and at the same time interesting. A large number of topics are touched upon, including family, war, and social customs, religions, languages, legends, and traditions, modes of communication, and Indian oratory. Sketches are given of Tecumseh, Red Jacket, and other Indian heroes, and there is a chapter consisting of frontier tales of adventure. The author tells of the results achieved by the missionaries in Christianizing and civilizing the Indians, and gives his ideas on the Indian problem. "Hand, head, and heart training must go together," he says,

"in elevating the Indian race." Many respects in which the Indians are commonly misjudged are pointed out in this volume, and a large store of material is furnished from which an intelligent opinion of these people may be formed.

THE STORY OF HAPPINOLANDE AND OTHER LEGENDS. By OLIVER BELL BUNCE. New York: D. Appleton & Co. Pp. 188. Price, 25 cents.

THESE are nineteenth-century legends, or essays they might be called, for the embodiment of story in each case is subordinate to the thought which it contains. They are of a critical character, but far from being ill-natured or pessimistic, and are attractive in style. "The Story of Happinolande" calls attention very forcibly to the fact that the necessity of providing for our own wants is the only thing that makes us consent to supply the wants of others, and that without this necessity the industrial system of the world could not exist. In "A Millionaire's Millions" a would-be public benefactor is gradually forced to the conviction that, for improving the condition of the poor, ideas are more powerful than money, and that a stimulus to industry and economy accomplishes the beneficent purpose which almsgiving only defeats. Certain schemes and tendencies which have recently attracted public attention, especially in New York city, are also critically examined. "The City Beautiful" is an ideal, which will stimulate the reader to do his share toward realizing it; while the closing story, "John's Attic," is an ideal of a "home beautiful" adapted to moderate circumstances.

Prof. *David O'Brine* has published a second edition, rewritten, of *A Laboratory Guide in Chemical Analysis* (Wiley, $2). In its present form the book comprises, first, a chapter giving the preparation, tests, and uses of each of the reagents employed; next, a description of tests in the dry way, including those specially applicable to minerals. The tests in the wet way for the bases are then described, and there is a page on separation by electrolysis, which is followed by the methods for separating the acids. The next chapter comprises tables showing, first, the reactions of the bases, then those of the acids, with the usual reagents, which are followed by a brief summary of the leading laws and principles of chemistry. Methods for the examination of water and the detection of various poisons are given, and the closing chapter deals with general stochiometry.

The treatise on *The Lixiviation of Silver-Ores with Hyposulphite Solutions*, by *Carl A. Stetefeldt* (The Scientific Publishing Company), is offered to metallurgists as a clear, complete description of the lixiviation process in its most improved modern form. Special prominence has been accorded to the Russell process as practically standing for the lixiviation of to-day. The author deals first with the chemistry of the process, describing the chemicals used, giving the reactions of the sodium hyposulphite and the extra solutions, and telling in some detail the solubilities of metals and various compounds in sodium hyposulphite solutions. This part includes also the chemistry of the wash-water, and of sodium and calcium sulphide, and a chapter on laboratory work. In the part of the volume devoted to the practical carrying out of the process, a minute description of the arrangement of the plant is given, with detailed drawings, dimensions, and estimates of the cost of erecting and running the mill. The making of the solutions, the charging and discharging of the vats, the treatment of roasted and raw ores, and the precipitation of the metals from a lixiviation solution receive attention in turn. The closing chapter is a comparison of results of the Russell process with those of ordinary lixiviation and of amalgamation. The author reports that he has found it difficult to obtain correct statistics of the lixiviation process, but he expects to issue supplements that will place the statistics upon as sound a basis as the chemistry of the subject rests upon. The first of these supplements accompanies our copy of the work; it contains some corrections and results from the Yedras Mill, Sinaloa, Mexico.

The *Elementary Biology*, prepared by *R. J. Harvey Gibson*, M.A. (Longmans, $1.75), is a text-book adapted to college students. It opens with a brief summary of the principal conclusions of physics and chemistry, dwelling especially upon those laws on which biology immediately rests. Many speculations and explanations in re-

gard to the relationship of morphological and physiological details to general principles have been introduced, because the author is convinced that "working hypotheses not only serve to weave apparently isolated facts together, but give a certain vividness and interest to what would otherwise prove too often a bare and lifeless catalogue of data." He has made the botanical aspect of biology predominate over the animal in this book, because he deems the former from its simplicity more suited to elementary study, and because the latter has been abundantly treated by other authors. The book contains 192 cuts.

Among the late "Bulletins" of the United States Geological Survey are No. 40, on *Changes in River Courses in Washington Territory due to Glaciation*, by *Bailey Willis*, with maps; No. 41, *The Fossil Faunas of the Upper Devonian—the Genesee Section, New York*, by *Henry S. Williams;* No. 42, *Report of the Work* done in the division of *Chemistry* and *Physics* (1885–'86), by *F. W. Clarke;* No. 43, *On the Tertiary and Cretaceous Strata of the Tuscaloosa, Tombigbee, and Alabama Rivers*, by *Eugene A. Smith* and *Lawrence C. Johnson;* No. 44, *Bibliography of North American Geology for 1886*, by *Nelson H. Darton;* No. 45, *Present Condition of Knowledge of the Geology of Texas*, by *Robert T. Hill;* No. 46, *The Nature and Origin of Deposits of Phosphate of Lime*, by *R. A. F. Penrose, Jr.*, with an introduction by Prof. Shaler, and a bibliography; and No. 47, *Analysis of Waters of the Yellowstone National Park, with an Account of the Methods of Analysis employed*, by *Frank Austin Gooch* and *James Edward Whitfield.*

Of two recent geological essays by *W J McGee*, *Notes on the Geology of Macon County, Missouri*, embodies the results of a survey which was made preliminary to putting down a prospect bore; and *Dynamical Geology* relates to certain fundamental definitions growing out of the discrimination of processes commonly confounded but really distinct.

A little manual of *Deductive Logic* has been issued by *St. George Stock*, M. A. (Longmans, $1.25). The author remarks in his preface that one critic who examined his book in manuscript advised him not to publish it, because it was too like all other logics, while another advised him to cut out a considerable amount of new matter. He followed the latter advice, and hopes that he has at least escaped the guilt of wanton innovation. His object has been "to produce a work which should be as thoroughly representative of the present state of the logic of the Oxford schools as any of the text-books of the past." As a qualification for his task, he refers to seventeen years of study and teaching of the subject at Oxford. A collection of exercises is appended. The volume is made in a neat and convenient form.

The most noticeable characteristic of *Cram's Standard American Atlas of the World* (George F. Cram, New York, $10.50) is its unconventional handiness. On the front cover is an index of the United States, Canada, and Mexico maps, and the pages referred to here and in the full index inside the volume can be readily found, as the leaves are printed on both sides, either with maps or letterpress. The volume contains maps of all the States and Territories of the United States, which, it is stated on the title-page, "are the largest scale and clearest print of any atlas maps published." There are also maps of the various divisions of Canada, the other countries of North America, Europe and its countries, South America, Asia, Africa, Australia, and the chief island groups of the world, and twenty-two maps of American cities. Each State map is accompanied by an index of its towns and villages, with information in regard to location, population, post offices, railways, etc. At the end of the book are twenty pages of "curiosities of statistics," and six pages of colored statistical diagrams. We have found with very little search a number of errors in its maps and its figures of population.

An American edition of *Sonnenschein's Cyclopædia of Education*, edited by *Alfred E. Fletcher*, is published by Bardeen ($3.75) It comprises a wide variety of pedagogical, psychological, historical, descriptive, and biographical articles, by such writers as Oscar Browning, J. S. Curwen, James Donaldson, Sir Philip Magnus, David Salmon, Arthur Sidgwick, and James Sully. A bibliography of education, occupying thirty-four pages, is appended.

A History of Education in North Carolina, by *Charles Lee Smith*, is published by

the United States Bureau of Education as one of its "Circulars of Information," among which it forms one of a series of "Contributions to American Educational History," under the editorial direction of Herbert B. Adams. In this essay, as Commissioner Dawson remarks, the writer has traced the genesis and development of education in North Carolina from the first settlement of that State to the present time; and for that purpose has examined the colonial records, the early laws of the State, works in public libraries, and private collections and personal correspondence, by the aid of which he has made a very satisfactory presentment of the story. While the history of primary and secondary instruction has not been neglected, the higher education has been principally treated in the sketch. The influence of certain classes of immigration and of institutions outside of the State is shown. Facts concerning noted educators are brought out. A full account of the University of North Carolina and of its influence on the South is given. In the picture of the present status of education in the State, we have been particularly interested in the story of what has been achieved since the war, and with the accounts of education among the colored people. One flourishing institution, Livingstone College, of the African Methodist Episcopal Zion Church, is wholly the product of their effort. The views of buildings, which are prominent in the volume, help illustrate how fast a hold the architectural idea still keeps in education.

Another of the Educational Bureau's circulars comprises a paper on *Industrial Education in the South*, by the Rev. *A. D. Mayo*. A general discussion of the conditions of American and Southern life leads to a consideration of the need of industrial training to improve those conditions, not only in the shops and on the farms, but in the home too; and to a review of the provisions that have been made to furnish such training. These seem to be good, so far as they have been made, to be distributed with fair evenness among the States, and to be afforded in such institutions as Tulane University and Washington University on a liberal and efficient scale.

Included in the *Proceedings of the Department of Superintendence of the National Educational Association*, at its meeting in Washington in February, 1888, are papers and discussions on "Manual Training in the Public Schools," "County Institutes," "Elocution," "Qualifications of Teachers," "Normal Schools," "Moral Training," "Can School Programmes be shortened and enriched?" "Alaska," the relations of "Superintendents and Teachers," and "National Aid to Education."

The *Massachusetts Society for promoting Good Citizenship* (Boston) issues as its first "Circular of Information" a report of the Committee upon Courses of Reading and Study on *Works on Civil Government*. The report contains a list of text-books recommended for schools, each accompanied by a descriptive and critical note, showing the scope and value of the book; a list of other text-books, with notes; a list of brief commentaries and similar books recommended; and a list of less valuable or more bulky commentaries and books of reference.

The fifth of the "Monographs" of the Industrial Education Association consists of a study, in the history of pedagogy, of *Aspects of Education*, by Mr. *Oscar Browning*. The author reviews the various shapes in which interest in education has manifested itself since the middle ages, with the factors which have influenced or worked to change them—ending with the present aspect, which he seems to regard as largely the following of Dr. Arnold's labors at Rugby School.

Hints for Teachers of Physiology, by *H. P. Bowditch, M. D.* (D. C. Heath & Co.), is No. 14 of the Boston Society of Natural History's "Guides for Science-Teaching." It furnishes suggestions for supplementing the instructions of the text-books by means of simple observations and experiments on living bodies or on organic material, for which teachers will need no other apparatus than is within their easy reach. Price, 25 cents.

The Training of Nurses, an address before the Michigan State Board of Charities and Correction, by Dr. *Hal C. Wyman*, gives a clear picture of what the ideal nurse should be, and of the manner in which she should perform the duties of her office.

The *Seaside and Wayside* series of readers, by *Julia McNair Wright*, has reached its third number (Heath, 55 cents). The present volume is similar in character to the

two which preceded it, the lessons dealing with plants, insects, birds, and fishes.

It inspires confidence in Mr. *Benjamin Y. Conklin's* text-book of *English Grammar and Composition* (Appleton, 75 cents) to find the author saying in his "hints to teachers": "In teaching grammar, it should never be forgotten that the real object is to teach pupils how to speak and to write the English language correctly, and how to read it intelligently. Analysis and parsing are only means to this end." The theory of the book is the gradual development of the sentence, beginning with its simplest form and adding new elements one after another. The learning of the proper forms which are required by the relations of words in sentences is deferred until the pupils have become familiar with the nature and office of the different parts of speech. The author states that he "has endeavored to avoid an excess of language-work on the one hand, and too much formal parsing and analysis on the other." The questions on the lessons are designed to cause the pupil to construct his own answers. Instead of the usual examples of false syntax, exercises are given for filling blanks in sentences by supplying the correct forms of the needed words. But, for teachers who desire to use the former, a collection is given in an appendix. The book is intended to compass the entire range of a two-book course.

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POPULAR MISCELLANY.

An Estray Wreck.—One of the most useful features of the monthly "Pilot Charts," published by the Hydrographic Office of the Navy Department, is the series comprising tracings of the courses of derelict vessels. It is said that between twenty-five and forty-five of these peripatetic dangers to navigation are recorded every month in the North Atlantic alone, and the supply is constantly kept up by the fruits of every great storm. Their wanderings are often very eccentric. Thus the W. L. White, a lumber-laden three-masted schooner, having been abandoned off Delaware Bay during the blizzard of March, 1888, started off to the southward under the influence of the inshore current and the northwest gale. Upon reaching the Gulf Stream she turned away to the eastward and began her long cruise toward Europe, directly in the track of thousands of vessels; drifting blindly about at the mercy of wind and current. During the former part of her wandering she followed a course about east-northeast, at an average rate of about thirty-two miles a day. From the beginning of May till the end of October she pursued an extraordinarily zigzag course, seesawing back and forth, and doubling upon herself, "staggering like a drunken man all over a comparatively small area, a constant menace to navigation in its most frequented ground." After escaping from this snarl, she moved east and northeast, 1,260 miles in eighty-four days, or an average of about fifteen miles a day. Finally, on the 23d of January, 1889, she was stranded on one of the islands of the Hebrides after a cruise of ten months and ten days, in which she traversed a distance of more than five thousand miles, and was reported forty-five times; while many more vessels may have passed dangerously near her at night or during thick weather.

The Canadian Lakes and the Glaciers.—In accounting for the origin of the great lake basins in Canada, Dr. Robert Bell regards Lake Superior as of volcanic origin, and Hudson Bay as having some points in common with it; while Athabasca, the Great Slave Lake, Lake Winnipeg, the Georgian Bay, and Lake Ontario, lie along the line where the limestones and sandstones meet the older Laurentian and Huronian strata, and were probably excavated by post-tertiary glaciers. Dr. Bell also points out that dikes of greenstones, etc., often formed the original lines along which the channels of rivers, arms of lakes, and fiords, were cut by denuding forces. Prof. A. T. Drummond suggests that the glaciers have been called upon to do too much work. There is difficulty in accepting the theory of such colossal glacial systems as geologists invoke. The vast effects of erosion by atmospheric and other agencies in Miocene and Pliocene ages which immediately preceded the Glacial epoch, and the great deposits of decomposed rock which must have accumulated during those ages, have been overlooked. The continental glacier, even if only a mile in thickness, of the extent demanded by the theory, would represent a depth of about five hundred or six hundred feet taken uniformly everywhere from the waters of the ocean and transformed into ice. The withdrawal of such a mass of water from the North Atlantic would have carried our coast-line from seventy-five to one hundred miles seaward, would have rendered the Gulf of St. Lawrence dry land and brought the Great Banks of Newfoundland to the surface, and would have obliterated the German Ocean. Are we prepared to ac-

cept these consequences? Prof. Drummond prefers a theory of great northern elevations of land creating mountain-chains and their glaciers, accompanied or followed by a depression farther south, which admitted the arctic currents, or perhaps formed an inland sea and a highway for icebergs bearing *débris* and bowlders, which they dropped on the bottom.

Orchids.—Orchids are commended by Mr. Frederick Boyle as pleasant room-ornaments, and clean, easily managed plants. "Observe my Oncidium," he says; "it stands in a pot, but this is only for convenience—a receptacle filled with moss. The long stem, feathered with great blossoms, springs from a bare slab of wood. No mold nor peat surrounds it; there is absolutely nothing save the roots that twine round their support, and the wire that sustains it in the air. It asks no attention beyond its daily bath." Sir Trevor Lawrence can see no reason, in the case of most orchids, why they should ever die. "The parts of the *Orchideæ* are annually reproduced in a great many instances, and there is really no reason why they should not live forever, unless . . . they are killed by errors in cultivation." Another authority says that, "like the domestic animals, they soon find out when there is one about them who is fond of them. With such a guardian they seem to be happy, and to thrive, and to establish an understanding, indicating to him their wants in many important matters as plainly as though they could speak." According to Mr. Boyle, the secret of orchid-culture lies in their indifference to detail "Secure the general conditions necessary for their well-doing, and they will gratefully relieve you of further anxiety; neglect those general conditions, and no care for detail will reconcile them." In Mr. Sander's orchid farm, at St. Albans, England, where three acres are occupied by orchids exclusively, growing in the most profuse luxuriance, no great pains are taken to exclude frost from the cool houses. It would be better to keep them at 50°, but the advantage does not equal the expense and inconvenience of warming such enormous buildings to the requisite degree. Mr. Boyle says that the "Indians of tropical America cherish a fine orchid to the degree that, in many cases, no sum, and no offer of valuables, will tempt them to part with it. Ownership is distinctly recognized when the specimen grows near a village." Mr. Roege has left a description of the scene when he first beheld the *Flor de Majo*. The church was hung with garlands of it, and such emotion seized him at the view that he choked. The natives showed him plots of this species acres in extent, where it was grown for the ornamentation of their church. A fine *Cattleya Morsiæ* in one of Mr. Sander's houses—the largest orchid of the kind that was ever brought to Europe—had grown upon a high tree beside an Indian's hut, and belonged to him, as it had belonged to his grandfather. He refused to part with it at any price for years, but was overcome at last by a rifle of peculiar fascination, added to the previous offers. "A magic-lantern has great influence in such cases, and the collector provides himself with one or more nowadays as part of his outfit."

Etching on Glass.—The object to be etched is immersed in a bath of melted wax, which on removal forms a thin coating over its surface. On this the designs are carefully scratched out by means of a pointed instrument, which removes the wax along the lines of the pattern. The glass is then immersed in a solution of hydrofluoric acid. The acid, which is very corrosive, attacks all the portions of the glass not protected by the wax, thus eating out the lines of the engraving on the glass. When this is done, all that remains is to clear away the wax. Owing to the destructive nature of hydrofluoric acid, a special room is kept, in which it is applied, the windows of which must be coated with wax, and the vessels used to contain the acid must be made of lead. Monograms and similar designs are printed in a kind of thick ink, on transfer paper, the lines of the monogram being left uncovered by the ink. The pattern is then transferred to the glass, the ink protecting the portions covered from the acid in the subsequent processes. As, however, the monogram only covers a small portion of say, a wine-glass or decanter, the rest is coated with wax. The bath of hydrofluoric acid is then used as before. The pretty zigzag patterns which so frequently adorn many wine-glasses are scratched on the wax by means of several ingenious machines.

One of the simplest patterns is produced by the tracing point rapidly revolving in a circle, while the glass slowly turns round on its axis. Another well-known pattern is traced out by a rather complicated mechanism, in which, by means of wheels having cogs along half their circumference, the tracing points are made to move up and down, and the glass to turn round, alternately, in a series of jerks. Although most of the patterns on glass are etched in this way, they lack the sharpness of definition required for the very best engravings. These latter are therefore carefully ground by hand, very small rapidly rotating wheels covered with fine rotten-stone powder being used to cut out the pattern on the glass. A large number of wheels of different shapes and sizes must be used for the various details of a complicated design, such as a bunch of flowers and fruit, and this method is only resorted to in the case of the most expensive dessert sets, as it involves a considerable amount of skilled workmanship. With regard to the embossed patterns, so common on butter-dishes and similar articles, these, as well as the lenses used in lighthouses, are formed by pressing the molten glass into molds of the desired form. The flutings and ribbings on decanters, and the familiar lozenge or diamond patterns on cruets, are carved on the glass by means of grindstones, whose edges are rounded, angular, or flat, as the case may be. In the preliminary grinding, rotten-stone and water are used, but for the final polish the finest putty powder is required.

Roman Wines.—The increase in late years of the wine production of the province of Rome has been attended with great improvements in the quality of the wine produced. The principal group of wine-making districts is that of the "Castelli Romani," the wines of which are robust and durable. The land is of volcanic origin, and the ancient Roman rules of cultivation are followed. The cultivation of the white grape is giving place to that of the black, with a corresponding change in the color of the wine. The wine is kept in caves that consist of long corridors or galleries hewn out in layers of tufa, and having lateral niches, in each of which a butt is placed holding between eight and twelve hectolitres. The caves are ventilated by means of wells, and even in the height of summer the wine is thus kept at a very low temperature. The Government exercises strict measures against adulteration; and this is held to include the addition of any substances that are not found in pure wine, or the use of which is not in accordance with the rational principles on which wine-making is based. The addition of substances naturally to be found in wine is also considered as adulteration, if the substances are beyond the just proportions existing in pure wines. An exception is made in the case of gypsum, for which the maximum quantity to be permitted is determined by the Superior Board of Health.

Lead-Poisoning.—Several cases of lead-poisoning, caused by the preparation of home-made wine in earthenware dishes coated with litharge glazing (oxide of lead) have recently been noted in the London "Lancet." The symptoms were the appearance of a bluish line around the gums, vomiting of bile in large quantities, obstinate constipation, and constant abdominal pains. On analysis of some cherry-wine, from the use of which one of the cases had arisen, lead, in the form of sulphate, was found in very dangerous proportions.

Getting to Sleep.—Among the many recipes that have been given for overcoming wakefulness is one devised by a Mr. Gardner, and formerly celebrated in England, but now almost forgotten. It is to lie on the right side, with the head so placed on the pillow that the neck shall be straight; keeping the lips closed tightly, a rather full inspiration is to be taken through the nostrils, and the lungs then left to their own action. The person must now imagine that he sees the breath streaming in and out of his nostrils, and confine his attention to this idea. If properly carried out, this method is said to be infallible. Counting and repeating poetry are other means that have been recommended. Combing the hair, brushing the forehead with a soft shaving-brush, or fanning, are all good sleep-inducers, and might well be tried on sleepless children. To these may be added the Spanish practice of getting a baby off to sleep by rubbing its back with the hand. A sensation of dry, burning heat

in the soles and palms, which accompanies certain diseases in some people, is a cause of sleeplessness that will give way to sponging the parts with vinegar and water. Wakefulness is sometimes the result of lack of food, and a glass of cold water or pale ale, or the eating of a sandwich, will, by setting up activity in the abdominal organs, divert the superabundant blood from the head, thus removing the cause of the unnatural activity of the brain. One reason why the most gifted minds have frequently been afflicted by sleeplessness is because bodily exercise is too often neglected by people devoted to intellectual pursuits. For such persons there is no better soporific than muscular exertion, carried even, in extreme cases, to a sense of fatigue.

Criminal Responsibility of the Insane.—It is a difficult matter to define with anything like precision the point at which we should cease to regard crime as the result of depravity and begin to treat the wrong-doer as the victim of disease. Prof. C. J. Cullingworth, of Owens College, thinks that certain forms of insanity are not properly regarded in the practice of the English criminal courts. In 1843 the House of Lords obtained from the judges who had acquitted the murderer McNaghten, on the plea of insanity, the opinion that, "to establish a defense on the ground of insanity, it must be clearly proved that at the time of committing the act the party accused was laboring under such a defect of reason from disease of the mind as not to know the nature and quality of the act he was doing, or, if he did know it, that he did not know he was doing what was wrong." Ever since it was put forth, this test has been treated as though it were the law of the land. It is, however, far from satisfactory, in that it restricts mind to the intelligence, and ignores the emotions and the will. Now it is by no means unusual to find the disorder of the emotions and the will far greater than that of the intellect, and especially in the cases of those whom insanity is most likely to impel to criminal acts. It is a common experience in lunatic asylums to find that the very persons who are the most dangerous to themselves and those about them are the most intelligent inmates in the institution. This is not a purely medical view of the question. Sir James Stephen has said: "No doubt there are cases in which madness interferes with the power of self-control, and so leaves the sufferer at the mercy of any temptation to which he may be exposed. . . . I do not think that a person unable to control his conduct should be the subject of legal punishment." Here we are brought face to face with the fiercely disputed question whether there is or is not such a thing as irresistible impulse—that is, whether persons apparently sane, and at any rate free from obvious delusion, may be impelled to insane acts by a force that they can not control. "I can not deny that medical witnesses have sometimes pressed this doctrine of irresistible influence unduly; still, there are undoubtedly cases where the insanity reveals itself chiefly, if not solely, in acts of violence, the consequence of uncontrollable impulse. The popular notions that one man can recognize lunacy as well as another, and that it invariably betrays itself by definite and unmistakable symptoms, are altogether erroneous. In a lunatic asylum the raving maniac is an exception, the majority of the inmates being quiet, orderly persons, who present, so far as their outward appearance goes, little or nothing to distinguish them from other people. Probably no one visits such an institution for the first time without being puzzled to know which are the officials and which the inmates. Like other chronic disorders, insanity is apt to come on insidiously. A certain alteration of manner, a disposition to talk a little more or a little less than usual, an unaccustomed recklessness in expenditure, a tendency to be suspicious of those who have hitherto been implicitly trusted, a slight failure in business capacity—these may be all the symptoms that mark the departure from mental health, until one day the smoldering insanity breaks out in an act of violence. The analogy between epilepsy and those forms of insanity which are accompanied with sudden outbursts is a very close one. The causes that have been at work in each case have been cumulative in their action, and only when the accumulated irritation has reached a certain degree of intensity has there been any, or but the very slightest, outward indication of the gathering storm. The spectacle

of an epileptic seizure taking place suddenly in an apparently healthy person is one of such every-day occurrence that it scarcely excites any notice. But if a medical witness stands up in court and suggests that an atrocious and apparently motiveless act of violence was the insane act of the apparently calm prisoner in the dock, he is in danger of being ridiculed as a theorist."

A Practical View of Parks.—Lord Brabazon, at the Sanitary Congress held in York in September, 1886, defended the propriety of maintaining parks in large towns upon the broadest practical grounds. Such establishments, he held, should not be considered luxuries, but public necessities. For health is one of the first of necessities, and no expense should be spared, and no opportunity neglected, to increase the average standard of the nation's health and strength. If a people's average standard of vitality be lowered, that people will assuredly be handicapped in the race of nations by as much as that standard has been lessened. The health of the mind is largely dependent on the health of the body, and a nation can only as have much muscular power and brain force as may be the sum total of those qualities possessed by the men and women of which it is formed. It is an axiom of hygienic science that, other things being equal, the health of a population is in inverse ratio to its density. Hence the density of population in large towns should be offset by providing as much open space as possible in the form of squares, parks, and pleasure-grounds.

Dangers of the Laboratory.—A striking instance of the dangerous quests which enthusiastic chemists undertake are the efforts to investigate the yellow oily substance called chloride of nitrogen. This terrible explosive was discovered in 1811 by Dulong, who lost one eye and three fingers in a vain attempt to ascertain its composition. So powerful is it that when Faraday and Sir Humphry Davy took it in hand they provided themselves with thick glass masks to protect their eyes from flying bits of glass, and to some extent from the irritating vapors of the oil itself. Faraday was on one occasion stunned by a detonation of only a few grains of the compound, and bits of the tube in which it had been contained almost penetrated his mask. On another occasion Sir H. Davy was severely injured by the explosion of a few drops under the receiver of an air-pump. Since their time the precise composition of the oil has been a mystery. At last, however, Dr. Gattermann, of Göttingen, has succeeded in its analysis. He finds that the substance examined hitherto was impure, and that the extreme danger of handling it was partly due to that fact, and partly to the varying action of light. Any bright light, he has found, is enough to produce detonation—a discovery made by the sudden destruction of his apparatus by a stray sunbeam. Chemical research nowadays is apt to stray among the teeming pastures of organic chemistry, to the neglect of the old problems offered by the inorganic world, though the solution of these problems should enlist the highest efforts of experimental science.

Superstitions about Snakes. — Besides certain errors in natural history, imagination has vested snakes with some supernatural or uncanny qualities. Thus, they are in some places believed to know where buried treasures are deposited; to lie upon the gold in winter; and, while too wary to show themselves near their hoard in summer, to come out in the bright, warm days of spring and bask in the neighborhood of their winter quarters. At such times a wise man will not kill them, but will watch where they go, mark the place, and take measures to possess himself of the treasure. But the snake is supposed to fight wildly for his property; and there are feigned to be in the old mines of Italy winged serpents which never come into the open air, but haunt the vaults where anything of value is hidden. They live upon the scent of gold, and violently attack any one who forces his way into their domain. No one, it is added, has ever seen them except by torch-light, when they must have looked rather like bats. The house-snake in Carinthia is supposed to bring good luck to the house he frequents. The fatter he grows the fuller will be the stalls, the granaries and the kitchen. So he is not disturbed, but has a bowl of milk placed every morning and evening in the cellar where he lives. Some of these serpents are fabled

to wear a crown—a small circlet of gold set with strange jewels, that brings good luck to any one who finds and knows how to deal with it—otherwise it may bring more harm than good. When it or any other treasure is found, it must not be touched first with the hands, but a part of the clothing should be cast over it. A maiden should use her apron for this purpose, but a man may take his coat or even his pocket-handkerchief. If a hat or any part of the head-gear is used, the finder will go mad. These snakes are thought to have a queen who is far more terrible than they. A legend is current at Friedbach that, in the old days when it was vexed with snakes, a stranger, Fridelo, came along, and promised to relieve them, provided, if he should be killed, they would say a mass for his soul every year. He ordered a fire built around an oak-tree, under which he placed himself. As the fire burned, Fridelo began to sing, or whistle, or call, and the snakes rushed into the fire and perished. Finally, a white serpent appeared, passed the fire, and bore Fridelo to the fire on the other side, where both were consumed. The district was ever afterward free from venomous creatures, and in gratitude for the riddance a church was built where the tree stood, in which serpent masses are said.

A Church-going Dog.—A story of almost reasoning intelligence is told of a dog belonging to the Rev. R. Ashton, superintendent of an Indian school and pastor of the church at Brantford, Ontario. He attends the church with the ninety Indian children of the school, and rises and sits down with the congregation. One day when a stranger-clergyman had preached too long for the dog, he bethought himself of a method for closing the service: he would have the collection taken which he had associated with the end of the sermon. He ran to the boy who was accustomed to carry the plate, and gazed steadfastly in his face. Finding that no notice was taken of this, he sat up and "begged" persistently for some time. This also receiving no attention, he put his nose under the lad's knee and tried with all his strength to force him out of his place, continuing this at intervals till the sermon was concluded.

Agricultural Maxims.—In the new edition of Stephens's "Book of the Farm" the student of agricultural science is advised to enter upon his course early in the winter, because most farming operations are begun at that time. Two years are considered necessary for a thorough grasp of the subject, for he "can not understand the object of a single operation in the first year of his pupilage." Those who have not been bred upon a farm and who can afford it, will find it better to spend their time at an agricultural college with a farm attached, than with some "practical" man as a private tutor, who is not gifted with teaching abilities. Of the branches of science applicable to agriculture are named botany, chemistry, germs, zoölogy, entomology, geology, meteorology, mechanics, and engineering. Among practical hygrometric indications is mentioned the vapor issuing from the funnel of a locomotive steam-engine, "for when the air is saturated with vapor, it can not absorb the spare steam as it is ejected from the funnel, and hence a long stream of white steam, sometimes four hundred yards in length, is seen attached to the train. When the air is dry, the steam is absorbed as it issues from the funnel, and little of it is seen." Other signs of weather are drawn from the behavior of animals. According to the calculations given in this book, most plowing, including turning and time spent in occasional stoppages, is done at the rate of about a mile an hour; and "a ridge of no more than seventy-eight yards in length requires five hours and eleven minutes out of every ten hours for turning at the landings, with a ten-inch furrow-slice; whereas a ridge of two hundred and seventy-four yards in length only requires one hour and twenty-two minutes for turning—making a difference of three hours and forty-nine minutes in favor of the long ridge as regards the saving of time" in one day's work.

Distribution of Lakes on the Globe.—The distribution of lakes on the earth has been studied by Dr. Bohm, of Vienna. Assuming that lakes usually exist in groups, and their origin is connected with the glaciers, the author shows that there is a relation between their situation and their altitude. It seems proved that the height of mountain

lakes above the level of the sea, in going from the pole to the equator, rises as the snow-line rises. Alpine lakes are classified as valley lakes and mountain lakes. The former are generally of considerable extent. They occupy the bottoms of the valleys and form a horizontal zone among themselves, bounding the circumference of a former glacial region, where the currents of ice, at the moment of maximum congelation, could exercise their greatest action. The others are generally small and lie at great elevations, in the heart of the mountainous region; but they are also frequently present in numbers at a common height in each chain of mountains, where they indicate the last stage in the retreat of the glaciers. Mountain lakes have only an ephemeral existence, for the amount of detritus which they receive and the depth of their effluents contribute to their speedy disappearance. More than a hundred lakes have gone out in this way in the Tyrol during the last century.

Famines and Irrigation in India.—Mr. H. C. Danvers has summarized the histories of fifty-two famines in India, extending over a period of twenty-three hundred or twenty-four hundred years, of which thirty occurred in the historical period, and twenty-two within the present century. The earliest was between 503 and 443 B. C. Then a period of fifteen hundred years follows without a record, though not, doubtless, without famines. The year A. D. 1033 was remarkable for very extensive drought and famine, succeeded by a pestilence. The earliest famine in the Deccan occurred in the year 1200, and lasted twelve years. The distress of 1345 was caused, in part, by excessive taxation, by reason of which "the poor became beggars, the rich became rebels, and the farmers were forced to fly to the woods, and to maintain themselves by rapine. The lands were left uncultivated, and grain consequently became scarce, famine began to desolate whole provinces, and the sufferings of the people obliterated from their minds every idea of government and subjection to authority." The great Doorga Deerce famine of 1396 arose from a total want of seasonable rain, and lasted twelve years. In the famine of 1811, the Government sanctioned disbursements on account of ceremonies for rain to be performed in the principal pagodas in Cuddapah. In Kattywar, men sold their children for food, and many respectable and well-to-do persons poisoned themselves to secure release from the pangs of hunger; and others died from want of that grain which their riches could not purchase. The great famine in southern India, of 1876–'78, was the worst which has been experienced since the beginning of the century. It is estimated that five and a half millions more, out of one hundred and ninety million people, perished than would have died had the seasons been ordinarily healthy. Mr. Danvers anticipates great results in mitigating the evils of famine from the extension of the railroads, by means of which provisions can be speedily taken into regions of scarcity, and prices kept down. In the discussion in the Society of Arts upon Mr. Danvers's paper, General Rundal laid great stress on the economical advantages of systems of irrigation. The total sum expended on irrigation works throughout India was £24,500,000, while the total loss which the Government had sustained in successive famines was given as £23,500,000. The irrigation works returned more than five per cent net, but the sum hopelessly spent in trying to mitigate famine returned nothing, and ten million lives had been lost during the century. The Godavery works, after thirty-five years, had netted £1,400,000, or double the whole capital outlay; the Kistna works, after twenty-five years, had netted £281,000, which was, perhaps, half what they had actually cost. These two works irrigated 563,700 acres and 303,000 acres respectively. The Tanjore works were still more remunerative. Other works had not given so large visible returns; but they could not be called failures, because they provided security against future famines, and were otherwise economically beneficial.

Identification by Thumb-Marks.—Among other anthropometrical data, Mr. Francis Galton has secured the impressions in printer's ink of the two thumbs of many hundred persons, in order to determine the possibility of using that method in identification. He says that a minute investigation of thumb or finger marks shows an extraordinary difference in small though perfectly

distinct peculiarities. Neither is there any room for doubt that these peculiarities are persistent throughout life. This method of testing identity would be valuable in many cases. A writer in the "British North Borneo Herald," commenting on a lecture by Mr. Galton on this subject, has spoken of the great difficulty of identifying coolies either by their photographs or measurements, and said that the question how this could best be done would probably become important in the early future of British North Borneo. Mr. Galton believes also that the difficulty of identifying pensioners and annuitants has led to the loss of large sums of money annually. A method of taking the impressions which he has used with good success is as follows: A copper plate is smoothly covered with a very thin layer of printer's ink, by means of a printer's roller. When the thumb is pressed upon the inked plate, no ink penetrates into the delicate furrows of the skin; the ridges only are inked, and these leave their impression when the thumb is pressed on paper. Turpentine readily removes the ink from the skin. A simpler process is to slightly smoke a piece of smooth metal or glass, press the thumb upon it, and then make the imprint on a bit of gummed paper that is slightly dampened. The impression is a particularly good one, and is durable enough for the purpose.

Judicious Charity.—The giving of money to beggars has been condemned on many sides. To bestow food or clothing upon a certain class of mendicants is also mistaken charity. The former is only an incumbrance, to be thrown away at the first opportunity; and the latter often finds its way to the pawn-shop. To prevent blankets being pawned, a benevolent Scotch lady once suggested buying them in two colors, cutting them down the middle, and sewing a half of one color to a half of the other. The purpose of the gift or loan would be answered, while the blanket would be unavailable as a pledge. The poor who are most deserving of sympathy and aid require much searching out, and often, when face to face with those who fain would relieve, make the most of their miserable surroundings in order to conceal their poverty. Indiscriminate almsgiving should be avoided and organization adopted—not the organization which requires elaborately furnished offices and a staff of heavily paid officials, but that which consists of benevolent individuals who have time at their disposal, and the heart and means to give, co-operating with each other. In all cases the assistance afforded should be adapted to the circumstances of the case, and, wherever possible, assume the form of a loan in preference to that of a gift. Money should demand an equivalent of labor in some form: an out-building whitewashed, a fence mended, wood cut, coal put in, ashes or snow removed, or something else. Organization could provide common material for shirt-making at proper prices by starving seamstresses, even if the articles were subsequently sold at a loss or given away. In any case let something, however simple, be required in return, so as not to destroy what self-reliance remains to the recipients of the bounty.

Arrow-Poison.—A letter from Mr. H. M. Stanley, read recently before the Royal Geographical Society of London, contained an extremely interesting reference to the arrow-poison used by the natives on the lower Congo. Mr. Stanley says that several of his party, being hit by the arrows of the natives, died almost immediately in great agony. The poison was found to consist of the bodies of red ants, ground to a fine powder, and then cooked in palm-oil. This mixture was smeared on the arrow-heads; its poisonous effects are due to the formic acid which is known to exist in the free state in red ants. This acid is also found in the stinging-nettle.

Expression in Infants.—It is not probable that infants in their earliest days give expressions of pleasure, for such expressions are largely imitative. There is but little difference during the first days of life between the joyful and the sad, the intelligent and the stupid face. The child's feelings have to be called out by his experiences, and his means of expression caught from those around him. He has a few movements of reflex origin, and some that may be intuitive. According to the "Lancet," an agreeable perception or a feeling of satisfaction is necessary to the causation of a smile, while the number of sensations of a pleasurable sort

which are possible to a baby a few days old is very small, and a perception in the proper sense is beyond its capacity. "The being bathed or suckled does not cause it to smile, but its countenance expresses simple satisfaction, probably because of the absence for the time being of all uncomfortable feeling. Even sleeping infants a few days old lift the angles of the mouth in an incipient smile, if such it may be named. Very lively faces with dimples in the cheeks, but with closed eyes and other signs of sleep, are matters of common observation. On the twelfth day of life Preyer observed on the face of a waking infant most of the characteristics of a smile, though the mouth movements were imperfect. It was on the twenty-sixth day of life that he first observed all the signs of an intelligent smile in his own child."

The Nest of the Water-Spider.—The ways of the water-spider (*Argyroneta aquatica*) were described in M. Blanchard's article several months ago. A fuller account of the breeding habits of this arachnid is given by Mr. Joseph L. Newton in "Science Gossip." The author had placed several of the spiders in a tank, in which suitable plants were growing. All made themselves at home but one, which appeared restless. "For the first two days it quickly traversed from side to side, making repeated attempts to climb the glass to effect an escape, but eventually it settled down, and was soon busily webbing together in a diverging manner the pectinate leaves of the water crowfoot; then going within its leafy shade, . . . to weave its silken cocoon, or nest, in which, on the fifth day, 10th of June, through a small opening it had left unwebbed . . . could be observed the yellowish mass of eggs, surrounded with a glistening layer of air, distinctly separate from its still unfinished harbor. After a day or so of rest, it further extended the nest downward, in a bell or funnel form, until nearing two inches long; then closed the lower or wider portion, with the exception of two openings, one on each side, just to give leave of its exit or admission. This being completed, the mother could often be seen gracefully wending her way to the surface, and carrying down large successive bubbles of air, then carefully liberating them, one by one, in order to form a sufficient supply, in which it then remained for some days. From the end of the first week the eggs now gradually grew darker, and on July 1st, exactly the third week, the upper portion of the nest or cocoon was completely laden with young; when the large globule of air slowly began to diminish, and, on being exhausted, the mother seemed reluctant to find a further supply—as though she had done her duty. Here the young naturally became troubled, and in the fourth week were quickly parading the interior of the cell, apparently for escape, which they, through the course of nature, effected on July 11th; thus, in about thirty days, over forty young were actively playing their delightful and youthful part, each bearing its silvery bubble."

Annual Rings of Trees.—In regarding the annual ring as it is marked in different kinds and qualities of timber, Prof. Fernow says that there are to be taken into consideration the absolute width of the rings, the regularity in their width from year to year, and the proportion of spring wood to autumn wood. The spring wood is characterized by less substantial elements (vessels of thin-walled cells in greater abundance), while the autumn wood is formed by thicker-walled cells, which therefore appear of darker color. In the wood of conifers and in that of deciduous-leaved trees, in which the vessels (appearing as pores on a transverse cut) are most frequent in the spring wood, the annual ring is usually very distinctly visible; while in those woods which, like the birch, linden, maple, etc., have the pores (or vessels) evenly distributed throughout the annual ring growth, the distinction is not so marked. Sometimes the gradual change in appearance of the annual ring from spring to autumn wood, which is due to the difference of its component elements, is interrupted in such a manner that seemingly a more or less pronounced layer of autumn wood can be recognized, which again changes to spring or summer wood, and then finishes with the regular autumn wood. This irregularity may occur even more than once in the same ring. Such double or counterfeit rings, which can be distinguished from the true annual ring by a practiced eye with the aid of a magnifying glass, have led to the notion that the annual rings are not a true indication of age. The

cause of such irregularity may be sought in some temporary interruption of the vigorous functions of the tree, induced by defoliation, for instance, or by extreme climatic conditions—such as sudden changes of temperature, cold days followed by sudden warm weather, or droughts followed by rain. The absolute breadth of the ring depends on the length of the period of vegetation, and is affected by the depth and richness of the soil, and the influence of light upon the tree.

NOTES.

ACCORDING to the "Medecinische Presse," of Vienna, a Dr. Terc has found a cure for rheumatism in bee-stingings. Having found that every stinging is followed by a swelling up to a point when the body seems to have become hardened against further effect, he tried the stingings on a rheumatic patient. Upon saturating the patient's system with the bee-poison the rheumatism disappeared —not to return for a long time. Dr. Terc has applied his remedy in one hundred and seventy-five cases and has inflicted thirty-nine thousand stingings; and now keeps a colony of bees on his premises, to be employed in this work.

ACCORDING to a count by Dr. W. J. Beal, of the Michigan Forestry Commission, there grow wild in Michigan seventy species of indigenous trees and three exotics that have escaped from cultivation; and of shrubs, one hundred and fifty native and five escaped exotics.

A DICTIONARY of Volapük, compiled by Assistant Surgeon M. W. Wood, U. S. A., is announced by Charles E. Sprague, New York. It will contain more than three hundred pages, and will embody the additions and emendations contained in the fourth edition of Schleyer's dictionary. A peculiar feature will be the arrangement of the Volapük-English and English-Volapük parts on the same pages; each page containing a Volapük-English and an alphabetically corresponding English-Volapük part.

PERTINENTLY to the interest that is taken in testing the vision and color-sense of seamen, a writer in the "Lancet" urges the importance of accuracy of hearing in men of this class. During fogs, sounds are the only means vessels possess of giving notice of their presence, and the only means by which they may be warned against danger of collision. It often requires a nice ear to hear a distant fog-whistle, and a nicer one to determine from what direction it comes. Seamen are as liable to affections which will blunt the acuteness of their hearing as they are to faults of eye-sight.

HERE is another instance of how observation trips up *a priori* reasoning. A correspondent of "The Spectator" relates that some one wrote to an English paper to say that "blackbirds did not eat fruit because they liked it, but because they were thirsty, and recommended we should place pans of water on the gravel walks and so save our garden fruit. A cottager in Montgomeryshire, being told of this interesting fact, replied in the dialect of that part of the country: 'Dern the bruts! they cross the bruck to come to my geërding.'"

AN opinion is growing that bovine tuberculosis is frequently transmitted to the human subject by eating the flesh and drinking the milk of tuberculous cows. It is to be hoped that thorough boiling of the meat destroys the vitality of the bacilli, which are assumed to produce this disease, but we are not warranted in believing that roasting the meat, as usually practiced, will have that effect; and as milk is seldom boiled before being partaken of, it is clear that the milk of a tuberculous animal is unfit for food, and dangerous to life.

BRITISH North Borneo is fast approaching the state of a regularly organized colony, with a fine promise of prosperity. The territory has been divided into nine provinces, named after the founders of the company, and grants of land have been issued covering 475,289 acres, in five of the provinces, those on the coast having the preference. The grantees are mostly Dutch; and a large proportion of the land granted is intended for tobacco cultivation. The total area of the territory will probably be found to be more than 20,000,000 acres. The price of the land, originally one dollar an acre, has been raised to two dollars. Regular steam communication was instituted September 1, 1888, between Sandakan and Hong-Kong and Singapore.

A STORY is told in the Ohio papers of a railroad engine-driver who was suspended because the examining physician pronounced him deaf. He asked to be reinstated because, when on a moving engine, he could hear perfectly well. This was found, on experiment, to be the case. Prof. W. M. Williams matches this story with another, within his own observation, of a man who was painfully deaf in a quiet house, but "could hear ordinary conversation with perfect ease in a cab or railway-carriage, provided the jolting was considerable."

A "DICTIONARY of Universal Climatology" is announced as in preparation by the Observatory of Rio Janeiro, M. L. Cruls, director. It is intended to present methodically the climatological data of as great a number of places on the earth as is possible, reduced to uniform standards of notation and terminology.

M. CHARLES RICHET, editor of the "Revue Scientifique," Paris, is investigating heredity in man, and invites information from correspondents respecting remarkable instances of the transmission of powers.

"VEGETABLE MUSK" is made from the seeds of the *Hibiscus abelmoschus*, a malvaceous plant. The ancient Egyptians used to chew the seeds to stimulate their appetites and make their breath fragrant, and they regarded them as aphrodisiac and astringent. Previous to the French Revolution, when it was the fashion to powder the hair, the seeds, called *ambrette*, were mixed with starch and kept till the starch had absorbed a suitable proportion of their perfume, when the seeds were removed and the musky-odored starch was put up in packets for sale. Ambrette is now imported in large quantities into Europe, and is used in the preparation of the alkermes of Florence, and to adulterate musk.

"How Sea-Birds dine" is described in "Nature" by a correspondent who caught them in the act off the island of Mull. Observing them collected at a single spot, he steamed toward it, and found that the center of their gathering was a reddish-brown ball, about two feet under the surface, composed of herring-fry, which had been driven into that shape by the divers surrounding the shoal and hemming them in on all sides, "so that the terrified fish huddled together in a vain effort to escape inevitable destruction. The divers work from below and the other sea-birds feed from above; and, as in some cases after the birds had been at work for some time I saw no ball, I suppose not one fish is left to tell the tale." The observation was repeated several times.

ASAYAMA, one of the most noted volcanoes in Japan, is the loftiest mountain in the country which is in a constant state of activity, and is nearest to the capital, and is also situated in a district that is famous for its health resorts. A correspondent who visited it describes the roar on approaching the edge of the crater as not unlike the noise produced by the passage of a railway-train across a bridge under which one is standing. There was no shaking, but loud hissing and bubbling constantly proceeded from numberless vapor-jets in the inner face of the crater-wall. The estimates of the diameter of the opening vary widely. The present crater is apparently the youngest and innermost of three.

THE important treatise of Buys Ballot on the distribution of temperature over the earth contains very plain cartographic representations of the variations of temperatures from means of the parallels and the difference between the temperatures of January and July. The least variations in the latter point are on the equator, and the greatest are in northeastern Asia (60°) and northwestern America (40°), and in the southern hemisphere, in Australia.

OBITUARY NOTES.

MR. ROBERT DAMAR, of Weymouth, England, a well-known naturalist and geologist, died May 4th, in his seventy-fifth year. He was an extensive traveler and assiduous collector. Among the collections he made were a series of fossil fishes from the cretaceous beds of the Lebanon, Syria; the most complete specimen of the extinct Steller's sea-cow, from Behring Island; and a series, called complete, of the fishes of the Caspian Sea. He had lately purchased the zoölogical collections forming the Godeffroy Museum in Hamburg, and had perhaps the largest collection in England of recent shells. He was the author of a work on the "Geology of Weymouth and the Island of Portland." He was contemplating, at the time of his death, another trip to Siberia, to procure an entire mammoth's skeleton.

AMONG recent deaths of scientific men in Europe are those of the Finnish botanist, Prof. Sextus Otto Lindberg; and Dr. Hermann Theodor Gayler, Director of the Botanical Gardens at Frankfort.

WARREN DE LA RUE, F. R. S., an eminent English physicist, died April 19th, aged about sixty-three years. He was born in Guernsey and educated in Paris; was interested in photographic observations of solar eclipses and of the transit of Venus in 1874; was associated with Prof. Balfour Stewart and Mr. B. Loweny in the publication of "Researches in Solar Physics"; carried on a series of researches on the electric discharge, the results of which were communicated to the Royal Society and the French Academy; was for two years President of the Royal and for eleven of the Chemical Society, and for three years a member of the Council of the Society of Arts; and was a corresponding member of several foreign scientific societies.

PROF. FRANZ CORNELIUS DONDERS, of the University of Utrecht, a distinguished physiologist and ophthalmologist, died March 24th, in the seventy-first year of his age. He studied in the Netherlands Military Hospital School and the university, and was a professor at Leyden and afterward at Utrecht. He was the author of many works, among them an inaugural dissertation on "Harmony of Animal Life"; "Dutch Contributions to Anatomical and Physiological Knowledge"; "Metabolism of Tissue as the Source of the Proper Heat of Plants and Animals"; treatises in optics, including his great work on "Anomalies of Refraction and Accommodation"; and technical and special essays. He has been called the first surgeon who approached the subject of lenses as aids to vision in a truly scientific spirit.

ANTOINE LAURENT LAVOISIER.

THE

POPULAR SCIENCE MONTHLY.

AUGUST, 1889.

THE SPIRIT OF MANUAL TRAINING.

By C. HANFORD HENDERSON,

PROFESSOR OF PHYSICS AND CHEMISTRY IN THE PHILADELPHIA MANUAL TRAINING SCHOOL.

AN observant foreigner once said of America, "I found progress in everything except in their schools and churches." One must take with a grain of allowance the impressions of foreign tourists. They are solicited so importunately by the objects of the senses that they fail, as a class, to appreciate the real significance of American institutions. But there was, nevertheless, not a little truth in this brief criticism. The schools and the churches have not kept pace with the march of events. Perhaps one notices them straggling the more, because of all institutions they are supposed to be the most jealous guardians of the interests of humanity. Yet in hundreds of communities the land over the masses of the people are but half persuaded of the utility of the one, and treat with increasing neglect the ministrations of the other. While these protestants against our current scholasticism and ecclesiasticism were few in number, their complaint attracted little notice. Now, however, that their ranks are grown to large proportions, a deep importance attaches to the question as to whether these institutions are, or are not, properly fulfilling their functions.

The hand of Destiny never seemingly pointed with more unerring certainty to an impending change than it does to-day as it stretches out toward the school and the church. The office of the teacher and the office of the priest are passing the review of a thoughtful public sentiment. Of the failure of the Church to justify her proud title of "the institute of humanity" little need be said. But, however imperfect one may regard her present ministrations, he can scarcely withhold his affection from an insti-

tution which has done so much to encourage the sentiment of worship. The liberal movement, the impulse toward Christian unity, the substitution of ethical for dogmatic teaching, the appeal to the soul of man rather than to his credulity, all seem to indicate that the Church, which has been so much in the past history of the race, is yet to adapt herself to the changed conditions of the times, and still be an important factor in its future.

But of even greater importance are those changes which seem imminent in the school. Its influence comes at an age when the mind is particularly plastic, and when life is new and fresh. It occupies the attention during the greater portion of at least five days in the week, and even during the remainder it is seldom absent from the thoughts for any considerable length of time. One can scarcely overestimate the importance of establishing so pervasive an institution upon the right basis.

It may seem a trite thing to particularize again the function of an old institution like the school, yet it is only by keeping this very constantly in mind that one can appreciate its present position, or pass intelligent judgment upon those innovations which have been proposed for its improvement.

The school, in the first place, then, is a means and not an end. It serves a purpose. It is not, like the state or the church, an organism and possessed of life. One can construct no pleasing ideal of what the perfect school ought to be. He can at best only specify what results it should produce. Like all other tools, its function is to form and to fashion. A machine is not valued for its proportions, its color, its material, but for its subserviency to the work required, and for the character of its products. The point demands emphasis, for educators too frequently look to the symmetry of the school itself instead of to the harmony of its results. They forget that different materials require different tools for their working.

It is a curious thing that the human mind should so delight in the idea of stability, and should attempt to attain it, when such an idea finds no place in all nature. Even the crystal, the most unchanging object of our admiration, has undergone innumerable births and deaths. All nature is in a state of solution and of flux. There is no stability, even comparative, except where there is no life. Yet we, who believe ourselves to live best when we are in the most perfect communion with that infinite intelligence whose manifestation we call Nature, are constantly denying our faith by the profane effort to give permanence to that which is essentially transitory. Our laws seem to us good. We crystallize them into a code, and so burden the generations to come with an evil mortgage upon their justice. Our faith seems to us divine. We kill it by formulating it into a creed, and so starve the souls of our

children. Oppressed with weariness, we paint our heaven as a place of eternal rest. As well might we extol the lifeless moon above the sentient earth. It is no wonder that men fear death, and hear with chill delight the holy name of heaven. Through all our human institutions there runs this same unnaturalness and inconsistency acting like a constant brake upon our progress. In theory we adore this progress, but the seraphim of our secret altars are insoluble, infusible, unchangeable. In the school this inconsistency of ours has been particularly glaring and particularly disastrous. We have found our imagination of sufficient compass to span the distance between man and protoplasm, but it seems to have halted at the less difficult task of recognizing that the principle of evolution is still working, and that the educational demands of one age are not the demands of all ages.

The cause of education, however, will be but poorly served if one demolish without building up again with as much zeal as he tears down. Nor must one complain too bitterly of an institution which, in spite of its short-comings, has assisted to produce in the community a culture sufficient to recognize them. But it would be well to remember that the school can never be made to conform to any crystallographic habit, however beautiful. Let it be regarded as what it is, simply a tool and a very plastic one at that, not too sacred to be sharpened and altered, whenever by so doing it can be made to accomplish better work.

The great question, then, concerning the schools is a very simple one: What effect has the institution upon its pupils? What sort of men and women does it make out of them? It is not what studies are taught, or what accomplishments are imparted, or what extent of information is bestowed. These considerations have their proper importance, but they are secondary; the real test is deeper. The standard so far has been too material. We want now something more spiritual. It is a truism to say that the function of the school is not to instruct, but to educate; but it is a truism which has not yet been taken sufficiently to heart to be translated into a fact. Struck by the manifest inadequacy of the ordinary school in preparing boys to meet the problems of life, a somewhat vehement reformer has declared that America has succeeded, not because of her public-school system, but in spite of it. The exaggeration is evident. There are many, however, who can not help feeling that as a moral force the modern school, whether public or private, has been scarcely less than impotent. It has given itself up to the business of instruction, and has found little or no time for the infinitely more important work of development. The whole force of the school should be devoted to the one supreme issue—the boy himself. If, while you are making a man, you can also make a scholar, it will be well, but look to the man

first. The majority of thoughtful people, if questioned, would, I believe, make answer that their own spiritual enlightenment had come from literature that happened to fall within their reading rather than from either pulpit or college chair. It looks very much as if we were leaving to chance—if there be such a thing—what ought to be the object of our mightiest effort.

I should deeply regret any exaggeration of the deficiencies of the school, but I think that I do not err in stating that in many of these institutions the work of true education would be better accomplished were the formal instruction now in vogue entirely abolished, and the children simply brought into daily contact with some living, spiritually-minded man or woman, and through them with the questions of life and with the rich literature of the race.

The end of education being discipline, it is manifest that the subjects chosen for study are less important than the spirit in which the study is pursued. In the atmosphere of a school where this sentiment prevails, almost any curriculum will produce living men. But there are certain branches of study which, better than any others, are calculated to provoke thought and serve the ends of education. There are certain ways of spending the time that promise the richest harvest. To select such studies and employ such modes is indisputably the function of those who attempt to guide the course of education. In this all are certainly agreed. Yet that old notion of the ideal school still hinders the search after these admittedly good things. In many schools the course pursued is much the same as if we mixed the colors on our palette with our eyes shut, and still expected to get the tint desired. The discrepancy between the end sought and the method employed would discourage any one less sophisticated than the average school-man. Hygiene, for example, is taught in rooms so ill-ventilated that the children are fairly pale. Grammar and parsing are inflicted in the blind hope that they may in some occult way influence the language of the child. They rarely do. On some unaccountable theory of culture years are devoted to languages that one will never use, and precious moments squandered on the geography of places one will never see or hear of. And so one might follow the entire list of studies undertaken in the majority of schools. They seem hopelessly inadequate.

In the face of such wide-spread failure it would appear that this search after a suitable scheme for the disposition of the time of children must be very difficult. The truth is, that it is difficult to the verge of the impossible, if one proceeds in this credulous fashion, selecting studies and occupations which bear no relation whatever to the result it is desired to produce, and then calmly trusts that by some alchemistic process these base metals will be transmuted into gold. But the task is not difficult if one goes

about it in the right way. And the right way, here as elsewhere, is the natural way. A definite result is wanted. Let definite means be taken to reach that result. If strong men are wanted, let the conditions of the school be such that strength will be a necessity. In many of them at present it is not even a possibility. If honest men are wanted, let the training of the school tend to that end, even if one's knowledge of Timbuctoo and the Karakorum Mountains is not very definite. If self-reliant men are wanted, let education take the place of instruction. If useful men are wanted, let useful things be taught. If thoughtful men are wanted, let the appeal be made to the individual reason of the boy rather than to external authority. All this is very obvious; it is merely common sense, but unfortunately it is not the method of the schools. In a word, the problem of education is to be approached from the other side. We are to work backward from results. Instead of assuming certain studies to be useful, and then working on to decidedly variable results, we are to begin with results admitted to be worthy, and then work backward to a curriculum as varied as Joseph's coat if individual cases demand it. What the true educator most wishes to influence is the conduct of life. The object he holds sacred; the methods by which he compasses it, indifferent.

This is the spirit of manual training. Where this system of education has been introduced, it gives so distinct a character to the course of study that it has loaned its name to the school as a whole. In many respects this is unfortunate, as it has caused serious misapprehension in regard to the purpose of such schools, but apparently the name is now too well rooted in educational nomenclature to be easily changed. It should be borne in mind, however, that the name stands for an object rather than a method. The manual training school has sprung into existence for a purpose much more profound than that of merely cultivating the hand. It has come in recognition of the growing demand for a complete man. Our educational methods have too long been at work turning out fractional products, men strong perhaps in this or that particular department, but sadly deficient when viewed from the standard of complete manhood. The specific purpose of such schools is to offer an education that includes as far as possible all of the faculties. Its favorite maxim is, "Put the whole boy to school." Its mode of carrying out this purpose is the very practical one of occupying the time in any way, formal or informal, that will best lead to the end proposed.

The manual training school is now in its formative period, and the time is a critical one. Two rival theories contend for the mastery of its future. The one regards manual training as an end in itself, and subordinates education to technical skill. It con-

cerns itself more with the production of artisans than of men. This view of manual training makes the school very much akin to the trade and industrial schools, and would end by converting it into a shop. The school is heralded as the legitimate successor of the apprentice system, and as an institution whose highest end is to restore the advantages lost in the abolition of that system. According to this theory, the ability to do becomes the standard of success for the school, and the chief object of its ambition, the production of well-executed handiwork. The results of the year's work would be summed up in an exhibition of things.

The other theory also sees in the school an establishment for the fabrication of a definite product, but it is a product too subtile to find its complete expression in wood or iron or clay. It is believed that the specific purpose of education is to cultivate character, to induce sound thinking, and to make a necessity of scientific inquiry. Its highest end is ethical. Of great value, but secondary to its supreme purpose, are the skill and the information which would be the natural result of such cultivation. The aim of the school is to prepare for completeness of life. The central thought in its entire organization is always the boy himself, and everything that is done, every study that is taken up, every influence that is brought to bear, has for its sole purpose his development. In this view of its proper function, the school is a purely educational institution, and is industrial only in making use of the tools of industry to accomplish its chosen purpose. The manual work, like the work in science and literature, is simply a means of development. It bears the same relation to the process of education that a railway train does to travel. One may select slower modes of approach if he choose, but, in his delight at the rapid transit, he must not confuse the journey with the end for which the journey is made. Those who hold this view of manual training, watch with sincere regret any encroachment of that spirit which places the inanimate product, however ingenious and beautiful it may be, above the human product. The object of manual training, they believe, is the production of thoughtful, self-reliant, honest men.

It will be seen that these two theories are antagonistic. The first, in its anxiety for material results, is somewhat impatient at the slower unfolding of the spiritual handiwork. The second, while it admits all the claims of the first, objects to their limited scope—they do not go far enough. It believes thoroughly in men and women who can do something, but it believes also, and more thoroughly, in men and women who are something. Both theorists sow in all sincerity, and reap as they have sown. One harvest is gathered before the other. The seed matures early, and blossoms and bears fruit in objects of beauty and utility. There

is much to exhibit on stated occasions to the public gaze and commendation. The other harvest is slow in maturing. It taxes faith and hope. It does not offer material well suited for public display. Yet this intangible result is so valued by those who labor for it, that they are content to wait, persuaded that a well-spent present can afford to leave the future to divine law.

In nearly every manual training school these two elements are present. In one way this is an advantage, for they act as a check upon each other. The practical side is kept from becoming sordid; the spiritual side from becoming visionary. But the balance of power between the two is of the utmost importance, for it determines the character of the school. If it be on the one side, the tendency of manual training must be regarded as unfortunate—the educational ideal is degraded; life contracts. If it be on the other, no finer nursery can be imagined for the rearing of a race which shall be strong in its passion for goodness and for knowledge. It teaches that the worth of a man lies in what he is. The question is one of fiber, not of veneer.

It is not unnatural that an enterprise with so ambitious a purpose should constantly bring disappointment to its projectors. When one has poured out his whole soul in an effort to regenerate, even a reasonable amount of success does not satisfy him. He looks, perhaps, for too much. The currents in human affairs which do not make for righteousness are too strong to be easily stemmed. The influence of the school is working against very powerful counter-influences. Arrayed against it are the low maxims of the street and the market, the sensationalism of much of our current literature, and not infrequently the indifferent moral atmosphere of the home itself. It is not alone that these opponents have contemporary power, but they have been in office for from thirteen to fourteen years. We have to fight not only the present, but the past as well. The leaven of the new ideas goes frequently into very obdurate dough, and its working is correspondingly sluggish. We must cope with both the boy and his great-grandmother.

A difficulty keenly felt in these schools is the necessity of spending the first few months in the negative work of undoing. Children, as a rule, are very badly trained. They are taught to work under a false stimulus, and from vicious motives. Their morality is generally the morality of rewards and punishments. Were the childish heart less beautiful and less pure than it is, the injury done to it would be even more irreparable.

Nor are these the only difficulties. The spirit of manual training is ethical and evolutionary. But, unfortunately, not all of those who presume to teach in such schools have themselves caught its fine meaning. One can not communicate what he has

not. Men will teach for bread and butter just as they will preach and pray. Too many are in the school because they have nothing else to do. They have not elected teaching. Like their boys, they must undo a great deal of their past, and this in a man requires not a small degree of plasticity. Some possess it, some do not. To look within the soul and draw one's inspiration from that well of living water is not given to all men; to communicate it, in all frankness and generosity, to but few. Our education has made us all too cautious. We are too afraid of speaking out and expressing our inmost convictions. And so our goodness, if we have any, does not prove contagious. No wave of spirituality proceeds from our teaching.

In contending against these odds, the pressure from without and the insufficiency within, the teacher experiences alternations of hope and despair. The faculty of a manual training school is commonly made up of young men. The more thoughtful among them have been attached to the movement by its immense promise, but under their hopefulness there is observable a current of almost premature seriousness. It is a grave task to undertake the regeneration of humanity, even when it is in the bud.

In attempting to carry out this idea of boy development, the atmosphere of the school is an object of constant solicitude. Great care is taken that it shall not be charged with the miasma called information. It is to be kept fresh, and, above all, morally wholesome. Character is to be grown there, but one spirit must pervade the school; it is that of a divine egotism. The boy is taught that for himself the one object of supreme importance in the whole universe is himself. His gaze is directed toward the naked human soul, stripped of the false props of apparel, of family, of possessions, even of knowledge. He is led to do this and that not for the sake of the product, although this is duly valued, but for the sake of the doing, and the reaction it will have upon himself. Education is thus made intensely subjective. The worth, the dignity, the responsibility of the individual are given greater emphasis than the facts of geography, of grammar, or of history. It is in this spirit, the constant recognition of a definite end, that manual training attempts to work. It would not do, however, to talk to boys very much about the soul. It is an abstraction to them, and they would soon cease to listen. They must be made to feel it. The task is a very subtle one; its nature must never be forgotten, but seldom displayed. The kingdom of heaven can not be taken by violence. It is through gentleness and patience, through love and sympathy, that the inner recesses of boys' hearts are to be reached. They have been taught in a vague way that the body has a soul. The statement is here reversed, and they are made to feel, if possible, that the soul has a body. They

come to the school deeply impressed concerning the objects of the senses, the concrete. They are here persuaded of the greater reality of the spirit; and appreciation is asked for the abstract and impersonal. So far these objects might be the objects of any school of high principle. They represent the spirit of the new education. But they belong peculiarly to manual training, since it is a system willing not only to cherish these sentiments, but also to work with complete singleness of purpose for their realization. It is a sincere and practical effort to do something better than has yet been done in the name of education.

The methods of manual training are too new to have been encumbered with any traditions; nor have they attained sufficient fixedness to threaten growth. For the most part, they are still tentative and experimental. This plasticity is very hopeful. A question left open is a constant stimulus to renewed searching after something still a little better. Each school that attempts to carry out manual training soon develops a certain individuality. Any teaching so intensively subjective as this is deeply influenced by the personality of its faculty. The character of the men who have it in charge is quick to find expression in the school. The distinctive features in the institution at Philadelphia are, perhaps, the predominance given to ethics and the unremitting effort to preserve unity throughout the many-sided development attempted. In defending our unity we are beset by difficulties. The over-enthusiasm of our friends would plunge us into many excesses. Manual training seems to them so good a thing that they can not realize the possibility of having too much of it. We who take the long view have often to counsel moderation, or the new idea would quite run away with us. In the intense delight which these good people feel in giving substance to ideas, they would discard everything which is not capable of such expression. They apparently forget that imagination is absolutely needful for perspective, and that of all useless, pitiable creatures the unimaginative man is superlative. Yet this excessive amount of representation would quite kill imagination. In careless hands the effect of manual training would be to set bounds and limits rather than to break them down. It is not a system that can be indiscriminately recommended. Men are so prone to mistake the means for the end, that those who esteem manual training most highly are least willing to encourage its introduction, unless they know the character of the men who are to have it in charge.

In its organization the manual training school differs little from the customary high school. It is an institution of similar grade, and covers about the same period of boy life. Its students enter at from thirteen to fifteen years of age, and remain, if they

complete their entire course, for three years. It is not less literary and not less scientific than the best of our high schools, but it is, we believe, far more practical in preparing boys to meet the real problems of life. The customary high-school course covers four years, but, as only a small percentage of students remain to graduate, it is thought wiser in the manual training school to limit the course to three years, and to offer a fourth year of post-graduate study in any department where a student has shown special aptitude. One third of the school day is devoted to manual work, and the rest to science and literature. It seems impossible, however, to consider such a school except as a whole. It refuses to be divided into sections. Representing, as it does, a purpose rather than a method, all departments are bound together by a common aim, and are subservient to that. They are members one of another, and the head no longer says to the hand, or, for that matter, to any other member of the anatomy, "I have no need of thee." We venture to hope that the impulse whose spirit I have been attempting to describe is only at the beginning of its work. When the new aspirations in education, which are now called manual training, come to a fuller development, they will concern themselves not with the hand only, but with the entire body and the entire being. We even hope that at some time in the future parents and teachers will feel it their duty to acquaint themselves with the condition and needs of the little bodies of which they are now the ignorant guardians, and will attempt by definite means to make them more fitting vestments for the human soul. The time has come, it seems to me, when evolution should be a conscious process, and man should work in happy sympathy with the purposes of that power which makes for righteousness.

Although the most distinctive feature in these schools is naturally the manual department, its success from the educational standpoint can only be judged by observing its effect upon the rest of the school work. It is true that the boy does not in all cases understand the full significance of his work, but he is, nevertheless, gaining unconsciously that degree of patience, of perseverance, and of judgment needed to accomplish his task. The next thing he undertakes demands these qualities in fuller measure, and so the work of character-building goes on simultaneously with the production of handiwork. The boy sees, perhaps, only these finished pieces of work as his result. We who are looking on see something vastly more important. We see the sturdier virtues—self-reliance, manliness, and helpfulness—developing to wholesome proportions. The boy takes pride in his work, and we take pride in him.

The constructive faculty in children and boys is very strong.

They seem never so thoroughly happy as when they are making something. This wonderful self-activity in children was what Froebel seized upon as the basis for the Kindergarten. In boys it is made the basis for manual training. Whenever possible, the appeal is made to their own resources and faculties in preference to the external world. Here, as in the lecture and recitation room, education is made to proceed subjectively.

In judging of the success of the enterprise, due allowance must be made for the quality of the material that is to be worked up. It is to be remembered that not a few of the boys who come to a manual training school come there for the express purpose of cultivating the mechanical side to the exclusion of everything else. In many cases these lads are finally converted to the broader view of life, but, if that enlightenment does not come, they can hardly be taken to represent in fairness either the aim or the result of manual training. Comparisons are always difficult to make successfully, and here particularly so, because allowances have to be made on both sides. While many of the most clever little workmen would possibly count as dullards in a school of different character, not a few of the boys represent an intelligence above the average. For it is the more advanced people who have been the first to recognize the significance of manual training, and have shown their faith in it by selecting it for their own sons. The visitor to a manual training school, if he come to it with the shop idea in his head, expresses constant surprise at the class of boys he sees there. Sometimes he very graciously compliments the institution on its excellent English, under the apparent impression that a little noise has a tendency to make the adverb and the adjective, the past tense and the perfect participle, play at stage-coach and change places with each other. His surprise is perhaps not unnatural, for he comes expecting to find a shop, and he finds a school.

The theory upon which a manual training school is conducted may not be lightly disregarded. It has here been dwelt upon as the all-important thing about the school, for it determines the aims and methods of the institution, and the very atmosphere of its lecture-rooms and laboratories. Moreover, it determines for what class of students the school is intended. If things be regarded as the proper product, only prospective artisans should enroll themselves among its students; but if men be the product sought, then its rolls will be as catholic as human want itself. There, in jackets and knickerbockers, will be found the embryo scientist and teacher, journalist and minister, lawyer and doctor, artist and artisan, merchant and manufacturer; and these men, though they may never have occasion to directly exercise their acquired dexterity, will be brought into fuller relation with all life through

that complete education of the faculties which it is the function of a manual training school to accomplish.

In glancing at the several schools of this character which have been established in America, one must admit that the artisan spirit is more prevalent than the educational. The fact is to be deplored. It means that unless the advocates of the higher position are alert and vigilant, the fine opportunity for broader culture offered by manual training will be lost in mere technique. The man-element will go under, and the world of things will again rule.

The chief claim of manual training, it must be repeated, is not mechanical. It is spiritual, the development of character; and while its success in this direction can not always be judged from the standard of formal scholarship, there are other and very ready tests which are infallible. Conduct is a sure gauge of the stuff of which a boy is made. No better index of the moral atmosphere of a school can be found, I think, than its discipline. The boys in a manual training school are not yet old. The younger among them are only thirteen or fourteen years, and to boys of this age there are special temptations to disorder in the freedom and movement of the laboratories. To maintain order among three hundred of these active young spirits without appealing to their fear of consequences, or to other vicious motives, would not seem an easy task. Yet it is accomplished in a highly satisfactory manner. There are plenty of noise and life, it is true, and a fair share of fun, but this seldom goes beyond wholesome bounds. As far as possible the order of the school is left to the boys themselves. Certain customs are observed as a matter of convenience, but there are no formal rules for conduct. The boys know perfectly well what is right, and they are encouraged to do it because it is the right, and not because they will get into trouble if they do otherwise. As little personal authority is exerted as possible. The inexorable law of right is taught as a principle, to which both teacher and boy must conform. It is a high ground to take, but it works—as all appeals to the better nature of a boy generally do. It is possible that this abnegation of authority robs the professorial chair of some of its dignity, but there are better levers in the world than this. The friendly, even affectionate, comradeship between teacher and pupil which takes its place, is the source of a deeper influence and of a more profitable intercourse.

It is felt by those imbued with the new idea of education that punishment, however judiciously applied, is an inadequate and superficial thing, and represents at best misapplied energy. Nature has placed an indissoluble bond between cause and effect. Wrong conduct is so surely followed by natural punishment that it seems a presumption on the part of a teacher to attempt to

measure out a suitable penalty in addition. The same effort can better be applied to an attempt to show the boy why a certain line of conduct is wrong, and the greater beauty of the right. All appeals are avoided which involve in any way the fear of consequences. This applies not only to the discipline of the school but also to questions of scholarship. The system of daily marking has been abolished, and an attempt made to substitute the natural and proper motive for study in place of the lower and artificial one. No rod, either mental or physical, is held over the boy. Solomon was the great advocate of that system of government, but, judging from the subsequent behavior of Rehoboam, it has been suggested that it was not a success even in the hands of so wise a man. The school is to prepare for life, and in life things are not conducted in that way. The difficult art of governing one's self can best be learned if the practice begins in boyhood. It becomes increasingly difficult to choose the wrong as one recognizes more and more clearly that the offense is primarily against one's own nature, and can meet forgiveness only by self-atonement. The deepest philosophy of life thus forms an essential part of the curriculum of a manual training school. I do not believe that a school conducted in this spirit ever graduates a boy who feels that he is escaping from restraint when he leaves the school. He is under the eye of an ever-present master, who judges with increasing culture, not according to appearance, but righteous judgment; for that master, if the school has been successful, is himself. We feel justified in subordinating the less serious ends of education to this one supreme end; for conduct, as Matthew Arnold says, is at least three fourths of life. It is the essence of religion, the material of men.

In thus seeking to reach the inner sources of conduct and achievement, the manual training school renders an inestimable service if it succeed in arousing boys to think for themselves, and in making them the guardians of their own destiny, working under divine law. But the work of the school does not end here. The occupations of life which open before its graduates are varied and numerous. There is something for all talents, however diverse. A school which produces men must so train its boys that they will be competent to take some definite and acceptable part in this complex activity. The selection of the right part to be taken is a matter of no small moment. It must be made ultimately by the boy himself, but he is as yet so young and so inexperienced, it is no wonder that many men declare in after-life that they have mistaken their vocation. Unless his genius be of the pronounced type which knows its future from the very cradle, this selection, all-important as it is, is extremely difficult to make. The boy needs help and friendly counsel. To prevent the enor-

mous waste of energy and the life-long unhappiness which arise from mistakes in one's calling, is certainly a highly important function of an institution which professes to prepare a lad for the problems of daily living. The absence of pronounced taste in the boy is not the only obstacle to be overcome. There are few boys totally devoid of some interest which may be made available for future work, but it needs something to bring it out. The ordinary school training does not do it. In the outcry which is periodically made against what is mistakenly called "over-education," there is discernible the bitter tone of men who feel in a blind way that somehow the schools have cheated them in so ill-preparing them for life. There is much reason in their complaint. It is not true that such questions are outside the business of the school. What a boy is to do after he leaves school is very much the business of the school, and its neglect is scarcely less than criminal. If what is done before graduation bears no relation to what is to be done after graduation, then the school—and it is said in all soberness—had better give place to the gymnasium, for that at least would give health and beauty in place of narrow chests and pseudo-culture. But the faculty of a manual training school do not so believe. They believe that the development of a useful, judiciously chosen purpose in life is a very important element in education, and it receives in such schools an amount of attention commensurate with its importance. A boy can not judge rightly for what sort of work he is best fitted unless his experience be so enlarged by those who guide his course that he shall at least come in contact with the different departments of human activity, and taste them, if we may so phrase it, for himself. Even with these advantages, the choice is a difficult one. The first boyish impulse is not always to be trusted; but, by giving these impulses as free play as practicable during the three years of the course, the chances of mistake are at least greatly reduced. In a well-equipped manual training school there are few boys who are not able to become interested and proficient in some one of its several departments. In the hope of making the school still more useful in helping boys to select a suitable life-work, and in helping to prepare them to carry it out with efficiency, the plan of post-graduate study has been introduced. By permitting a boy to work a year in that particular department where his undergraduate performances have shown the greatest promise, he can be still more effectively prepared for the work of the world. This is a special and experimental feature of the school at Philadelphia. The results indicate that it is worthy of further extension.

It is significant of the spirit of its teaching that so large a proportion of manual-training graduates continue their studies in

universities and higher technical schools. Its effect, as far as one can judge, has been to make boys aspire after the better things of life.

I have read that Pestalozzi, in his eager enthusiasm, used to find many things in his little school which less partial though not less careful observers failed to discover. I should be sorry to repeat his mistake in connection with the manual training school. I have tried, therefore, to so temper my praise with criticism that both the beauty of the system and its danger should be fairly represented. The view taken might still be too favorable, if it were given as the veritable history of a single school. The spirit of manual training, to which I have tried to give expression, represents rather an ideal, which in moments of extreme hopefulness we are tempted to believe that we have partially realized, and in moments of discouragement we still hold to be worthy of our effort.

AGNOSTICISM AND CHRISTIANITY.

By Prof. T. H. HUXLEY, F. R. S.

Nemo ergo ex me scire quærat, quod me nescire scio, nisi forte ut nescire discat.*
Augustinus, *De Civ. Dei*, xii, 7.

CONTROVERSY, like most things in this world, has a good and a bad side. On the good side, it may be said that it stimulates the wits, tends to clear the mind, and often helps those engaged in it to get a better grasp of their subject than they had before; while, mankind being essentially fighting animals, a contest leads the public to interest themselves in questions to which, otherwise, they would give but a languid attention. On the bad side, controversy is rarely found to sweeten the temper, and generally tends to degenerate into an exchange of more or less effective sarcasms. Moreover, if it is long continued, the original and really important issues are apt to become obscured by disputes on the collateral and relatively insignificant questions which have cropped up in the course of the discussion. No doubt both of these aspects of controversy have manifested themselves in the course of the debate which has been in progress, for some months, in these pages. So far as I may have illustrated the second, I express repentance and desire absolution; and I shall endeavor to make amends for any foregone lapses by an endeavor to exhibit only the better phase in these concluding remarks.

* Let no one therefore seek to know from me what I know I do not know, except in order to learn not to know.

The present discussion has arisen out of the use, which has become general in the last few years, of the terms "agnostic" and "agnosticism."

The people who call themselves "agnostics" have been charged with doing so because they have not the courage to declare themselves "infidels." It has been insinuated that they have adopted a new name in order to escape the unpleasantness which attaches to their proper denomination. To this wholly erroneous imputation, I have replied by showing that the term "agnostic" did, as a matter of fact, arise in a manner which negatives it; and my statement has not been, and can not be, refuted. Moreover, speaking for myself, and without impugning the right of any other person to use the term in another sense, I further say that agnosticism is not properly described as a "negative" creed, nor indeed as a creed of any kind, except in so far as it expresses absolute faith in the validity of a principle which is as much ethical as intellectual. This principle may be stated in various ways, but they all amount to this: that it is wrong for a man to say that he is certain of the objective truth of any proposition unless he can produce evidence which logically justifies that certainty. This is what agnosticism asserts; and, in my opinion, it is all that is essential to agnosticism. That which agnostics deny and repudiate as immoral is the contrary doctrine, that there are propositions which men ought to believe, without logically satisfactory evidence; and that reprobation ought to attach to the profession of disbelief in such inadequately supported propositions. The justification of the agnostic principle lies in the success which follows upon its application, whether in the field of natural or in that of civil history; and in the fact that, so far as these topics are concerned, no sane man thinks of denying its validity.

Still speaking for myself, I add that, though agnosticism is not, and can not be, a creed, except in so far as its general principle is concerned; yet that the application of that principle results in the denial of, or the suspension of judgment concerning, a number of propositions respecting which our contemporary ecclesiastical "gnostics" profess entire certainty. And in so far as these ecclesiastical persons can be justified in the old-established custom (which many nowadays think more honored in the breach than the observance) of using opprobrious names to those who differ from them, I fully admit their right to call me and those who think with me "infidels"; all I have ventured to urge is that they must not expect us to speak of ourselves by that title.

The extent of the region of the uncertain, the number of the problems the investigation of which ends in a verdict of not

proven, will vary according to the knowledge and the intellectual habits of the individual agnostic. I do not very much care to speak of anything as unknowable. What I am sure about is that there are many topics about which I know nothing, and which, so far as I can see, are out of reach of my faculties. But whether these things are knowable by any one else is exactly one of those matters which is beyond my knowledge, though I may have a tolerably strong opinion as to the probabilities of the case. Relatively to myself, I am quite sure that the region of uncertainty—the nebulous country in which words play the part of realities—is far more extensive than I could wish. Materialism and idealism; theism and atheism; the doctrine of the soul and its mortality or immortality—appear in the history of philosophy like the shades of Scandinavian heroes, eternally slaying one another and eternally coming to life again in a metaphysical "Nifelheim." It is getting on for twenty-five centuries, at least, since mankind began seriously to give their minds to these topics. Generation after generation, philosophy has been doomed to roll the stone up hill; and, just as all the world swore it was at the top, down it has rolled to the bottom again. All this is written in innumerable books; and he who will toil through them will discover that the stone is just where it was when the work began. Hume saw this; Kant saw it; since their time, more and more eyes have been cleansed of the films which prevented them from seeing it; until now the weight and number of those who refuse to be the prey of verbal mystification has begun to tell in practical life.

It was inevitable that a conflict should arise between agnosticism and theology; or rather I ought to say between agnosticism and ecclesiasticism. For theology, the science, is one thing; and ecclesiasticism, the championship of a foregone conclusion * as to the truth of a particular form of theology, is another. With scientific theology, agnosticism has no quarrel. On the contrary, the agnostic, knowing too well the influence of prejudice and idiosyncrasy, even on those who desire most earnestly to be impartial, can wish for nothing more urgently than that the scientific theologian should not only be at perfect liberty to thrash out the matter in his own fashion, but that he should, if he can, find flaws in the agnostic position, and, even if demonstration is not to be had, that he should put, in their full force, the grounds of the conclusions he thinks probable. The scientific theologian admits the agnostic principle, however widely his results may differ from those reached by the majority of agnostics.

But, as between agnosticism and ecclesiasticism, or, as our

* "Let us maintain, before we have proved. This seeming paradox is the secret of happiness." (Dr. Newman, "Tract 85," p. 85.)

neighbors across the Channel call it, clericalism, there can be neither peace nor truce. The cleric asserts that it is morally wrong not to believe certain propositions, whatever the results of a strict scientific investigation of the evidence of these propositions. He tells us that "religious error is, in itself, of an immoral nature."* He declares that he has prejudged certain conclusions, and looks upon those who show cause for arrest of judgment as emissaries of Satan. It necessarily follows that, for him. the attainment of faith, not the ascertainment of truth, is the highest aim of mental life. And, on careful analysis of the nature of this faith, it will too often be found to be not the mystic process of unity with the divine, understood by the religious enthusiast—but that which the candid simplicity of a Sunday scholar once defined it to be. "Faith," said this unconscious plagiarist of Tertullian, "is the power of saying you believe things which are incredible."

Now I, and many other agnostics, believe that faith, in this sense, is an abomination; and though we do not indulge in the luxury of self-righteousness so far as to call those who are not of our way of thinking hard names, we do feel that the disagreement between ourselves and those who hold this doctrine is even more moral than intellectual. It is desirable there should be an end of any mistakes on this topic. If our clerical opponents were clearly aware of the real state of the case, there would be an end of the curious delusion, which often appears between the lines of their writings, that those whom they are so fond of calling "infidels" are people who not only ought to be, but in their hearts are, ashamed of themselves. It would be discourteous to do more than hint the antipodal opposition of this pleasant dream of theirs to facts.

The clerics and their lay allies commonly tell us that, if we refuse to admit that there is good ground for expressing definite convictions about certain topics, the bonds of human society will dissolve and mankind lapse into savagery. There are several answers to this assertion. One is, that the bonds of human society were formed without the aid of their theology, and in the opinion of not a few competent judges have been weakened rather than strengthened by a good deal of it. Greek science, Greek art, the ethics of old Israel, the social organization of old Rome, contrived to come into being without the help of any one who believed in a single distinctive article of the simplest of the Christian creeds. The science, the art, the jurisprudence, the chief political and social theories of the modern world have grown out of those of Greece and Rome—not by favor of, but in the teeth of, the fundamental teachings of early Christianity, to

* Dr. Newman, "Essay on Development," p. 357.

which science, art, and any serious occupation with the things of this world were alike despicable.

Again, all that is best in the ethics of the modern world, in so far as it has not grown out of Greek thought or barbarian manhood, is the direct development of the ethics of old Israel. There is no code of legislation, ancient or modern, at once so just and so merciful, so tender to the weak and poor, as the Jewish law; and if the Gospels are to be trusted, Jesus of Nazareth himself declared that he taught nothing but that which lay implicitly, or explicitly, in the religious and ethical system of his people.

> And the scribe said unto him, Of a truth, Teacher, thou hast well said that he is one; and there is none other but he: and to love him with all the heart, and with all the understanding, and with all the strength, and to love his neighbor as himself, is much more than all whole burnt-offerings and sacrifices. (Mark xii, 32, 33.)

Here is the briefest of summaries of the teaching of the prophets of Israel of the eighth century; does the Teacher, whose doctrine is thus set forth in his presence, repudiate the exposition? Nay, we are told, on the contrary, that Jesus saw that he "answered discreetly," and replied, "Thou art not far from the kingdom of God."

So that I think that even if the creeds, from the so-called "Apostles'" to the so-called "Athanasian," were swept into oblivion; and even if the human race should arrive at the conclusion that whether a bishop washes a cup or leaves it unwashed, is not a matter of the least consequence, it will get on very well. The causes which have led to the development of morality in mankind, which have guided or impelled us all the way from the savage to the civilized state, will not cease to operate because a number of ecclesiastical hypotheses turn out to be baseless. And, even if the absurd notion that morality is more the child of speculation than of practical necessity and inherited instinct, had any foundation; if all the world is going to thieve, murder, and otherwise misconduct itself as soon as it discovers that certain portions of ancient history are mythical, what is the relevance of such arguments to any one who holds by the agnostic principle?

Surely the attempt to cast out Beelzebub by the aid of Beelzebub is a hopeful procedure as compared to that of preserving morality by the aid of immorality. For I suppose it is admitted that an agnostic may be perfectly sincere, may be competent, and may have studied the question at issue with as much care as his clerical opponents. But, if the agnostic really believes what he says, the "dreadful consequence" argufier (consistently I admit with his own principles) virtually asks him to abstain from tell-

ing the truth, or to say what he believes to be untrue, because of the supposed injurious consequences to morality. "Beloved brethren, that we may be spotlessly moral, before all things let us lie," is the sum total of many an exhortation addressed to the "infidel." Now, as I have already pointed out, we can not oblige our exhorters. We leave the practical application of the convenient doctrines of "reserve" and "non-natural interpretation" to those who invented them.

I trust that I have now made amends for any ambiguity, or want of fullness, in my previous exposition of that which I hold to be the essence of the agnostic doctrine. Henceforward, I might hope to hear no more of the assertion that we are necessarily materialists, idealists, atheists, theists, or any other *ists*, if experience had led me to think that the proved falsity of a statement was any guarantee against its repetition. And those who appreciate the nature of our position will see, at once, that when ecclesiasticism declares that we ought to believe this, that, and the other, and are very wicked if we don't, it is impossible for us to give any answer but this: We have not the slightest objection to believe anything you like, if you will give us good grounds for belief; but, if you can not, we must respectfully refuse, even if that refusal should wreck morality and insure our own damnation several times over. We are quite content to leave that to the decision of the future. The course of the past has impressed us with the firm conviction that no good ever comes of falsehood, and we feel warranted in refusing even to experiment in that direction.

In the course of the present discussion it has been asserted that the "Sermon on the Mount" and the "Lord's Prayer" furnish a summary and condensed view of the essentials of the teaching of Jesus of Nazareth, set forth by himself. Now this supposed *Summa* of Nazarene theology distinctly affirms the existence of a spiritual world, of a heaven, and of a hell of fire; it teaches the fatherhood of God and the malignity of the devil; it declares the superintending providence of the former and our need of deliverance from the machinations of the latter; it affirms the fact of demoniac possession and the power of casting out devils by the faithful. And, from these premises, the conclusion is drawn that those agnostics who deny that there is any evidence of such a character as to justify certainty, respecting the existence and the nature of the spiritual world, contradict the express declarations of Jesus. I have replied to this argumentation by showing that there is strong reason to doubt the historical accuracy of the attribution to Jesus of either the "Sermon on the Mount" or the "Lord's Prayer"; and, therefore, that the conclusion in question is not warranted, at any rate on the grounds set forth.

But, whether the Gospels contain trustworthy statements about this and other alleged historical facts or not, it is quite certain that from them, taken together with the other books of the New Testament, we may collect a pretty complete exposition of that theory of the spiritual world which was held by both Nazarenes and Christians; and which was undoubtedly supposed by them to be fully sanctioned by Jesus, though it is just as clear that they did not imagine it contained any revelation by him of something heretofore unknown. If the pneumatological doctrine which pervades the whole New Testament is nowhere systematically stated, it is everywhere assumed. The writers of the Gospels and of the Acts take it for granted, as a matter of common knowledge; and it is easy to gather from these sources a series of propositions, which only need arrangement to form a complete system.

In this system, man is considered to be a duality formed of a spiritual element, the soul; and a corporeal* element, the body And this duality is repeated in the universe, which consists of a corporeal world embraced and interpenetrated by a spiritual world. The former consists of the earth, as its principal and central constituent, with the subsidiary sun, planets, and stars. Above the earth is the air, and below it the watery abyss. Whether the heaven, which is conceived to be above the air, and the hell in, or below, the subterranean deeps, are to be taken as corporeal or incorporeal is not clear.

However this may be, the heaven and the air, the earth and the abyss, are peopled by innumerable beings analogous in nature to the spiritual element in man, and these spirits are of two kinds, good and bad. The chief of the good spirits, infinitely superior to all the others, and their Creator as well as the Creator of the corporeal world and of the bad spirits, is God. His residence is heaven, where he is surrounded by the ordered hosts of good spirits; his angels, or messengers, and the executors of his will throughout the universe.

On the other hand, the chief of the bad spirits is Satan—*the* devil *par excellence.* He and his company of demons are free to roam through all parts of the universe, except heaven. These bad spirits are far superior to man in power and subtlety, and their whole energies are devoted to bringing physical and moral evils upon him, and to thwarting, so far as their power goes, the benevolent intentions of the Supreme Being. In fact, the souls and bodies of men form both the theatre and the prize of an incessant warfare between the good and the evil spirits—the powers of light and the powers of darkness. By leading Eve astray, Satan brought sin and death upon mankind. As the gods of the hea-

* It is by no means to be assumed that "spiritual" and "corporeal" are exact equivalents of "immaterial" and "material" in the minds of ancient speculators on these topics.

then, the demons are the founders and maintainers of idolatry; as the "powers of the air," they afflict mankind with pestilence and famine; as "unclean spirits," they cause disease of mind and body.

The significance of the appearance of Jesus, as the Messiah or Christ, is the reversal of the satanic work, by putting an end to both sin and death. He announces that the kingdom of God is at hand, when the "prince of this world" shall be finally "cast out" (John xii, 31) from the cosmos, as Jesus, during his earthly career, cast him out from individuals. Then will Satan and all his deviltry, along with the wicked whom they have seduced to their destruction, be hurled into the abyss of unquenchable fire—there to endure continual torture, without a hope of winning pardon from the merciful God, their Father; or of moving the glorified Messiah to one more act of pitiful intercession; or even of interrupting, by a momentary sympathy with their wretchedness, the harmonious psalmody of their brother angels and men, eternally lapped in bliss unspeakable.

The straitest Protestant, who refuses to admit the existence of any source of divine truth, except the Bible, will not deny that every point of the pneumatological theory here set forth has ample scriptural warranty: the Gospels, the Acts, the Epistles, and the Apocalypse assert the existence of the devil and his demons and hell, as plainly as they do that of God and his angels and heaven. It is plain that the Messianic and the satanic conceptions of the writers of these books are the obverse and the reverse of the same intellectual coinage. If we turn from Scripture to the traditions of the fathers and the confessions of the churches, it will appear that in this one particular, at any rate, time has brought about no important deviation from primitive belief. From Justin onward, it may often be a fair question whether God, or the devil, occupies a larger share of the attention of the fathers. It is the devil who instigates the Roman authorities to persecute; the gods and goddesses of paganism are devils, and idolatry itself is an invention of Satan; if a saint falls away from grace, it is by the seduction of the demon; if a heresy arises, the devil has suggested it; and some of the fathers* go so far as to challenge the pagans to a sort of exorcising match, by way of testing the truth of Christianity. Mediæval Christianity is at one with patristic, on this head. The masses, the clergy, the theologians, and the philosophers alike, live and move and have their being in a world full of demons, in which sorcery and possession are

* Tertullian ("Apolog. adv. Gentes," cap. xxiii) thus challenges the Roman authorities: let them bring a possessed person into the presence of a Christian before their tribunal; and, if the demon does not confess himself to be such, on the order of the Christian, let the Christian be executed out of hand.

every-day occurrences. Nor did the Reformation make any difference. Whatever else Luther assailed, he left the traditional demonology untouched; nor could any one have entertained a more hearty and uncompromising belief in the devil, than he and, at a later period, the Calvinistic fanatics of New England did. Finally, in these last years of the nineteenth century, the demonological hypotheses of the first century are, explicitly or implicitly, held and occasionally acted upon, by the immense majority of Christians of all confessions.

Only here and there has the progress of scientific thought, outside the ecclesiastical world, so far affected Christians that they and their teachers fight shy of the demonology of their creed. They are fain to conceal their real disbelief in one half of Christian doctrine by judicious silence about it; or by flight to those refuges for the logically destitute, accommodation or allegory. But the faithful who fly to allegory in order to escape absurdity resemble nothing so much as the sheep in the fable who—to save their lives—jumped into the pit. The allegory pit is too commodious, is ready to swallow up so much more than one wants to put into it. If the story of the temptation is an allegory; if the early recognition of Jesus as the Son of God by the demons is an allegory; if the plain declaration of the writer of the first Epistle of John (iii, 8), "To this end was the Son of God manifested that he might destroy the works of the devil," is allegorical, then the Pauline verson of the fall may be allegorical, and still more the words of consecration of the Eucharist, or the promise of the second coming; in fact, there is not a dogma of ecclesiastical Christianity the scriptural basis of which may not be whittled away by a similar process.

As to accommodation, let any honest man who can read the New Testament ask himself whether Jesus and his immediate friends and disciples can be dishonored more grossly than by the supposition that they said and did that which is attributed to them; while, in reality, they disbelieved in Satan and his demons, in possession and in exorcism?*

An eminent theologian has justly observed that we have no right to look at the propositions of the Christian faith with one eye open and the other shut. ("Tract 85," p. 29.) It really is not permissible to see with one eye, that Jesus is affirmed to declare the personality and the fatherhood of God, his loving providence, and his accessibility to prayer, and to shut the other to the no less definite teaching ascribed to Jesus in regard to the personality and the misanthropy of the devil, his malignant watchfulness,

* See the expression of orthodox opinion upon the "accommodation" subterfuge, already cited, "Nineteenth Century," February, 1889, p. 173; "Popular Science Monthly," April, 1889, p. 754.

and his subjection to exorcistic formulæ and rites. Jesus is made to say that the devil "was a murderer from the beginning" (John viii, 44) by the same authority as that upon which we depend for his asserted declaration that "God is a spirit" (John iv, 24).

To those who admit the authority of the famous Vincentian dictum that the doctrine which has been held "always, everywhere, and by all" is to be received as authoritative, the demonology must possess a higher sanction than any other Christian dogma, except, perhaps, those of the resurrection and of the Messiahship of Jesus; for it would be difficult to name any other points of doctrine on which the Nazarene does not differ from the Christian, and the different historical stages and contemporary subdivisions of Christianity from one another. And, if the demonology is accepted, there can be no reason for rejecting all those miracles in which demons play a part. The Gadarene story fits into the general scheme of Christianity, and the evidence for "Legion" and their doings is just as good as any other in the New Testament for the doctrine which the story illustrates.

It was with the purpose of bringing this great fact into prominence, of getting people to open both their eyes when they look at ecclesiasticism, that I devoted so much space to that miraculous story which happens to be one of the best types of its class. And I could not wish for a better justification of the course I have adopted than the fact that my heroically consistent adversary has declared his implicit belief in the Gadarene story and (by necessary consequence) in the Christian demonology as a whole. It must be obvious, by this time, that, if the account of the spiritual world given in the New Testament, professedly on the authority of Jesus, is true, then the demonological half of that account must be just as true as the other half. And, therefore, those who question the demonology, or try to explain it away, deny the truth of what Jesus said, and are, in ecclesiastical terminology, "infidels" just as much as those who deny the spirituality of God. This is as plain as anything can well be, and the dilemma for my opponent was either to assert that the Gadarene pig-bedevilment actually occurred, or to write himself down an "infidel." As was to be expected, he chose the former alternative; and I may express my great satisfaction at finding that there is one spot of common ground on which both he and I stand. So far as I can judge, we are agreed to state one of the broad issues between the consequences of agnostic principles (as I draw them), and the consequences of ecclesiastical dogmatism (as he accepts it), as follows:

Ecclesiasticism says: The demonology of the Gospels is an essential part of that account of that spiritual world, the truth of which it declares to be certified by Jesus.

Agnosticism (*me judice*) says: There is no good evidence of the existence of a demonic spiritual world, and much reason for doubting it.

Hereupon the ecclesiastic may observe: Your doubt means that you disbelieve Jesus; therefore you are an "infidel" instead of an "agnostic." To which the agnostic may reply: No; for two reasons: first, because your evidence that Jesus said what you say he said is worth very little; and, secondly, because a man may be an agnostic in the sense of admitting he has no positive knowledge; and yet consider that he has more or less probable ground for accepting any given hypothesis about the spiritual world. Just as a man may frankly declare that he has no means of knowing whether the planets generally are inhabited or not, and yet may think one of the two possible hypotheses more likely than the other, so he may admit that he has no means of knowing anything about the spiritual world, and yet may think one or other of the current views on the subject, to some extent, probable.

The second answer is so obviously valid that it needs no discussion. I draw attention to it simply in justice to those agnostics, who may attach greater value than I do to any sort of pneumatological speculations, and not because I wish to escape the responsibility of declaring that, whether Jesus sanctioned the demonological part of Christianity or not, I unhesitatingly reject it. The first answer, on the other hand, opens up the whole question of the claim of the biblical and other sources, from which hypotheses concerning the spiritual world are derived, to be regarded as unimpeachable historical evidence as to matters of fact.

Now, in respect of the trustworthiness of the Gospel narratives, I was anxious to get rid of the common assumption that the determination of the authorship and of the dates of these works is a matter of fundamental importance. That assumption is based upon the notion that what contemporary witnesses say must be true, or, at least, has always a *prima facie* claim to be so regarded; so that if the writers of any of the Gospels were contemporaries of the events (and still more if they were in the position of eye-witnesses) the miracles they narrate must be historically true, and, consequently, the demonology which they involve must be accepted. But the story of the "Translation of the Blessed Martyrs Marcellinus and Petrus," and the other considerations (to which endless additions might have been made from the fathers and the mediæval writers) set forth in this review for March last, yield, in my judgment, satisfactory proof that, where the miraculous is concerned, neither considerable intellectual ability, nor undoubted honesty, nor knowledge of the world, nor proved faithfulness as civil historians, nor profound piety, on the part of eye-

witnesses and contemporaries, affords any guarantee of the objective truth of their statements, when we know that a firm belief in the miraculous was ingrained in their minds, and was the presupposition of their observations and reasonings.

Therefore, although it be, as I believe, demonstrable that we have no real knowledge of the authorship, or of the date of composition of the Gospels, as they have come down to us, and that nothing better than more or less probable guesses can be arrived at on that subject, I have not cared to expend any space on the question. It will be admitted, I suppose, that the authors of the works attributed to Matthew, Mark, Luke, and John, whoever they may be, are personages whose capacity and judgment in the narration of ordinary events are not quite so well certified as those of Eginhard; and we have seen what the value of Eginhard's evidence is when the miraculous is in question.

I have been careful to explain that the arguments which I have used in the course of this discussion are not new; that they are historical and have nothing to do with what is commonly called science; and that they are all, to the best of my belief, to be found in the works of theologians of repute.

The position which I have taken up, that the evidence in favor of such miracles as those recorded by Eginhard, and consequently of mediæval demonology, is quite as good as that in favor of such miracles as the Gadarene, and consequently of Nazarene demonology, is none of my discovery. Its strength was, wittingly or unwittingly, suggested, a century and a half ago, by a theological scholar of eminence; and it has been, if not exactly occupied, yet so fortified with bastions and redoubts by a living ecclesiastical Vauban, that, in my judgment, it has been rendered impregnable. In the early part of the last century, the ecclesiastical mind in this country was much exercised by the question, not exactly of miracles, the occurrence of which in biblical times was axiomatic, but by the problem, When did miracles cease? Anglican divines were quite sure that no miracles had happened in their day, nor for some time past; they were equally sure that they happened sixteen or seventeen centuries earlier. And it was a vital question for them to determine at what point of time, between this *terminus a quo* and that *terminus ad quem*, miracles came to an end.

The Anglicans and the Romanists agreed in the assumption that the possession of the gift of miracle-working was *prima facie* evidence of the soundness of the faith of the miracle-workers. The supposition that miraculous powers might be wielded by heretics (though it might be supported by high authority) led to consequences too frightful to be entertained by people who were

busied in building their dogmatic house on the sands of early church history. If, as the Romanists maintained, an unbroken series of genuine miracles adorned the records of their Church, throughout the whole of its existence, no Anglican could lightly venture to accuse them of doctrinal corruption. Hence, the Anglicans, who indulged in such accusations, were bound to prove the modern, the mediæval Roman, and the later patristic miracles false; and to shut off the wonder-working power from the Church at the exact point of time when Anglican doctrine ceased and Roman doctrine began. With a little adjustment—a squeeze here and a pull there—the Christianity of the first three or four centuries might be made to fit, or seem to fit, pretty well into the Anglican scheme. So the miracles, from Justin say to Jerome, might be recognized; while, in later times, the Church having become "corrupt"—that is to say, having pursued one and the same line of development further than was pleasing to Anglicans—its alleged miracles must needs be shams and impostures.

Under these circumstances, it may be imagined that the establishment of a scientific frontier, between the earlier realm of supposed fact and the later of asserted delusion, had its difficulties; and torrents of theological special pleading about the subject flowed from clerical pens; until that learned and acute Anglican divine, Conyers Middleton, in his "Free Inquiry," tore the sophistical web they had laboriously woven to pieces, and demonstrated that the miracles of the patristic age, early and late, must stand or fall together, inasmuch as the evidence for the later is just as good as the evidence for the earlier wonders. If the one set are certified by contemporaneous witnesses of high repute, so are the other; and, in point of probability, there is not a pin to choose between the two. That is the solid and irrefragable result of Middleton's contribution to the subject. But the Free Inquirer's freedom had its limits; and he draws a sharp line of demarkation between the patristic and the New Testament miracles—on the professed ground that the accounts of the latter, being inspired, are out of the reach of criticism.

A century later, the question was taken up by another divine, Middleton's equal in learning and acuteness, and far his superior in subtlety and dialectic skill; who, though an Anglican, scorned the name of Protestant; and, while yet a Churchman, made it his business to parade, with infinite skill, the utter hollowness of the arguments of those of his brother Churchmen who dreamed that they could be both Anglicans and Protestants. The argument of the "Essay on the Miracles recorded in the Ecclesiastical History of the Early Ages,"* by the present Roman cardinal, but then

* I quote the first edition (1843). A second edition appeared in 1870. Tract 85 of the "Tracts for the Times" should be read with this "Essay." If I were called upon to

Anglican doctor, John Henry Newman, is compendiously stated by himself in the following passage:

> If the miracles of church history can not be defended by the arguments of Leslie, Lyttleton, Paley, or Douglas, how many of the Scripture miracles satisfy their conditions? (p. cvii).

And, although the answer is not given in so many words, little doubt is left on the mind of the reader that in the mind of the writer it is: None. In fact, this conclusion is one which can not be resisted, if the argument in favor of the Scripture miracles is based upon that which laymen, whether lawyers, or men of science, or historians, or ordinary men of affairs, call evidence. But there is something really impressive in the magnificent contempt with which, at times, Dr. Newman sweeps aside alike those who offer and those who demand such evidence.

> Some infidel authors advise us to accept no miracles which would not have a verdict in their favor in a court of justice; that is, they employ against Scripture a weapon which Protestants would confine to attacks upon the Church, as if moral and religious questions required legal proofs, and evidence were the test of truth* (p. cvii).

"As if evidence were the test of truth"!—although the truth in question is the occurrence or non-occurrence of certain phenomena at a certain time and in a certain place. This sudden revelation of the great gulf fixed between the ecclesiastical and the scientific mind is enough to take away the breath of any one unfamiliar with the clerical organon. As if, one may retort, the assumption that miracles may, or have, served a moral or a religious end in any way alters the fact that they profess to be historical events, things that actually happened; and, as such, must needs be exactly those subjects about which evidence is appropriate and legal proofs (which are such merely because they afford adequate evidence) may be justly demanded. The Gadarene miracle either happened, or it did not. Whether the Gadarene "question" is moral or religious, or not, has nothing to do with the fact that it is a purely historical question whether the demons said what they are declared to have said, and the devil-possessed pigs did or did not rush over the cliffs of the Lake of Gennesareth on a certain day of a certain year, after A. D. 26 and before A. D. 36; for, vague and uncertain as New Testament chronology is, I suppose it may be assumed that the event in question, if it happened at all, took place during the procuratorship of Pilate.

compile a primer of "infidelity," I think I should save myself trouble by making a selection from these works, and from the "Essay on Development" by the same author.

* Yet, when it suits his purpose, as in the introduction to the "Essay on Development," Dr. Newman can demand strict evidence in religious questions as sharply as any "infidel author"; and he can even profess to yield to its force ("Essays on Miracles," 1870, note, p. 391).

If that is not a matter about which evidence ought to be required, and not only legal but strict scientific proof demanded by sane men who are asked to believe the story—what is? Is a reasonable being to be seriously asked to credit statements which, to put the case gently, are not exactly probable, and on the acceptance or rejection of which his whole view of life may depend, without asking for as much "legal" proof as would send an alleged pickpocket to jail, or as would suffice to prove the validity of a disputed will?

"Infidel authors" (if, as I am assured, I may answer for them) will decline to waste time on mere darkenings of counsel of this sort; but to those Anglicans who accept his premises, Dr. Newman is a truly formidable antagonist. What, indeed, are they to reply when he puts the very pertinent question:

"whether persons who, not merely question, but prejudge the ecclesiastical miracles on the ground of their want of resemblance, whatever that be, to those contained in Scripture—as if the Almighty could not do in the Christian church what he had not already done at the time of its foundation, or under the Mosaic covenant—whether such reasoners are not siding with the skeptic,"

and

"whether it is not a happy inconsistency by which they continue to believe the Scriptures while they reject the Church"* (p. liii).

Again, I invite Anglican orthodoxy to consider this passage:

the narrative of the combats of St. Antony with evil spirits is a development rather than a contradiction of revelation, viz., of such texts as speak of Satan being cast out by prayer and fasting. To be shocked, then, at the miracles of ecclesiastical history, or to ridicule them for their strangeness, is no part of a scriptural philosophy (p. liii–liv).

Further on, Dr. Newman declares that it has been admitted

that a distinct line can be drawn in point of character and circumstance between the miracles of Scripture and of church history; but this is by no means the case (p. lv). . . . Specimens are not wanting in the history of the Church of miracles as awful in their character and as momentous in their effects as those which are recorded in Scripture. The fire interrupting the rebuilding of the Jewish temple, and the death of Arius, are instances in ecclesiastical history of such solemn events. On the other hand, difficult instances in the Scripture history are such as these: the serpent in Eden, the ark, Jacob's vision for the multiplication of his cattle, the speaking of Balaam's ass, the axe swimming at Elisha's word, the miracle on the swine, and various instances of prayers or prophecies, in which, as in that of Noah's blessing and curse, words which seem the result of private feeling are expressly or virtually ascribed to a divine suggestion (p. lvi).

Who is to gainsay our ecclesiastical authority here? "Infidel authors" might be accused of a wish to ridicule the Scripture

* Compare Tract 85, p. 110: "I am persuaded that were men but consistent who oppose the Church doctrines as being unscriptural, they would vindicate the Jews for rejecting the gospel."

miracles by putting them on a level with the remarkable story about the fire which stopped the rebuilding of the temple, or that about the death of Arius—but Dr. Newman is above suspicion. The pity is that his list of what he delicately terms "difficult" instances is so short. Why omit the manufacture of Eve out of Adam's rib, on the strict historical accuracy of which the chief argument of the defenders of an iniquitous portion of our present marriage law depends? Why leave out the account of the "Bene Elohim" and their gallantries, on which a large part of the worst practices of the mediæval inquisitors into witchcraft was based? Why forget the angel who wrestled with Jacob, and, as the account suggests, somewhat overstepped the bounds of fair play at the end of the struggle? Surely we must agree with Dr. Newman that, if all these camels have gone down, it savors of affectation to strain at such gnats as the sudden ailment of Arius in the midst of his deadly, if prayerful,* enemies; and the fiery explosion which stopped the Julian building operations. Though the *words* of the "Conclusion" of the "Essay on Miracles" may, perhaps, be quoted against me, I may express my satisfaction at finding myself in substantial accordance with a theologian above all suspicion of heterodoxy. With all my heart, I can declare my belief that there is just as good reason for believing in the miraculous slaying of the man who fell short of the Athanasian power of affirming contradictories, with respect to the nature of the Godhead, as there is for believing in the stories of the serpent and the ark told in Genesis, the speaking of Balaam's ass in Numbers, or the floating of the axe, at Elisha's order, in the second book of Kings.

It is one of the peculiarities of a really sound argument that it is susceptible of the fullest development; and that it sometimes leads to conclusions unexpected by those who employ it. To my mind it is impossible to refuse to follow Dr. Newman when he extends his reasoning from the miracles of the patristic and mediæval ages backward in time as far as miracles are recorded. But, if the rules of logic are valid, I feel compelled to extend the argument forward to the alleged Roman miracles of the present day, which Dr. Newman might not have admitted.

* According to Dr. Newman, "This prayer [that of Bishop Alexander, who begged God to 'take Arius away'] is said to have been offered about 3 P.M. on the Saturday; that same evening Arius was in the great square of Constantine, when he was suddenly seized with indisposition" (p. clxx). The "infidel" Gibbon seems to have dared to suggest that "an option between poison and miracle" is presented by this case; and it must be admitted, that if the bishop had been within reach of a modern police magistrate, things might have gone hardly with him. Modern "infidels," possessed of a slight knowledge of chemistry, are not unlikely, with no less audacity, to suggest an "option between fire-damp and miracle" in seeking for the cause of the fiery outburst at Jerusalem.

but which Cardinal Newman may hardly reject. Beyond question, there is as good, or perhaps better, evidence for the miracles worked by our Lady of Lourdes, as there is for the floating of Elisha's axe or the speaking of Balaam's ass. But we must go still further; there is a modern system of thaumaturgy and demonology which is just as well certified as the ancient.* Veracious, excellent, sometimes learned and acute persons, even philosophers of no mean pretension, testify to the "levitation" of bodies much heavier than Elisha's axe; to the existence of "spirits" who, to the mere tactile sense, have been indistinguishable from flesh and blood, and occasionally have wrestled with all the vigor of Jacob's opponent; yet, further, to the speech, in the language of raps, of spiritual beings, whose discourses, in point of coherence and value, are far inferior to that of Balaam's humble but sagacious steed. I have not the smallest doubt that, if these were persecuting times, there is many a worthy "spiritualist" who would cheerfully go to the stake in support of his pneumatological faith, and furnish evidence, after Paley's own heart, in proof of the truth of his doctrines. Not a few modern divines, doubtless struck by the impossibility of refusing the spiritualist evidence, if the ecclesiastical evidence is accepted, and deprived of any *a priori* objection by their implicit belief in Christian demonology, show themselves ready to take poor Sludge seriously, and to believe that he is possessed by other devils than those of need, greed, and vainglory.

Under these circumstances, it was to be expected, though it is none the less interesting to note the fact, that the arguments of the latest school of "spiritualists" present a wonderful family likeness to those which adorn the subtle disquisitions of the advocate of ecclesiastical miracles of forty years ago. It is unfortunate for the "spiritualists" that, over and over again, celebrated and trusted media, who really, in some respects, call to mind the

* A writer in a spiritualist journal takes me roundly to task for venturing to doubt the historical and literal truth of the Gadarene story. The following passage in his letter is worth quotation: "Now to the materialistic and scientific mind, to the uninitiated in spiritual verities, certainly this story of the Gadarene or Gergesene swine presents insurmountable difficulties; it seems grotesque and nonsensical. To the experienced, trained, and cultivated Spiritualist this miracle is, as I am prepared to show, one of the most instructive, the most profoundly useful, and the most beneficent which Jesus ever wrought in the whole course of his pilgrimage of redemption on earth." Just so. And the first page of this same journal presents the following advertisement, among others of the same kidney:

"To Wealthy Spiritualists.—A lady medium of tried power wishes to meet with an elderly gentleman who would be willing to give her a comfortable home and maintenance in exchange for her spiritualistic services, as her guides consider her health is too delicate for public sittings: London preferred.—Address 'Mary,' office of 'Light.'"

Are we going back to the days of the Judges, when wealthy Micah set up his private ephod, teraphim, and Levite?

Montanist* and gnostic seers of the second century, are either proved in courts of law to be fraudulent impostors; or, in sheer weariness, as it would seem, of the honest dupes who swear by them, spontaneously confess their long-continued iniquities, as the Fox women did the other day in New York.† But whenever a catastrophe of this kind takes place, the believers are nowise dismayed by it. They freely admit that not only the media, but the spirits whom they summon, are sadly apt to lose sight of the elementary principles of right and wrong; and they triumphantly ask: How does the occurrence of occasional impostures disprove the genuine manifestations (that is to say, all those which have not yet been proved to be impostures or delusions)? And, in this, they unconsciously plagiarize from the churchman, who just as freely admits that many ecclesiastical miracles may have been forged; and asks, with the same calm contempt, not only of legal proofs, but of common-sense probability, Why does it follow that none are to be supposed genuine? I must say, however, that the spiritualists, so far as I know, do not venture to outrage right reason so boldly as the ecclesiastics. They do not sneer at "evidence"; nor repudiate the requirement of legal proofs. In fact, there can be no doubt that the spiritualists produce better evidence for their manifestations than can be shown either for the miraculous death of Arius, or for the invention of the cross.‡

From the "levitation" of the axe at one end of a period of near three thousand years to the "levitation" of Sludge & Co. at the other end, there is a complete continuity of the miraculous with every gradation from the childish to the stupendous, from the gratification of a caprice to the illustration of sublime truth. There is no drawing a line in the series that might be set out of plausibly attested cases of spiritual intervention. If one is true, all may be true; if one is false, all may be false.

This is, to my mind, the inevitable result of that method of

* Consider Tertullian's "sister" ("hodie apud nos"), who conversed with angels, saw and heard mysteries, knew men's thoughts, and prescribed medicine for their bodies ("De Anima," cap. 9). Tertullian tells us that this woman saw the soul as corporeal, and described its color and shape. The "infidel" will probably be unable to refrain from insulting the memory of the ecstatic saint by the remark that Tertullian's known views about the corporeality of the soul may have had something to do with the remarkable perceptive powers of the Montanist medium, in whose revelations of the spiritual world he took such profound interest.

† See the New York "World" for Sunday, October 21, 1888; and the "Report of the Seybert Commission," Philadelphia, 1887.

‡ Dr. Newman's observation that the miraculous multiplication of the pieces of the true cross (with which "the whole world is filled," according to Cyril of Jerusalem; and of which some say there are enough extant to build a man-of-war) is no more wonderful than that of the loaves and fishes, is one that I do not see my way to contradict. See "Essay on Miracles," second edition, p. 163.

reasoning which is applied to the confutation of Protestantism, with so much success, by one of the acutest and subtlest disputants who have ever championed ecclesiasticism—and one can not put his claims to acuteness and subtlety higher.

> . . . the Christianity of history is not Protestantism. If ever there were a safe truth it is this. . . . "To be deep in history is to cease to be a Protestant." *

I have not a shadow of doubt that these anti-Protestant epigrams are profoundly true. But I have as little that, in the same sense, the "Christianity of history is not" Romanism; and that to be deeper in history is to cease to be a Romanist. The reasons which compel my doubts about the compatibility of the Roman doctrine, or any other form of Catholicism, with history, arise out of exactly the same line of argument as that adopted by Dr. Newman in the famous essay which I have just cited. If, with one hand, Dr. Newman has destroyed Protestantism, he has annihilated Romanism with the other; and the total result of his ambidextral efforts is to shake Christianity to its foundations. Nor was any one better aware that this must be the inevitable result of his arguments—if the world should refuse to accept Roman doctrines and Roman miracles—than the writer of Tract 85.

Dr. Newman made his choice and passed over to the Roman Church half a century ago. Some of those who were essentially in harmony with his views preceded, and many followed him. But many remained; and, as the quondam Puseyite and present Ritualistic party, they are continuing that work of sapping and mining the Protestantism of the Anglican Church which he and his friends so ably commenced. At the present time, they have no little claim to be considered victorious all along the line. I am old enough to recollect the small beginnings of the Tractarian party; and I am amazed when I consider the present position of their heirs. Their little leaven has leavened, if not the whole, yet a very large, lump of the Anglican Church; which is now pretty much of a preparatory school for Papistry. So that it really behooves Englishmen (who, as I have been informed by high authority, are all, legally, members of the state Church, if they profess to belong to no other sect) to wake up to what that powerful organization is about, and whither it is tending. On this point, the writings of Dr. Newman, while he still remained within the Anglican fold, are a vast store of the best and the most authoritative information. His doctrines on ecclesiastical miracles and on development are the corner-stones of the Tractarian fabric. He believed that his arguments led either Romeward, or to what ecclesiastics call "infidelity," and I call agnosticism. I believe that

* "An Essay on the Development of Christian Doctrine," by J. H. Newman, D. D., pp. 7 and 8. (1878.)

he was quite right in this conviction; but while he chooses the one alternative, I choose the other; as he rejects Protestantism on the ground of its incompatibility with history, so, *a fortiori*, I conceive that Romanism ought to be rejected, and that an impartial consideration of the evidence must refuse the authority of Jesus to anything more than the Nazarenism of James and Peter and John. And let it not be supposed that this is a mere "infidel" perversion of the facts. No one has more openly and clearly admitted the possibility that they may be fairly interpreted in this way than Dr. Newman. If, he says, there are texts which seem to show that Jesus contemplated the evangelization of the heathen:

> . . . Did not the apostles hear our Lord? and what was *their* impression from what they heard? Is it not certain that the apostles did not gather this truth from his teaching? ("Tract 85," p. 63.)
>
> He said, "Preach the gospel to every creature." These words *need* have only meant "Bring all men to Christianity through Judaism." Make them Jews, that they may enjoy Christ's privileges which are lodged in Judaism; teach them those rites and ceremonies, circumcision and the like, which hitherto have been dead ordinances, and now are living; and so the apostles seem to have understood them (Ibid., p. 65).

So far as Nazarenism differentiated itself from contemporary orthodox Judaism, it seems to have tended toward a revival of the ethical and religious spirit of the prophetic age, accompanied by the belief in Jesus as the Messiah, and by various accretions which had grown round Judaism subsequently to the exile. To these belong the doctrines of the resurrection, of the last judgment, of heaven and hell; of the hierarchy of good angels; of Satan and the hierarchy of evil spirits. And there is very strong ground for believing that all these doctrines, at least in the shapes in which they were held by the post-exilic Jews, were derived from Persian and Babylonian * sources, and are essentially of heathen origin.

How far Jesus positively sanctioned all these indrainings of circumjacent paganism into Judaism; how far any one has a right to say that the refusal to accept one or other of these doctrines as ascertained verities comes to the same thing as contradicting Jesus, it appears to me not easy to say. But it is hardly less difficult to conceive that he could have distinctly negatived any of them; and, more especially, that demonology which has been accepted by the Christian churches in every age and under all their mutual antagonisms. But, I repeat my conviction that,

* Dr. Newman faces this question with his customary ability. "Now, I own, I am not at all solicitous to deny that this doctrine of an apostate angel and his hosts was gained from Babylon: it might still be divine nevertheless. God who made the prophet's ass speak, and thereby instructed the prophet, might instruct his church by means of heathen Babylon" ("Tract 85," p. 83). There seems to be no end to the apologetic burden that Balaam's ass can carry.

whether Jesus sanctioned the demonology of his time and nation or not, it is doomed. The future of Christianity as a dogmatic system and apart from the old Israelitish ethics which it has appropriated and developed, lies in the answer which mankind will eventually give to the question whether they are prepared to believe such stories as the Gadarene and the pneumatological hypotheses which go with it, or not. My belief is they will decline to do anything of the sort, whenever and wherever their minds have been disciplined by science. And that discipline must and will at once follow and lead the footsteps of advancing civilization.

The preceding pages were written before I became acquainted with the contents of the May number of this review, wherein I discover many things which are decidedly not to my advantage. It would appear that "evasion" is my chief resource, "incapacity for strict argument" and "rottenness of ratiocination" my main mental characteristics, and that it is "barely credible" that a statement which I profess to make of my own knowledge is true. All which things I notice, merely to illustrate the great truth, forced on me by long experience, that it is only from those who enjoy the blessing of a firm hold of the Christian faith that such manifestations of meekness, patience, and charity are to be expected.

I had imagined that no one who had read my preceding papers could entertain a doubt as to my position in respect of the main issue as it has been stated and restated by my opponent:

> an agnosticism which knows nothing of the relation of man to God must not only refuse belief to our Lord's most undoubted teaching, but must deny the reality of the spiritual convictions in which he lived and died.*

That is said to be "the simple question which is at issue between us," and the three testimonies to that teaching and those convictions selected are the Sermon on the Mount, the Lord's Prayer, and the Story of the Passion.

My answer, reduced to its briefest form, has been: In the first place, the evidence is such that the exact nature of the teachings and the convictions of Jesus is extremely uncertain, so that what ecclesiastics are pleased to call a denial of them may be nothing of the kind. And, in the second place, if Jesus taught the demonological system involved in the Gadarene story—if a belief in that system formed a part of the spiritual convictions in which he lived and died—then I, for my part, unhesitatingly refuse belief in that teaching, and deny the reality of those spiritual convictions. And I go further and add, that exactly in so far as it

* "Popular Science Monthly," July, 1889, p. 328.

can be proved that Jesus sanctioned the essentially pagan demonological theories current among the Jews of his age, exactly in so far, for me, will his authority in any matter touching the spiritual world be weakened.

With respect to the first half of my answer, I have pointed out that the Sermon on the Mount, as given in the first Gospel, is, in the opinion of the best critics, a "mosaic work" of materials derived from different sources, and I do not understand that this statement is challenged. The only other Gospel, the third, which contains something like it, makes, not only the discourse, but the circumstances under which it was delivered, very different. Now, it is one thing to say that there was something real at the bottom of the two discourses—which is quite possible; and another to affirm that we have any right to say what that something was, or to fix upon any particular phrase and declare it to be a genuine utterance. Those who pursue theology as a science, and bring to the study an adequate knowledge of the ways of ancient historians, will find no difficulty in providing illustrations of my meaning. I may supply one which has come within range of my own limited vision.

In Josephus's "History of the Wars of the Jews" (chap. xix) that writer reports a speech which he says Herod made at the opening of a war with the Arabians. It is in the first person, and would naturally be supposed by the reader to be intended for a true version of what Herod said. In the "Antiquities," written some seventeen years later, the same writer gives another report, also in the first person, of Herod's speech on the same occasion. This second oration is twice as long as the first, and though the general tenor of the two speeches is pretty much the same, there is hardly any verbal identity, and a good deal of matter is introduced into the one which is absent from the other. Now Josephus prides himself on his accuracy; people whose fathers might have heard Herod's oration were his contemporaries; and yet his historical sense is so curiously undeveloped, that he can, quite innocently, perpetrate an obvious literary fabrication; for one of the two accounts must be incorrect. Now, if I am asked whether I believe that Herod made some particular statement on this occasion; whether, for example, he uttered the pious aphorism, "Where God is, there is both multitude and courage," which is given in the "Antiquities," but not in the "Wars," I am compelled to say I do not know. One of the two reports must be erroneous, possibly both are: at any rate, I can not tell how much of either is true. And, if some fervent admirer of the Idumean should build up a theory of Herod's piety upon Josephus's evidence that he propounded the aphorism, is it a "mere evasion" to say, in reply, that the evidence that he did utter it is worthless?

It appears again that, adopting the tactics of Conachar when brought face to face with Hal o' the Wynd, I have been trying to get my simple-minded adversary to follow me on a wild-goose chase through the early history of Christianity, in the hope of escaping impending defeat on the main issue. But I may be permitted to point out that there is an alternative hypothesis which equally fits the facts; and that, after all, there may have been method in the madness of my supposed panic.

For suppose it to be established that Gentile Christianity was a totally different thing from the Nazarenism of Jesus and his immediate disciples; suppose it to be demonstrable that, as early as the sixth decade of our era at least, there were violent divergencies of opinion among the followers of Jesus; suppose it to be hardly doubtful that the Gospels and the Acts took their present shapes under the influence of these divergencies; suppose that their authors, and those through whose hands they passed, had notions of historical veracity not more eccentric than those which Josephus occasionally displays—surely the chances that the Gospels are altogether trustworthy records of the teachings of Jesus become very slender. And as the whole of the case of the other side is based on the supposition that they are accurate records (especially of speeches, about which ancient historians are so curiously loose), I really do venture to submit that this part of my argument bears very seriously on the main issue; and, as ratiocination, is sound to the core.

Again, when I passed by the topic of the speeches of Jesus on the cross, it appears that I could have had no other motive than the dictates of my native evasiveness. An ecclesiastical dignitary may have respectable reasons for declining a fencing-match "in sight of Gethsemane and Calvary"; but an ecclesiastical "infidel"! Never. It is obviously impossible that, in the belief that "the greater includes the less," I, having declared the Gospel evidence in general, as to the sayings of Jesus, to be of questionable value, thought it needless to select, for illustration of my views, those particular instances which were likely to be most offensive to persons of another way of thinking. But any supposition that may have been entertained that the old familiar tones of the ecclesiastical war-drum will tempt me to engage in such needless discussion had better be renounced. I shall do nothing of the kind. Let it suffice that I ask my readers to turn to the twenty-third chapter of Luke (revised version), verse thirty-four, and he will find in the margin

> Some ancient authorities omit: And Jesus said, "Father, forgive them, for they know not what they do."

So that, even as late as the fourth century, there were ancient authorities, indeed some of the most ancient and weightiest, who

either did not know of this utterance, so often quoted as characteristic of Jesus, or did not believe it had been uttered.

Many years ago, I received an anonymous letter, which abused me heartily for my want of moral courage in not speaking out. I thought that one of the oddest charges an anonymous letter-writer could bring. But I am not sure that the plentiful sowing of the pages of the article with which I am dealing with accusations of evasion, may not seem odder to those who consider that the main strength of the answers with which I have been favored (in this review and elsewhere) is devoted not to anything in the text of my first paper, but to a note which occurs at page 171.* In this I say:

> Dr. Wace tells us: "It may be asked how far we can rely on the accounts we possess of our Lord's teaching on these subjects." And he seems to think the question appropriately answered by the assertion that it "ought to be regarded as settled by M. Renan's practical surrender of the adverse case."

I requested Dr. Wace to point out the passages of M. Renan's works in which, as he affirms, this "practical surrender" (not merely as to the age and authorship of the Gospels, be it observed, but as to their historical value) is made, and he has been so good as to do so. Now let us consider the parts of Dr. Wace's citation from Renan which are relevant to the issue:

> The author of this Gospel [Luke] is certainly the same as the author of the Acts of the Apostles. Now the author of the Acts seems to be a companion of St. Paul—a character which accords completely with St. Luke. I know that more than one objection may be opposed to this reasoning; but one thing, at all events, is beyond doubt, namely, that the author of the third Gospel and of the Acts is a man who belonged to the second apostolic generation; and this suffices for our purpose.

This is a curious "practical surrender of the adverse case." M. Renan thinks that there is no doubt that the author of the third Gospel is the author of the Acts—a conclusion in which I suppose critics generally agree. He goes on to remark that this person *seems* to be a companion of St. Paul, and adds that Luke was a companion of St. Paul. Then, somewhat needlessly, M. Renan points out that there is more than one objection to jumping, from such data as these, to the conclusion that "Luke" is the writer of the third Gospel. And, finally, M. Renan is content to reduce that which is "beyond doubt" to the fact that the author of the two books is a man of the second apostolic generation. Well, it seems to me that I could agree with all that M. Renan considers "beyond doubt" here, without surrendering anything, either "practically" or theoretically.

Dr. Wace ("Nineteenth Century," March, p. 363)† states that

* "Popular Science Monthly," April, 1889, p. 752. † Ibid., May, 1889, p. 77.

he derives the above citation from the preface of the fifteenth edition of the "Vie de Jésus." My copy of "Les Evangiles," dated 1877, contains a list of Renan's "Œuvres Complètes," at the head of which I find "Vie de Jésus," 15e édition. It is, therefore, a later work than the edition of the "Vie de Jésus" which Dr. Wace quotes. Now "Les Evangiles," as its name implies, treats fully of the questions respecting the date and authorship of the Gospels; and any one who desired, not merely to use M. Renan's expressions for controversial purposes, but to give a fair account of his views in their full significance, would, I think, refer to the later source.

If this course had been taken, Dr. Wace might have found some as decided expressions of opinion in favor of Luke's authorship of the third Gospel as he has discovered in "The Apostles." I mention this circumstance because I desire to point out that, taking even the strongest of Renan's statements, I am still at a loss to see how it justifies that large-sounding phrase "practical surrender of the adverse case." For, on p. 438 of "Les Evangiles," Renan speaks of the way in which Luke's "excellent intentions" have led him to torture history in the Acts; he declares Luke to be the founder of that "eternal fiction which is called ecclesiastical history"; and, on the preceding page, he talks of the "myth" of the Ascension—with its *mise en scène voulue.* At p. 435, I find "Luc, ou l'auteur quel qu'il soit du troisième Evangile" [Luke, or whoever may be the author of the third Gospel]; at p. 280, the accounts of the Passion, the death and the resurrection of Jesus are said to be "peu historiques" [little historical]; at p. 283, "La valeur historique du troisième Evangile est sûrement moindre que celles des deux premiers" [the historical value of the third Gospel is surely less than that of the first two].

A Pyrrhic sort of victory for orthodoxy this "surrender"! And, all the while, the scientific student of theology knows that the more reason there may be to believe that Luke was the companion of Paul, the more doubtful becomes his credibility, if he really wrote the Acts. For, in that case, he could not fail to have been acquainted with Paul's account of the Jerusalem conference, and he must have consciously misrepresented it. We may next turn to the essential part of Dr. Wace's citation ("Nineteenth Century," p. 365)* touching the first Gospel:

> St. Matthew evidently deserves peculiar confidence for the discourses. Here are "the oracles"—the very notes taken while the memory of the instruction of Jesus was living and definite.

M. Renan here expresses the very general opinion as to the existence of a collection of "logia," having a different origin from

* "Popular Science Monthly," May, 1889, p. 79.

the text in which they are imbedded, in Matthew. "Notes" are somewhat suggestive of a short-hand writer, but the suggestion is unintentional, for M. Renan assumes that these "notes" were taken, not at the time of the delivery of the "logia," but subsequently, while (as he assumes) the memory of them was living and definite; so that, in this very citation, M. Renan leaves open the question of the general historical value of the first Gospel, while it is obvious that the accuracy of "notes," taken, not at the time of delivery, but from memory, is a matter about which more than one opinion may be fairly held. Moreover, Renan expressly calls attention to the difficulty of distinguishing the authentic "logia" from later additions of the same kind ("Les Evangiles," p. 201). The fact is, there is no contradiction here to that opinion about the first Gospel which is expressed in "Les Evangiles" (p. 175).

The text of the so-called Matthew supposes the pre-existence of that of Mark, and does little more than complete it. He completes it in two fashions—first, by the insertion of those long discourses which gave their chief value to the Hebrew Gospels; then by adding traditions of a more modern formation, results of successive developments of the legend, and to which the Christian consciousness already attached infinite value.

M. Renan goes on to suggest that besides "Mark," "pseudo-Matthew" used an Aramaic version of the Gospel originally set forth in that dialect. Finally, as to the second Gospel ("Nineteenth Century," p. 365):*

He [Mark] is full of minute observations, proceeding, beyond doubt, from an eye-witness. There is nothing to conflict with the supposition that this eye-witness . . . was the apostle Peter himself, as Papias has it.

Let us consider this citation also by the light of "Les Evangiles":

This work, although composed after the death of Peter, was, in a sense, the work of Peter; it represents the way in which Peter was accustomed to relate the life of Jesus (p. 116).

M. Renan goes on to say that, as an historical document, the Gospel of Mark has a great superiority (p. 116), but Mark has a motive for omitting the discourses; and he attaches a "puerile importance" to miracles (p. 117). The Gospel of Mark is less a legend than a biography written with credulity (p. 118). It would be rash to say that Mark has not been interpolated and retouched (p. 120).

If any one thinks that I have not been warranted in drawing a sharp distinction between "scientific theologians" and "counsel for creeds"; or that my warning against the too ready acceptance

* "Popular Science Monthly," May, 1889, p. 79.

of certain declarations as to the state of biblical criticism was needless; or that my anxiety as to the sense of the word "practical" was superfluous, let him compare the statement that M. Renan has made a "practical surrender of the adverse case" with the facts just set forth. For what is the adverse case? The question, as Dr. Wace puts it, is, "It may be asked how far can we rely on the accounts we possess of our Lord's teaching on these subjects." It will be obvious, that M. Renan's statements amount to an adverse answer—to a "practical" denial that any great reliance can be placed on these accounts. He does not believe that Matthew, the apostle, wrote the first Gospel; he does not profess to know who is responsible for the collection of "logia," or how many of them are authentic; though he calls the second Gospel the most historical, he points out that it is written with credulity, and may have been interpolated and retouched; and, as to the author "quel qu'il soit" of the third Gospel, who is to "rely on the accounts" of a writer who deserves the cavalier treatment which "Luke" meets with at M. Renan's hands?

I repeat what I have already more than once said, that the question of the age and the authorship of the Gospels has not, in my judgment, the importance which is so commonly assigned to it; for the simple reason that the reports, even of eye-witnesses, would not suffice to justify belief in a large and essential part of their contents; on the contrary, these reports would discredit the witnesses. The Gadarene miracle, for example, is so extremely improbable, that the fact of its being reported by three, even independent, authorities could not justify belief in it unless we had the clearest evidence as to their capacity as observers and as interpreters of their observations. But it is evident that the three authorities are not independent; that they have simply adopted a legend, of which there were two versions; and instead of their proving its truth, it suggests their superstitious credulity; so that, if "Matthew," "Mark," and "Luke" are really responsible for the Gospels, it is not the better for the Gadarene story, but the worse for them.

A wonderful amount of controversial capital has been made out of my assertion in the note to which I have referred, as an *obiter dictum* of no consequence to my argument, that, if Renan's work* were non-extant, the main results of biblical criticism as set forth in the works of Strauss, Baur, Reuss, and Volkmar, for example, would not be sensibly affected. I thought I had explained it satisfactorily already, but it seems that my explanation has only exhibited still more of my native perversity, so I ask for one more chance.

* I trust it may not be supposed that I undervalue M. Renan's labors or intended to speak slightingly of them.

In the course of the historical development of any branch of science, what is universally observed is this: that the men who make epochs and are the real architects of the fabric of exact knowledge are those who introduce fruitful ideas or methods. As a rule, the man who does this pushes his idea or his method too far; or, if he does not, his school is sure to do so, and those who follow have to reduce his work to its proper value, and assign it its place in the whole. Not unfrequently they, in their turn, overdo the critical process. and, in trying to eliminate errors, throw away truth.

Thus, as I said, Linnæus, Buffon, Cuvier, Lamarck, really "set forth the results" of a developing science, although they often heartily contradict one another. Notwithstanding this circumstance, modern classificatory method and nomenclature have largely grown out of the results of the work of Linnæus; the modern conception of biology, as a science, and of its relation to climatology, geography, and geology, are as largely rooted in the results of the labors of Buffon; comparative anatomy and paleontology owe a vast debt to Cuvier's results; while invertebrate zoölogy and the revival of the idea of evolution are intimately dependent on the results of the work of Lamarck. In other words, the main results of biology up to the early years of this century are to be found in, or spring out of, the works of these men.

So, if I mistake not, Strauss, if he did not originate the idea of taking the mythopœic faculty into account in the development of the Gospel narratives; and, though he may have exaggerated the influence of that faculty, obliged scientific theology hereafter to take that element into serious consideration; so Baur, in giving prominence to the cardinal fact of the divergence of the Nazarene and Pauline tendencies in the primitive Church; so Reuss, in setting a marvelous example of the cool and dispassionate application of the principles of scientific criticism over the whole field of Scripture; so Volkmar, in his clear and forcible statement of the Nazarene limitations of Jesus, contributed results of permanent value in scientific theology. I took these names as they occurred to me. Undoubtedly, I might have advantageously added to them; perhaps I might have made a better selection. But it really is absurd to try to make out that I did not know that these writers widely disagree; and I believe that no scientific theologian will deny that, in principle, what I have said is perfectly correct. Ecclesiastical advocates, of course, can not be expected to take this view of the matter. To them, these mere seekers after truth, in so far as their results are unfavorable to the creed the clerics have to support, are more or less "infidels," or favorers of "infidelity"; and the only thing they care to see, or probably can see, is the fact that, in a great many matters, the truth-seekers differ

from one another, and therefore can easily be exhibited to the public, as if they did nothing else; as if any one who referred to them, as having each and all contributed his share to the results of theological science, was merely showing his ignorance; and, as if a charge of inconsistency could be based on the fact that he himself often disagrees with what they say. I have never lent a shadow of foundation to the assumption that I am a follower of either Strauss, or Baur, or Reuss, or Volkmar, or Renan; my debt to these eminent men—so far my superiors in theological knowledge—is, indeed, great; yet it is not for their opinions, but for those I have been able to form for myself, by their help.

In "Agnosticism: a Rejoinder" (p. 484) * I have referred to the difficulties under which those professors of the science of theology, whose tenure of their posts depends on the results of their investigations, must labor; and, in a note, I add:

> Imagine that all our chairs of astronomy had been founded in the fourteenth century, and that their incumbents were bound to sign Ptolemaic articles. In that case, with every respect for the efforts of persons thus hampered to attain and expound the truth, I think men of common sense would go elsewhere to learn astronomy.

I did not write this paragraph without a knowledge that its sense would be open to the kind of perversion which it has suffered; but, if that was clear, the necessity for the statement was still clearer. It is my deliberate opinion: I reiterate it; and I say that, in my judgment, it is extremely inexpedient that any subject which calls itself a science should be intrusted to teachers who are debarred from freely following out scientific methods to their legitimate conclusions, whatever those conclusions may be. If I may borrow a phrase paraded at the Church Congress, I think it "ought to be unpleasant" for any man of science to find himself in the position of such a teacher.

Human nature is not altered by seating it in a professorial chair, even of theology. I have very little doubt that if, in the year 1859, the tenure of my office had depended upon my adherence to the doctrines of Cuvier, the objections to those set forth in the "Origin of Species" would have had a halo of gravity about them that, being free to teach what I pleased, I failed to discover. And, in making that statement, it does not appear to me that I am confessing that I should have been debarred by "selfish interests" from making candid inquiry, or that I should have been biased by "sordid motives." I hope that even such a fragment of moral sense as may remain in an ecclesiastical "infidel" might have got me through the difficulty; but it would be unworthy to

* "Popular Science Monthly" for June, 1889, p. 166.

deny or disguise the fact that a very serious difficulty must have been created for me by the nature of my tenure. And let it be observed that the temptation, in my case, would have been far slighter than in that of a professor of theology; whatever biological doctrine I had repudiated, nobody I cared for would have thought the worse of me for so doing. No scientific journals would have howled me down, as the religious newspapers howled down my too honest friend, the late Bishop of Natal; nor would my colleagues in the Royal Society have turned their backs upon me, as his episcopal colleagues boycotted him.

I say these facts are obvious, and that it is wholesome and needful that they should be stated. It is in the interests of theology, if it be a science, and it is in the interests of those teachers of theology who desire to be something better than counsel for creeds, that it should be taken to heart. The seeker after theological truth, and that only, will no more suppose that I have insulted him than the prisoner who works in fetters will try to pick a quarrel with me, if I suggest that he would get on better if the fetters were knocked off; unless, indeed, as it is said does happen in the course of long captivities, that the victim at length ceases to feel the weight of his chains or even takes to hugging them, as if they were honorable ornaments.*—*Nineteenth Century.*

LIFE IN THE SOLOMON ISLANDS.†

By C. M. WOODFORD.

IN October, 1885, I left England with the object of paying a visit to the group of islands known as the "Solomon Islands," for the purpose of making collections of the fauna, and, if possible, penetrating to the mountains of the interior of some of the larger islands, which had not yet been visited by white men. The Solomon Islands are a group lying about five hundred miles to the eastward of New Guinea. They extend for six hundred miles in a northwest and southeast direction, and are situated between the parallels of 5° and 11° south latitude, and the meridians of 154° and 163° east longitude. They were first discovered by Mendaña, the Spaniard, in 1567, who gave them the name of the Islands of Solomon, in order that his countrymen, supposing them to be the

* To-day's "Times" contains a report of a remarkable speech by Prince Bismarck, in which he tells the Reichstag that he has long given up investing in foreign stock, lest so doing should mislead his judgment in his transactions with foreign states. Does this declaration prove that the chancellor accuses himself of being "sordid" and "selfish," or does it not rather show that, even in dealing with himself, he remains the man of realities?

† From a paper read before the Royal Geographical Society, March 26, 1888.

islands whence King Solomon got his gold, might be induced to colonize them. There are seven principal islands and numerous smaller ones. The total land area of the group I estimate at fifteen thousand square miles, or considerably more than twice the area of Wales. They present evidences of recent volcanic activity. The island of Savo was an active volcano at the time the Spaniards discovered the group in 1567. There is an active volcano near the center of the island of Bougainville; hot springs and sulphur are found at Savo, Simbo, and Vella Lavella, while Kulambangara is an extinct volcano. During my residence of six weeks at Alu I experienced frequent shocks of earthquake, but of no great violence. The mountains of Bougainville rise to a height of 10,000 feet, and those of the other large islands to from 3,000 to 5,000 feet, except on Guadalcanar, where they reach an elevation of 8,000 feet. I made three attempts to reach the interior of this island, but was prevented by the hostility of the mountain tribes and the timidity of my guides. The highest point which I attained on Guadalcanar was 1,140 feet. Tin and copper have been found in small quantities on the island of San Cristoval, while I myself discovered copper on the island of Guadalcanar, and from the northwest end of the island of Malayta I obtained a mineral from the natives which proves to be iron pyrites. The people told me they used it for staining their teeth. The coast natives buy it from the bushmen in bamboos, at the fair that takes place on the coast every two or three days. The islands are for the most part clothed from the coast to the mountain-tops with the densest tropical forest, in which the immense ficus-trees, of several species, are often conspicuous objects, their trunks covered with creepers and ferns; the undergrowth consisting of small palms of many species, among which and over the trees the immensely long rattans or climbing canes twine in and out in inextricable confusion. In the neighborhood of native villages the beach will be found fringed with cocoanut palms, but my observation tends to prove that the cocoanut rarely grows unless planted. I know, however, that this is opposed to the opinions of some.

[Mr. Woodford made two or three visits to the Solomon Islands, by means of the schooners engaged in recruiting boys to work upon the plantations at Fiji, and returning them to their homes at the expiration of their terms of service; and by trading-vessels from Sydney. It is not necessary to follow the author in the details of his journeying from place to place, and of bargainings with the natives. We present the more striking incidents of life in this region.]

From the trading station at Rubiana, which is the center of the head-hunting district, our first visit was to a small island occupied by another trader. This island he is allowed to occupy on suffer-

ance only. It belongs to the natives of Sisieta; they will not sell it, as they use it for their cannibal feasts. I was told that six bodies were eaten here a fortnight before my visit. From here we went to a town called Oneavesi, and thence crossed to the small island of Rubiana proper, where we found nearly all the men away on a head-hunting expedition to the island of Isabel. I here photographed the interior of a tambu house, the post of which was carved to represent a crocodile. Along the rafters was a row of heads. I also took a photograph of a collection of sacred images, near to which was a heap of skulls, upon every one of which I

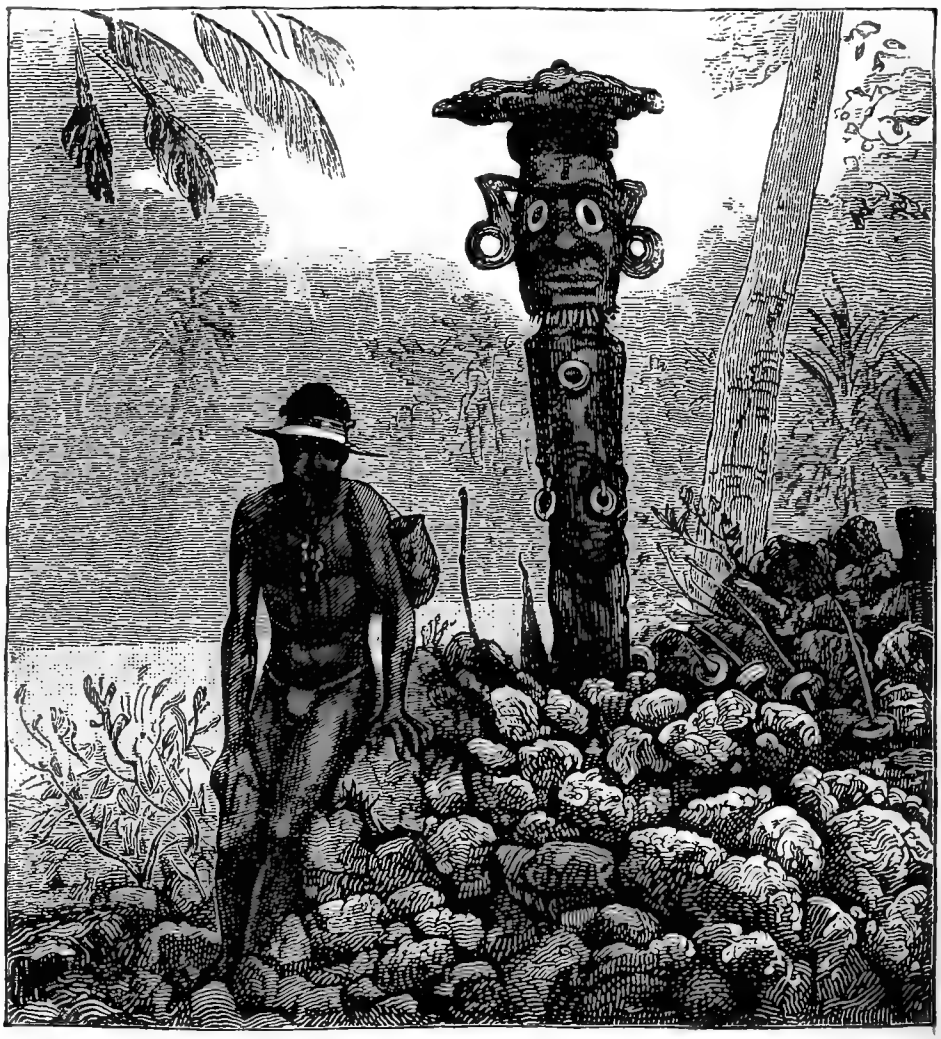

FIG. 1.—SACRED IMAGE AT RUBIANA.

noticed the mark of the tomahawk. These collections of images are to be found in nearly every town throughout the lagoon, and are strictly tambu (Fig. 1). I found out afterward that the natives strongly objected to my photographing them, or indeed approaching them at all. At another village close by on the same island we again found nearly all the male population absent on the same expedition. The women and those left at home were preparing a feast for them on their return. At the principal canoe-house

in another village we visited there were five large head-hunting canoes, profusely ornamented and inlaid with pearl-shell. The house was about eighty feet long, with a high-pitched roof, the end being closed in, but two narrow slits being left for the high prows of the canoes to pass through (Fig. 2). In this house there were eight heads; I recognized among them the straight hair of natives

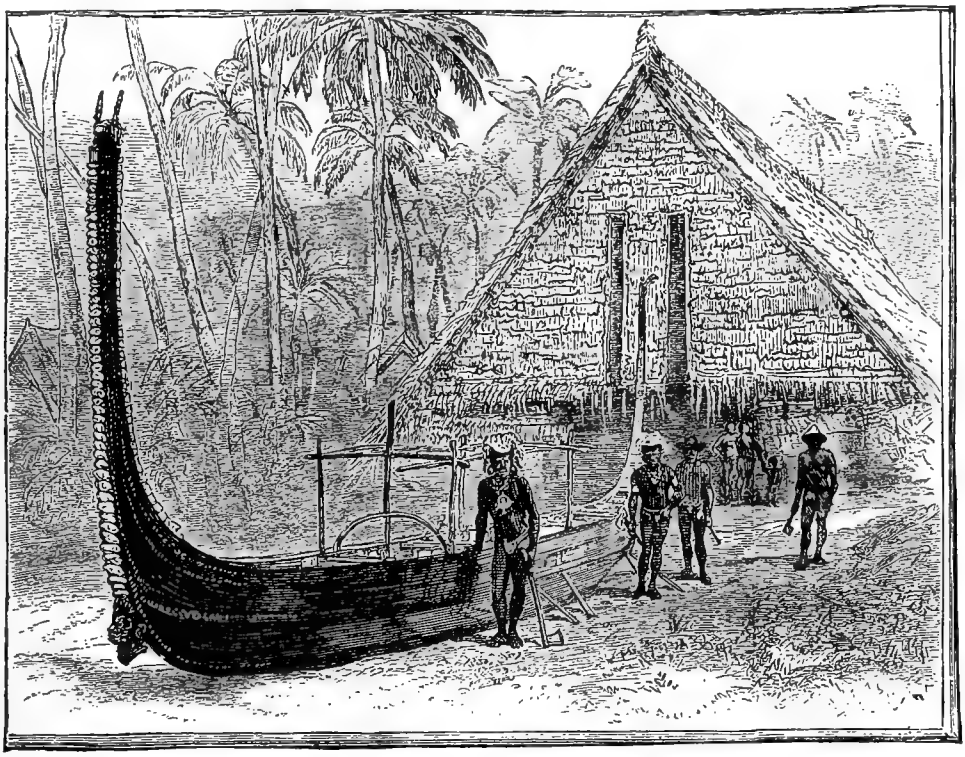

FIG. 2.—HEAD-HUNTING CANOE AND CANOE-HOUSE AT RUBIANA.

of the Lord Howe's group, and was told that a year or so previously a canoe containing sixteen of them had been driven from Lord Howe's group to Isabel, where they have been caught from time to time by the head-hunters. In another canoe-house in the same town I counted thirteen heads. After some persuasion they carried out the largest canoe for me to photograph. The Rubiana men returned next day from Isabel with five heads, from three men and two women; they also brought five prisoners alive. During the fortnight that I spent in the lagoon I heard of no less than thirty-one heads being brought home, as follows: Rubiana village, five; Sisieta, six; Kokorapa, three; Lokorokongo, seventeen.

I, for the second time, spent a fortnight at this place; and having on my previous visit gained the confidence of the two chiefs of Sisieta, named Wange and Ingova, I went frequently ashore at their town. On one occasion I saw the inauguration of a large trough for preparing and pounding food, the ceremony taking place in the chief canoe-house of the town. I was assigned a seat next to Ingova, while above my head were the eight heads pre-

viously mentioned. The trough was about thirty feet long, and carved to represent a crocodile. Twenty-two men were seated on each side of the trough, and an old man at either end. They had all their ornaments on, and wore their shields over their shoulders, while their spears and tomahawks were close behind them. The food, consisting of taro, yams, and nuts, was placed in the trough, and the men sat ready. An old man in full fighting rig was then seen advancing toward the house. Walking up to the entrance, he suddenly started back and raised his spear, exclaiming, "Basioto!" ("A crocodile!") and standing on the defensive. Ingova then advanced from the interior of the house, and, placing one hand on the crocodile's head, began a speech which lasted about ten minutes. At a given signal the men began pounding the food, all of them keeping excellent time. When they got tired or hot they were relieved by others, and the pounding was continued for over half an hour. I was then asked to go, and, not wishing to offend them, I did so.

[On another occasion the author had walked with some natives from Aola, on the coast of Guadalcanar, to a town called Kobua, situated on the river of that name, and about four miles inland.] While walking along the river-bank with my men we heard a number of natives approaching, shouting and making a great noise. I was told they were coast natives returning from a raid upon a mountain town. My men all stood on the defensive with their spears ready poised, and I got my revolver ready, but they proved to be friends. They were very proud of their victory, and told me that they had killed one man and got one alive. I saw the dead man's hand and a piece of flesh carried in triumph by one of them on his spear. I did not see the prisoner, and I was glad to hear afterward that he had escaped. It is these constant raids of the coast natives upon the bushmen, and retaliatory ones on the part of the bushmen upon the coast natives, that render it difficult and dangerous to penetrate any distance into the interior. I had been over three months at Aola before I could induce the natives to accompany me into the interior, during which time I had surveyed all the lower coast of the rivers in the neighborhood.

[A typical illustration of the vegetation of the islands is furnished in the picture of the sago palms (Fig. 3) on the Bokokimbo River, a stream which runs down from the mountains of the interior.] The vegetation [the author says] is here most luxuriant, and composed of large ficus and other large forest trees, with occasional clumps of sago and areca palms, but few cocoanuts. The river was ascended and surveyed for about ten miles, for the whole of which it runs through a rich alluvial flat, densely wooded.

[Valemanga, where the author stopped in an attempt to make

the ascent of Mount Vatupusau (4,360 feet high), was situated at the height of 800 feet on the top of a narrow ridge, sloping abruptly down on the eastern and western sides], and was surrounded with a stockade about seven feet high, with a narrow opening, closed at night, through which we squeezed one by one. In

FIG. 3.—SAGO PALMS AND NUTS—VIEW ON THE BOKOKIMBO RIVER, GUADALCANAR.

weak places, sharpened bamboos were stuck in the ground on the inside of the fence to transfix any one breaking through. Walking into the center of the town, I inquired for the head man, and when he appeared I held out my hand to him, which he took, and then he put his arms round me and embraced me. The settlement consisted of ten or a dozen houses and thirty inhabitants. . . . At dusk we were conducted to a perfectly clean new house, with, as usual, the bare ground for floor, and were supplied with cooked yams. After we had finished our meal, the whole town crowded into the house, and my men sang a song, and when they had finished the women of the town sang one of their dismal chants. In the midst of the performance, Sosoni, one of my men, suddenly sprang to his feet, and, after a short speech, presented the chief

man of the town with three or four sticks of tobacco. I had not intended to make my present before morning; but, as I thought the opportunity a good one, I gave Beta an axe, a knife, and some pipes, matches, and a quantity of tobacco, and told him to present them with a suitable speech. Shortly afterward one of the men of the town stood up, and, leaning his two hands upon his tomahawk, returned thanks. Each man before commencing his speech gave a shrill scream, I suppose to attract attention, but the singing went on all the time. [A few days after this, eleven natives, consisting of six men, three women, two little girls, and a baby, arrived at Aola, being the sole survivors out of the thirty inhabitants. The town had been attacked at daylight two days after the author's visit, and the old chief, Tambougi, who had given the traveler the affectionate embrace, was among the killed.]

Natives of different parts of the group differ considerably from one another, but they belong to the Melanesian or Papuan type. The natives of Buka and Bougainville and of the islands of Bougainville Straits and of Choiseul are intensely black in color, but as one journeys eastward the color changes to a dark brown. They have woolly hair, but occasionally natives are met with wavy and in some cases straight hair. The men wear no clothes beyond the T-bandage usually met with among savage races, but frequently men are seen without even this. The natives of Alu, however, wear a small piece of calico round the waist. On San Cristoval and the more eastern islands the women wear a small plaited square of grass fiber, about six inches by four, which is suspended round the waist by a string and hangs down the front. Upon Malayta they wear the same, but one frequently sees women without even this. On Guadalcanar the women wear a series of fringes, one over the other, made out of some vegetable fiber resembling hemp. For working in they wear a similar fringe made out of a shredded banana-leaf. The dress of the women of Rubiana and the neighboring district was declared by Captain Cheyne, who visited the islands in 1846, to be indescribable. At Alu the women wore pieces of calico bought from the traders. These Solomon natives are not so addicted to the practice of tattooing as the lighter-colored Polynesians, probably because the pattern would not show so conspicuously upon their dusky skins. In San Cristoval, however, both men and women have frequently the face cut all over with a pattern of chevron-shaped cicatrices; and on Guadalcanar the same practice is in vogue, but the pattern takes the form of small circles, which are traced by a sharpened bone from the wing of the flying fox, and a small bamboo with the edge sharpened. The operation, which is completed at one sitting, is a particularly painful one, and the operator is highly paid for his trouble, tattooing being a profession.

Many of these natives pierce and gradually distend the lobe of the ear, and enlarge it by degrees until at length it attains an enormous size. On San Cristoval a circular disk of soft, white

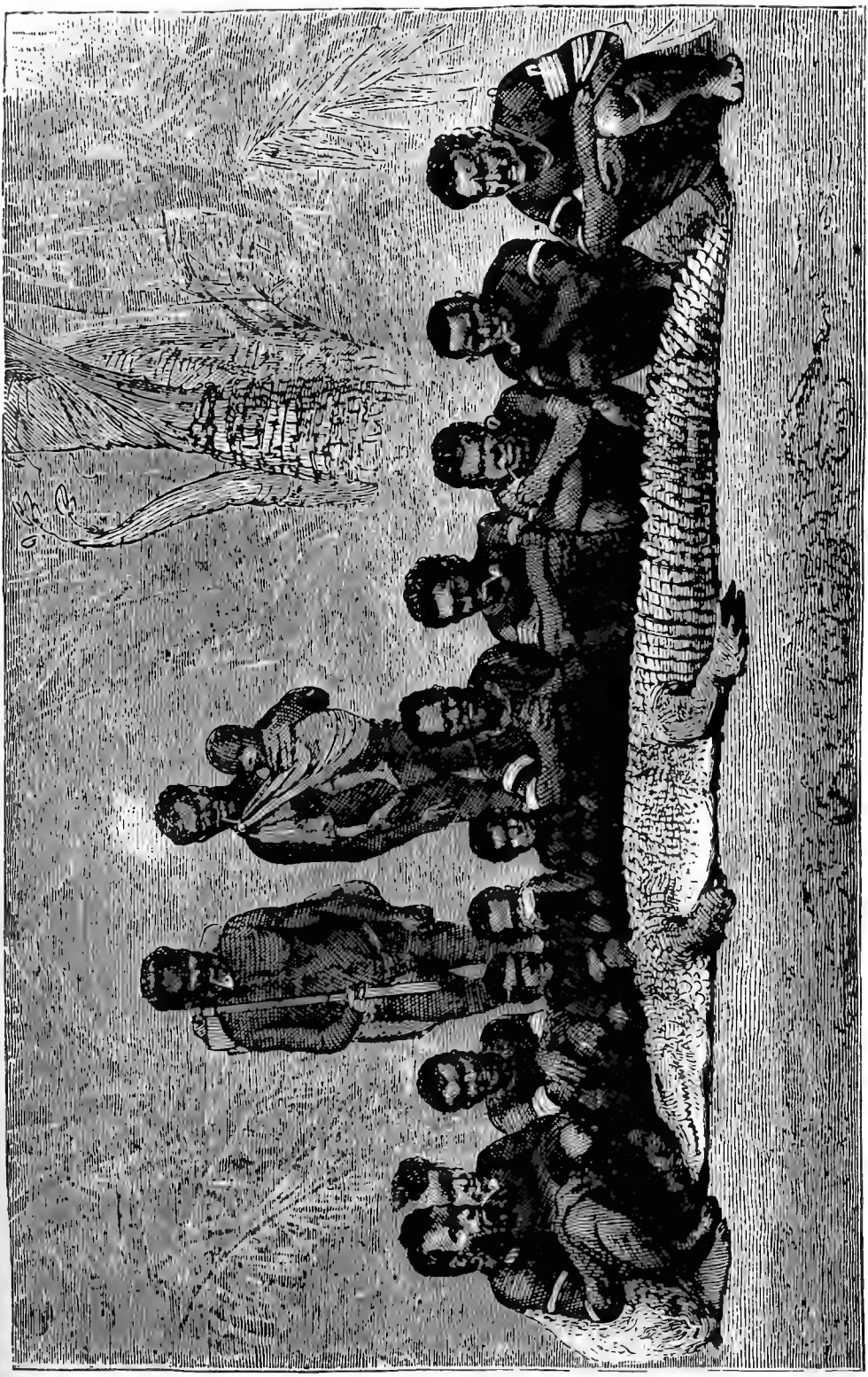

FIG. 4.—NATIVES OF AOLA, GUADALCANAR.

wood, from two inches to two inches and a half in diameter, is carried in the hole, but at Rubiana the hole was kept stretched by pieces of sago-palm leaf, or pandanus leaf, which were bent into

a hoop, and, by constantly exerting a pressure, tended to enlarge the hole. A boy, whose photograph I took at Rubiana, had the hole in his ears enlarged to a diameter of at least four inches. They are excessively fond of and prize highly armlets made from the shell of the giant clam (*Tridacna gigas*). A native chief, whom I saw at Santa Anna with a remarkably fine pair, told me he had given a boy for each. At Guadalcanar, Rubiana, and to the westward they take rather the form of bangles, and as many as eight or ten are frequently worn on each arm. Large crescents cut out of pearl-shell are frequently worn round the neck, and, especially on Malayta, frontlets of a white cowry. Perhaps, however, the ornament most highly prized is a necklace of dogs' teeth. A good necklace will consist of five hundred teeth, each one being carefully bored and mounted with great ingenuity. As only two teeth are available from each dog, it would require two hundred and fifty dogs to make a necklace such as I refer to. On San Cristoval, where most of the dogs' teeth come from, I am told that they extract the teeth from live dogs, burying them up to the neck in the ground for the purpose. Porpoise teeth, cuscus teeth, and the teeth of the flying fox are also used, but are not so highly valued as dogs' teeth.

The natives of Rubiana and New Georgia also wear a neck ornament known by them as a *buckea*. This is a ring cut from the solid shell of the *Tridacna gigas*, and suspended round the neck by a sort of plaited red straw. The buckea is more highly prized if it possesses a peculiar yellow stain, and I am told that the best are made from shells that are found as fossils in the bush in regions of coral upheaval.

I must not forget to mention the strings of bead-money, generally about a fathom in length, which are made from shells at the expense of great labor. It is of two kinds, red and white, the red being more highly prized by them.

Their weapons are bows and arrows, spears, clubs, tomahawks, and defensive shields. But, while the natives of San Cristoval and Malayta use the arrow, spear, and tomahawk, I never saw on Guadalcanar any arrows or bows except those used for bird-shooting. At Rubiana and New Georgia also arrows are not used, the tomahawk and spear being preferred. But it is on Bougainville that the finest specimens of arrows and spears are found. In fact, the latter, barbed with the wing-bones of the flying fox, are eagerly sought after and bought by the natives of the more eastern islands, the Alu natives paying two or three visits a year to Bougainville for the purpose of buying spears, arrows, baskets, and other things in the manufacture of which the Bougainville natives excel.

Perhaps the thing that most strikes a stranger visiting the

group is the beauty of shape and decoration of the canoes. These vary in size from the tiny thing just able to support a boy of twelve, to the great head-hunting canoes, capable of carrying fifty or sixty men. They are built of planks laboriously adzed down from the solid tree, and are sewn together with a tough vegetable fiber, the seams being calked with a sort of putty scraped from the kernel of a nut (*Parinarium laurinum*) that grows plentifully in the bush. This vegetable putty sets perfectly hard in a few hours and is quite water-tight. The canoes are ornamented exteriorly at bow and stern with white cowry shells and inlaid with pieces of pearl-shell cut into patterns, and at the bow end, just above the water-line, is often a small human-shaped figure-head. These canoes are propelled solely by paddles, being unadapted to sailing, and, being long, narrow, and light for their size, they travel at a great rate.

Except perhaps on Bougainville, the use of stone implements has gone out among these natives, but while at Guadalcanar I obtained more than two hundred stone adzes. These were brought me by the natives, and were for the most part dug up by boys upon the sites of old houses. I asked an old man to mount me one upon a wooden handle in the correct way. The same form of handle is still used, but a plane-iron is now employed instead of the stone axe. With these they cut out their canoe-planks and fashion the wooden bowls in which they serve their food.

The houses vary in shape somewhat in different parts of the group, and in Florida and Fauro houses built on posts may be seen. On Guadalcanar the eaves of the roof come right down to the ground. The material is always the same, the leaf of the sago palm, which makes a durable and dry roof. There is no floor but the bare ground, but rough couches are made of palm-stems laid side by side, and raised from a few inches to a couple of feet from the ground. They are most uncomfortable to sleep upon, being very hard and rough and invariably too short. A fireplace is made in the center of the house, and the smoke finds its way out through the door, or through the roof or sides of the house. Strings of pigs' jaw-bones, cuscus and flying-fox skulls, fishes' bones, turtles' heads, and sometimes human jaw-bones may be seen strung on strings along the rafters as mementoes of former feasts; but the human heads, at least in the head-hunting districts, are reserved for the canoe-houses. These are larger and better built than the ordinary dwelling-houses, and are *tambu* (tabooed) for women—i. e., a woman is not allowed to enter them, or indeed to pass in front of them.

Both men and women take their parts in the gardens; felling the trees and fencing against wild pigs being men's work, while the actual gardening—planting, weeding, and digging—is done by

the women. Having few wants, blest with a climate in which the rudest methods of cultivation produce abundance of food for their use, they ought to be a happy and contented race, and no doubt, were security to life more assured, they would be. But a man would as soon think of going to his garden of a morning without his spear and tomahawk as an Englishman would of wearing his hat in church. The greatest distinction a native can earn is to have taken a life, and it matters not whether it is an old woman surprised working in her yam-patch, or a man surprised and killed in the bush, the glory is just as great. Such a thing as a square, stand-up fight between equal numbers I never heard of. This renders them suspicious in the presence of strangers; always ready for treachery themselves, they are constantly suspecting it in others. Having given them a bad character in their dealings with one another, I must in justice say that my own relations with them were throughout of the most friendly character.

The shark is held in high veneration among certain of these natives, and notably upon the island of Savo. The Savo natives say that their island was made by the shark, who carried the stones there and planted yams and cocoanuts, and put upon it men and women, and the bird known as the *megapode*. The megapodes increased so rapidly that they began to make havoc by digging in the yam-patches. The men went to the shark and asked him to take the megapodes away. This was done, but now the men missed the megapode's eggs, which are a favorite article of food with them. They accordingly went again to the shark and asked him to bring the birds back, but to confine them to one place. This request was also complied with. The result may be now seen: the megapodes lay their eggs on two large open patches of sandy ground, which are several acres in extent, and nowhere else on the island. These laying-grounds are fenced off into small divisions for different owners, and I am told that several thousands a day are taken out of them. I myself bought eighteen eggs for the value of three-halfpence when calling there.

The sharks at Savo grow to a great size and are extremely bold. At the time of a child's birth the mother decides whether it belongs to the land or the water. If to the latter, it is thrown into the sea at death, with all the property it may have accumulated during life. If the mother declares it belongs to the land, it is buried ashore, the property also being buried with it, which, strange to say, is always found to have been stolen a few days afterward by the *devil*.

These natives believe in the power of some of their number to produce rain, while I met with a belief in the existence of a man in the moon, which was related to me by a native of Aola, named Muri Lau.

I can not conclude my description of the natives and their customs without some reference to cannibalism and head-hunting. I may state that very few white men have ever had the good fortune to see a cannibal feast, as the natives, knowing the detestation in which the practice is held by white men, always keep the occurrence as quiet as possible. On one occasion only did I ever see human flesh, and the owner assured me he was not going to eat it. I never heard of cannibalism the whole (six months) time I was living at Aola on Guadalcanar, and the natives, in answer to my inquiries, most strenuously denied the practice, but this, of course, they would do. On San Cristoval it is said to be common, and bodies are hawked about for sale from town to town, and the same is the case on Malayta. The head-hunters of New Georgia and the neighboring islands are also notorious cannibals, while my own boy, Hogare, who was a native of the island of Buka, confessed to me that the practice was common there. Not only will the New Georgian natives eat the bodies of those killed in battle, or prisoners, but they will exhume the bodies of people recently buried for their disgusting purpose.

Throughout the group one constantly sees human skulls hung up either in or outside the houses, but it is from New Georgia and the adjacent islands that head-hunting is carried on to its fullest extent. Among these natives it appears to be a perfect passion. No canoe-house can be completed and no canoe launched without a head being obtained. They make long voyages in their large *tomakos,* or head-hunting canoes, for the purpose of securing heads, the chief hunting-ground at the present time being the two islands of Choiseul and Isabel, ninety to one hundred miles away, which, however, are becoming somewhat "worked out." The basest treachery is often employed. They will at times visit a village as friends, and, after staying for a day or two, at a given signal turn upon their hosts, and either kill them or take them alive. Such a case occurred while I was at Rubiana. At other times they will surprise or cut off a party fishing on the reef, and no matter whether they are men, women, or children, the heads count. The heads, after being slightly smoked, are stuck up along the rafters of the roof in the canoe-houses, and I have myself counted thirteen recent heads in a house at Sisieta. Occasionally the head-hunters themselves meet with reverses; and while at Rubiana I inquired the reason of some particularly fine cocoanut-trees having been cut down; I was told that it was in consequence of the death of a chief who was killed on a head-hunting expedition to Isabel.

"SCIENTIFIC CHARITY."

By A. G. WARNER, Ph. D.

IN 1844 C. C. Greville made this entry in his journal: "We are now overrun with philanthropy, and God only knows where it will stop, or whither it will lead us!" When he wrote these words he was appalled lest the malign influence of philanthropy should avail to secure additional legislation for the protection of women and children in the mines and factories of England.

During the first half of the present century the English philanthropists and the English economists joined issue squarely upon two great questions, and the victor in one case was vanquished in the other: the economists won in the fight for the reform of the poor-laws, the philanthropists in the fight for factory legislation. Of course, no sharp line of distinction can be drawn between the two classes thus labeled, but in the main it is true that the apostles of self-sacrifice were on one side and the apostles of self-interest on the other. Especially in the struggle for factory legislation were the two classes distinct, and distinctly antagonistic. Cobden doubted the sincerity of Shaftesbury, and Shaftesbury rejected the reasoning of Cobden. Results have indicated that

"Each was partly in the right,
And both were in the wrong."

While political economy was getting itself called the "dismal science," it was actually fighting the battles of the poor as well as the rich; and while philanthropy was being charged with a mischievous meddlesomeness, hurtful to the poor and fatal to the industrial supremacy of England, it was, in truth, cutting the tap-root of the Chartist agitation and re-establishing the foundations of British industry. From these dual experiences of success and failure in the attempted solution of social problems the obvious conclusion has been that neither class of thinkers can be regarded as infallible, while at the same time the conclusions of neither can be considered valueless.

The conclusion is commonplace enough, but the unusual feature of the case is that both parties seem to have accepted it entire. All are pretty well agreed that both sense and sentiment are necessary to guide us properly along the devious paths of politico-economic investigation. He who approaches a social question from the side exclusively of the reason, or exclusively of the emotions, is apt, like the blind man feeling of an elephant, to mistake a part for the whole, and to err accordingly. In consequence of a fuller appreciation of the necessity for the many-sided

investigation of social questions, we have lately come to hear of a "new political economy," and very lately of a "new charity." The former is said to be less "dismal" and the latter more "scientific" than their respective progenitors, and it is hoped that a mutual exchange of the surest conclusions and the best methods in each will result in the improvement of both.

The title of this paper has been put in quotation-marks because it is believed by some that no such thing as "scientific charity" exists, and, when these two words are joined, that either the adjective or the substantive or both must lose all natural significance. They say that those interested in science and those interested in charity have an equal right to complain of the phrase, and that its use is only another instance of the confused thinking that results from a tendency to count our sciences before they are hatched. But right or wrong the term exists, and will serve as well as another to stand for a certain phase of recent charitable work. It has come to be much used by the members of the National Conference of Charities and Correction; and it seems unlikely that one more profanation of the word "science" can add much to the exasperation of those who contend for its more restricted application.

Social pathology is not an attractive study. The failure of the unfit to survive forms the subject of the dreariest chapter in social science. Indeed, it is so entirely dreary that it is seldom written. Those calling themselves scientists have been very willing to leave the care of defectives and incapables to the philanthropists, and equally willing to complain of the latter for alleged bad management. Those interested in the new charity are endeavoring to devise such methods of work as will make benevolence more certainly beneficent, and such methods of investigation as will enable them to give at least an approximate answer to Greville's question, "Whither will philanthropy lead us?" Certainly in the past it has led to many quagmires, and much has been and still more could be written on the subject of philanthropy as a failure.

"We can have as many paupers as we will pay for." The truth of this somewhat frequently quoted statement one might possibly reach by a study of his own inner consciousness. Such a study would show, probably, the truth of Emerson's assertion that "men are as lazy as they dare to be," and thence, by deductive reasoning, we might prove the correctness of the conclusion indicated. But the new political economy is inclined to ask that *a priori* reasoning should be re-enforced by reasoning from observed facts. Now, fortunately, the truth we are trying to establish is capable of demonstration by experiment. The apparatus needed is very simple, and consists merely of a pocketful of five-

cent pieces. Provided with these, go to any crowded thoroughfare, and give them out to the children or others that ask for help —perhaps under pretense of peddling. Notice how the number of askers multiplies—how older children and better-dressed children take part in the asking—and you will realize that, if your pocket were big enough, you could pauperize half the city. The same experiment may be tried by simply giving a little money to each one that chooses to ring your door-bell and ask for it. It may almost be considered fortunate that a great nation was so unfortunate as to try just such experiments on a gigantic scale. Walker thus summarizes the influence of English outdoor poor relief while the Gilbert Act was in force: "The disposition to labor was cut up by the roots; all restraints upon an increase of population disappeared under a premium upon births; self-respect and social decency vanished before a money-premium on bastardy." Cities in our own country—notably Brooklyn and Philadelphia—have found that, when public outdoor relief, given prodigally for a long series of years, was cut short off, the number of indoor poor actually decreased, as also the demands upon the private charities of the cities, and this in the face of an increasing population.

It is characteristic of the new or scientific charity as opposed to purely emotional philanthropy that it regards poverty as an evil to be assailed in its causes. It does not merely pity poverty, but studies it. It believes that a doctor might as well give pills without a diagnosis, as a benevolent man give alms without an investigation. It insists that "hell is paved with good intentions," and that the philanthropist must be careful as well as kindly.

Mr. Smiley, in his recent article in "The Popular Science Monthly" on "Altruism economically considered," says but little of this more rational phase of charitable work. The evils he condemns are very evil, but others are attacking them as vigorously as himself, and possibly along lines of greater strategic advantage. To prosecute existing charitable methods at the bar of true charity is apt to have more practical results than to arraign the same culprits at the bar of political economy.

Most of the workers in the new charity in this country have entered more or less fully into the movement for what is known as "charity organization." Speaking broadly, the purpose of this movement is to make the benevolent work of our large cities more systematic and more intelligent. The plans of those interested in the movement are already sufficiently well realized, so that each year they seek out, analyze, classify, and record a vast number of facts regarding the poor and poor-relief in the principal cities of the country. An examination of some of the statis-

tics already collated by them will best serve to indicate their methods and the value of their work.

Charity organization societies have been formed in cities embracing about one seventh of the entire population of the United States. Thirty-four of them, representing cities containing one eighth of the population of the country and probably one sixth of its pauperism, reported to the fourteenth National Conference of Charities and Correction, which met at Omaha in September, 1887. From careful estimates it is supposed that these cities contained about 456,000 paupers. Over 62 per cent of this number actually came under the cognizance of the charity organization societies of the cities indicated—that is, they dealt with 57,000 families, containing about 285,000 persons. Not all of the societies made full reports, or they made them in such a form that the facts contained were not easily comparable with those reported by the others. Twenty-five societies, however, agreed in classifying under four heads the cases that came before each. These societies made a careful analysis of nearly 28,000 cases, including something over 100,000 persons. The result by percentages of the classification above referred to was as follows:

Should have continuous relief	10·3 per cent.
" temporary "	26·6 "
Needing work rather than relief	40·4 "
Unworthy of relief	22·7 "

Charles D. Kellogg, who made the report to the National Conference, goes on to say: "For several years there has been a very close correspondence of published experience between Boston and New York, and in these cities the percentage of those needing work rather than relief has been 53·4, and of the unworthy, 15·8. . . . On the other hand, there is a notable unity of opinion that only from 31 to 37 per cent, or, say, one third of the cases actually treated, were in need of that material assistance for which no offices of friendly counsel or restraint could compensate. The logical application of this generalization to the whole country is that two thirds of its real or simulated destitution could be wiped out by a more perfect adjustment of the supply and demand for labor and a more vigorous and enlightened police administration. Subsequent and wider experience may modify this conclusion, but hardly can wholly overturn it; and, while it stands, it is of the highest significance in the solution of the poor problem." Not only are these deductions of "the highest significance in the solution of the poor problem," but they contain important suggestions for the philanthropist's should-be friend, the student of political economy.

But it was felt by the charity organizationists that a still more

penetrating analysis was needed, and at the meeting of the sixteenth National Conference, where about forty representatives of this branch of philanthropic work were present, a schedule was adopted for the collation of more elaborate and, it is hoped, more useful statistics. This schedule, except for a few minor alterations and additions, is the same as the one elaborated and used by the Buffalo society. As an example of the manner in which the figures will tell their story when collated, we may glance at some of the results reached by the Buffalo society through a very careful study of 1,407 families, including 5,388 persons. The chief cause of destitution was adjudged to be lack of employment in 263 cases, sickness in 326, no male support in 373, intemperance in 124, physical defects in 113, insufficient earnings in 87, accidents in 45, imprisonment of bread-winner in 35, shiftlessness in 26, and insanity in 15.

The personal equation must enter very largely into the collection of such statistics. For instance, it might be inferred *a priori*, from the foregoing figures, that those who were responsible for the decisions are not rabid "temperance people" nor prohibitionists. Such is, indeed, the fact; but, at the same time, it must be said that in Boston, and among workers inclined to give intemperance its full meed of discredit as a cause of poverty, a careful statistical analysis of this character convinced them that it was the chief cause in only about half the cases. Though statistics of this nature may not be the firmest ground to tread upon, they yet afford better footing than the quicksands of hap-hazard opinion.*

In some matters, also, the facts are more tangible, and the results, therefore, more reliable. For instance, it has for some time been the opinion of practical workers that a considerable portion of the most hopeless poverty is caused by the decay of the ties of the family. It is found that, in the 1,407 families reported on in Buffalo, there were, in fact, 183 deserted wives. Where, as in this case, investigation merely confirms a previous opinion, it is still of the greatest use, because it enables the workers to make a more cogent appeal for remedial legislation.

Recently, more than in the immediate present, it was the fashion to talk as though a common-school education was the one thing needful to cure all social ills, and to bring down upon us an imminent millennium. The reformers of that time went to battle with a spelling-book shield that might have borne the device of a schoolmaster rampant. In such a connection it is interesting to notice that in the 1,407 destitute families investigated in Buffalo it was found that the respective heads of 1,019 of them could both

* See an article by the present writer, "Notes on the Statistical Determination of the Causes of Poverty," in the "Publications of the American Statistical Association," March, 1889.

read and write, that 49 others could read but not write, and that only 339, or twenty-four per cent, were wholly illiterate.

It will be seen from the foregoing examples that the field of investigation upon which the charity organizationists have entered is a large and important one. A good deal might be said in the way of criticism, especially of the analysis of the causes of poverty, but it is rather the purpose of this paper to describe than to criticise. The facts it is aimed to accumulate are of a character that could not be got by public officials without very great expense, since they take account of the cases of many dependants whose names never appear on the records of public poor-relief.

Besides the statistics, which all the societies will work together to accumulate, different societies have undertaken elaborate special investigations into the heredity of pauperism and similar topics. Oscar C. McCulloch, at the last National Conference, read a paper entitled "The Children of Ishmael: a Study in Social Degradation," which was based upon such an investigation made by the society in Indianapolis. It gave the hideous story of thirty interrelated families, embracing two hundred and seventy persons, nearly all of whom belong to the pauper and criminal classes, as did their ancestors before them. The study resembles that which Dugdale made of the Juke family, by which it was suggested; but it embraces a larger number of families formerly distinct.

The workers in the new charity are active propagandists. They insist continually upon the evils of indiscriminate giving. They assail the public authorities with facts and figures, and the churches with biblical quotations. They assure the latter that bread indiscriminately given is cast not "upon the waters," but into the bottomless pit—that it is "the bread by which men die." They establish in each city an office to serve as a clearing-house of charities, and so endeavor to prevent the overlapping of the relief given by different agencies. Their general view of the situation enables them to devise new and needed forms of benevolence, and to ascertain what additional legislation can be really helpful.

It is very satisfactory when the conclusions of one set of thinkers coincide with the conclusions of others who have approached the same subject from a different standpoint. When, therefore, the philanthropist, trying to think and work in accordance with the principles of enlightened self-sacrifice, finds himself agreeing in theory and practice with the economist whose guiding star has been "enlightened self-interest," there is reason to congratulate them both. In speaking in this manner, we of course ignore the philosophical subtlety by which it is said to be proved that all our actions must necessarily have their origin in motives of self-interest. Assuming the proof of this to be perfect, it is yet to be said that the different forms in which self-interest manifests itself

have been so differentiated that we may rightly separate and classify them. The man who is convinced that all organic life came from a single form is yet justified in practical—e. g., gastronomical—affairs in making a distinction between meats and vegetables, or even between beefsteak and mutton. So, there is a practical if not a philosophical difference between the motives that guide men in stock speculations and those that guide them in the founding of hospitals. To reach charity by the way of self-interest is following too roundabout a road for the average man or the average thinker, and many there be that have failed most sadly in the attempt.

It is therefore exceedingly fortunate that the philanthropists seem likely to work out their own salvation from mischief-making by studying with scientific care the lessons that their own experience teaches. Such a course not only gives valuable facilities for checking the conclusions of those who have thought and worked along other lines, but it secures the acceptance by those charitably inclined of correct ideas much more readily than could any amount of outside pressure. The dictates of wisdom are formulated in language to which they are accustomed, and the motives to which appeal is made are those to which they have taught themselves obedience. Not that acceptance of the new ideas is easy under any circumstances for those trained in the older methods. It can only be said that it is a trifle less difficult to rout this variety of old fogyism by attacking from within rather than from without.

But there is, happily, an increasing number of those who appreciate the fact that the introduction of scientific methods into charitable work will not hamper charity but aid it; that the resulting restrictions that may be placed upon us will merely guide our sympathies, and not thwart them. The restraints that will be put upon benevolence will be merely to prevent its waste and insure its usefulness—"restriction for the purpose of expansion." Scientific methods carefully used for such purposes will not make the charity of the future cold-blooded and calculating, but will prevent it from being foiled, defeated, and turned back from its high purposes by its own gratuitous blunders; they will render that charity helpful, constructive, progressive, and make it possible that love of neighbor may "shape with growing sway the growing life of man."

THE Rev. Dr. Dallinger, who is also an eminent student of microscopic life, remarked in a recent lecture at Birmingham, England, that since the human mind had given itself fearlessly and without bias to the study of the phenomena, evolution had become no longer a bugbear, and might be looked upon, even by the most timid theologian, as the actual method of creation.

THE INFLUENCE OF RACE IN HISTORY.*

By M. GUSTAVE LE BON.

HISTORICAL studies have undergone a great transformation in our days. Almost exclusively literary a few years ago, they are tending at this time to become almost as exclusively scientific. It is not the recent progress of archæology alone that has caused a remodeling of our knowledge and our ideas in history. The discoveries in the physical and natural sciences have had a still greater effect upon them; and it is by means of these discoveries that the notion of natural causes is entering into history more and more, and that we are habituating ourselves to consider historical phenomena as subject to laws as invariable as those that control the course of the stars and the transformations of bodies. The part which all the ancient historians attributed to Providence or to chance, is now no longer attributed to anything but natural laws, as entirely removed from chance as from the will of the gods.

The new ideas which are entering into history are due chiefly to the progress of natural science. Making more and more evident the preponderant influence of the past on the evolution of beings, it teaches us that we must first study the past in societies to comprehend their present condition and foresee their future. In the same way that the naturalist now finds the explanation of beings in the study of their ancestral forms, the philosopher who wishes to comprehend the genesis of our ideas and institutions should examine primitive usages. Thus regarded, history, the interest of which might seem but slight so long as it is limited to the enumeration of dynasties and battles, is acquiring an immense significance.

The method which the modern man of science applies to history to-day is identical with that which the naturalist applies in his laboratory. A society can be regarded as an organism in process of development. There is a social embryology as there are an animal and a vegetable embryology, and the laws of evolution that govern them all are of the same order. Social embryology, or the study of civilizations, shows us the series of advances by which the marvelous and complicated mechanism of refined societies has issued from the savage condition in which the first men long lived; how our thoughts, feelings, institutions, and creeds had their roots in the primal ages of mankind. Instead of, as formerly, seeing a gulf between the peoples who ate their aged parents and those who lavish cares upon them in their old age and weep at their tombs; between those who look upon their

* From the author's work, "Les Premières Civilisations," now appearing in parts.

women as lower animals belonging to all the members of the tribe, and those who have made them the object of a chivalrous cult; between those who expose their malformed children to perish, and those who lodge their idiots and incurables in magnificent hospitals—we trace out the close bonds which connect, through the ages, the most different thoughts, institutions, and creeds. We realize that present civilizations have been derived from past civilizations, and contain in the germ all the civilizations to come. The evolution of thoughts, religions, industries, and art—in short, of all the elements that enter into the constitution of a civilization—is as regular and inevitable as that of the different forms of an animal series.

The factors that determine the birth and development of the constituent elements of a civilization are as numerous as those which control the development of a living being. The study of them has as yet hardly begun; but the influence of some of them can be brought into evidence. One of the most important among these factors is race—that is, the aggregation of the physical, moral, and mental traits that characterize a people.

When human races appear in history they have generally already acquired marked characteristics, which afterward undergo only very slow transformations. The oldest Egyptian bas-reliefs, on which are depicted the various types of the peoples with whom the Pharaohs had to do, are proof that our present grand characterizations of races could have been applied even then, in the dawn of history.

The various human races had formed themselves during the hundreds of thousands of years that preceded historical times. They were so formed, no doubt, like all the animal species, by means of slow changes produced by variability of the environment, limited by selection and enforced by heredity. The first step toward understanding the history of a people and the origin of their institutions, moral ideas, and creeds, is to study their mental constitution. It is vain to ask from anatomical characteristics, as has been done for a long time, for the means of differentiating races. Psychology alone permits a precise definition of racial distinctions. It shows us that peoples of similar mental constitution will have similar fates when placed in like circumstances, however they may differ in external aspect. In this way we have been able to make a rational comparison between the modern English and the ancient Romans. There exists, in fact, an evident mental relationship between these two peoples; the same indomitable energy of character, the same respect for their institutions, the same capacity for conquering people and for holding colonies. But, regarding the external type, there is a complete want of resemblance between the two peoples.

Two fundamental psychological elements to be always studied among any people are character and intelligence. Character is infinitely more important to the success of an individual or a race than intelligence. Rome, in her decline, certainly possessed more superior minds than the Rome of the earlier ages of the republic. Brilliant artists, eloquent rhetoricians, and graceful writers appeared then by the hundred. But she was lacking in men of manly and energetic character, who may perhaps have been careless of the refinements of art, but were very careful of the power of the city whose grandeur they had founded. When it had lost all of these, Rome had to give way to peoples much less intelligent but more energetic. The conquest of the ancient, refined, and lettered Græco-Latin world by tribes of semi-barbarous Arabs constitutes another example of the same kind. History is full of such.

While character thus plays the chief part in the historical development of a people, it is intelligence that prevails in determining their civilization; but it must be creative, and not assimilative only. Peoples having only an assimilative intelligence, like the Phœnicians of old and the Mongolians and the Russians of the present time, are capable of appropriating more or less of foreign civilization, but can not make civilization advance. Peoples endowed with a certain intelligence, like the Greeks in antiquity and the Arabs in the middle ages, have been the factors of all the general progress by which mankind has profited.

The most superficial observation soon demonstrates that the several individuals composing a race differ from one another in physical aspect as well as in moral and mental constitution; but a little more attentive observation will show that under these apparent diversities is hidden a mass of characteristics common to all the individuals of the race, the aggregation of which constitutes what has justly been named the national character of a people. When we speak of an Englishman, a Japanese, or a negro, we at once attribute to him—and without hardly ever being much mistaken—a collection of general traits which are a kind of precise condensation of the characteristics of his race. These national characteristics, created among homogeneous peoples by the long-continued influences of the same mediums, the same institutions, and the same creeds, play a fundamental, though invisible, part in the life of peoples.

In human races, as in animal species, some offer many varieties, others but few. The fewer varieties a race presents—or the less they diverge from a mean type—the more homogeneous it is. Such, for example, is the modern English race, in which the ancient Briton, the Saxon, and the Norman have been effaced to form a wholly new and quite distinct type. If, on the contrary, the groups have been juxtaposed without having been sufficiently

mixed, the race continues heterogeneous, and the mean type becomes more difficult to establish, because the common traits that compose it are less numerous. It is easy to comprehend that the more homogeneous a race is, the stronger it will be, and the more called upon to march rapidly in the way of progress. When, on the contrary, thoughts, traditions, creeds, and interests remain separated, dissensions will be frequent, and progress always slow and often completely hindered.

We see by this how important to the explanation of the history of a people is the study of its composition. We see also that the word "people" can not be in any case considered synonymous with "race." An empire, a people, or a state is a more or less considerable number of men united by the same political or geographical necessities, and subjected to the same institutions and laws. These men may belong to the same race, but they may equally belong to different races. If the races are too dissimilar, no fusion is possible. They may, under necessity, live side by side, like Hindus subject to Europeans, but we must not think of giving them common institutions. All great empires uniting dissimilar peoples are created only by force, and are condemned to perish by violence. Those only can endure which are formed slowly by the gradual mixture of races differing but little, continually crossing with one another, living on the same soil, subject to the action of the same climate, and having the same institutions and creeds. These different races may thus, after a few centuries, form a new homogeneous race.*

As the world grew old, the races gradually became more stable, and their transformations by mixture rarer. In prehistorical times, when man's hereditary past was not so long, when he had neither well-fixed institutions nor well-assured conditions of existence, mediums had a more profound action upon him than now. Civilization has permitted man to subtract himself, to a large extent, from the influence of the medium, but not from that of his past. As mankind grows older, the weight of heredity grows heavier. For heredity to act in the mixture of races, it is necessary that one of the races shall not be too inferior to the other in numbers, and that their physical and mental constitutions shall not be too different.

The first of these conditions is fundamental. When two different races are brought together, the more numerous one absorbs the other. In a black population, a few families of whites will

* The mechanism of this fusion of the different elements of a race is rarely observed. I, however, witnessed it once, during my travels, among a mountaineer population isolated in the interior of Galicia, at the foot of the Tatras Mountains. The memoir in which I recorded my observations appeared in the "Bulletin de la Société de Géographie de Paris" (1888).

disappear without leaving any traces. Such has been the lot of all conquering peoples which, though strong in arms, have been weak in numbers. Those only have escaped obliteration which, like the Aryans in India, formerly, and the English, also in India, to-day, have observed a rigid system of castes, preventing the mixture of conquerors and conquered. Except where the rule of caste has operated, the general result has been to see the conquering people absorbed, after a few generations, by the conquered. It has not disappeared, however, without having left traces of its work in civilization behind it. Egypt, conquered by the Arabs, quickly absorbed its conquerors; but they left the most important elements of civilization—religion, language, and arts—there. A like phenomenon took place in Europe among the peoples called Latin. The French, Italians, and Spaniards have, in reality, no traces of Latin blood in their veins; but the institutions of the Romans were so strong, their organization was so perfect, their influence in civilization so great, that the countries occupied by them for centuries have remained Latin in language, institutions, and peculiar genius.

It is not, however, by reason of its strength that one people imposes its civilization upon another; very often the conquered people leads the conquerors in this line. The Franks finally triumphed over the Gallo-Roman society, but they were in a short time morally conquered by it. They were also physically overcome, for they had plunged into a population more numerous than themselves. This conquest of the conquerors by the conquered is to be seen in a still higher degree among the Mussulman peoples. It was precisely when the political power of the Arabs had wholly disappeared, that their religion, language, and arts were spread most extensively.

But when races too dissimilar are brought in contact by the chance of invasions and conquest, fusion is impossible by any force, and the only result that can be produced is the extermination of the weaker race. This disappearance of the inferior people in the face of a superior race does not always take place by means of a systematic and sanguinary extermination; the simple action of presence, to use a chemical term, is sufficient to bring on destruction. When the superior people has established itself in a barbarous country, with its complicated mode of life and its numerous means of subsistence, it monopolizes and masters the living forces of the country much more easily and speedily than the former occupants. The latter, formerly masters of all the resources of the land, come at last to only toilsomely gleaning what their conquerors have left.

When two different races become mingled, notwithstanding a great inequality of civilization, the result is disastrous rather to

the inferior than to the superior race. It soon disappears, and gives place to a race which may represent, in a mental respect, a kind of mean between the two races, but morally is inferior to either of them. Half-breeds have never made a society advance; the part they have played has been to degrade the civilizations of which they have by chance been the heirs. The disastrous results of such mixtures of superior races with inferior were clearly perceived by the most ancient civilized peoples. This was doubtless the origin of that rule of castes, preventing unions between persons of different races, which we find in many ancient societies. Without it, man would never have risen above the dawn of civilization.

But, while the mixture of races which have reached very unequal stages of evolution is always disastrous, the result is otherwise when these races, although still possessing different qualities, have arrived at nearly the same period of development. Their qualities can then very usefully complement one another. The republic of the United States has been formed by precisely such a mixture of races, already elevated in civilization and having qualities complementary to one another. The people owes its astonishing vigor to the fact not only that it is constituted of a mixture of elements—English, Irish, French, German, etc.—already highly developed, but also that the individuals through whom the crossing was effected were themselves the results of a selection from among the most active and vigorous members of those nations.

The general laws which we have just summarized can of themselves furnish the explanation of a large number of historical events. They show, for example, why one conquest was the origin of a brilliant civilization, and why another introduced an era of disorder and anarchy; why the Oriental has always easily imposed his yoke and his customs upon Orientals whose mental constitution was like his own; and why struggles between Orientals and Westerners have been so ferocious, and usually terminated in pitiless massacres of the conquered. They likewise tell us why certain peoples have been colonizers, and how they have been able, naturally, if they were of the race of the conquered, or by respecting their customs and creeds if they were of a different stock, to maintain their authority over distant nations.

A question has arisen as to whether the steady advance of man tends to equalize races, or to differentiate them more and more. To it we have to answer that the upper level of civilization is always ascending; but by this fact itself, and since there are always nations at the lowest step, the gulf between them and the higher races is constantly growing deeper. There is progress, it is true, even in the most backward groups. But the law of this

progress gives it an accelerated march as it advances. The superior races are now developing themselves by giant steps, while the others still demand the long ages which our ancestors traversed in order to reach the point where we are now. And when the inferior races reach that point, where shall we be? Farther from them, without doubt, than we are now, unless we shall have disappeared. The evident conclusion then is, that as human races become civilized they tend to greater differentiation rather than to an approach to equality. Civilization not being able to act equally on unequal intelligences, and the most developed necessarily profiting more than those who are less so, it is easy to see that the difference between them will increase considerably in each generation.* It increases all the more because the division of labor, condemning the lower strata to a uniform and identical work, tends to destroy all intelligence in them. The engineer of our days, who composes a new machine, needs much more intelligence than the engineer of the last century; but the modern workman requires much less intelligence to make the detached piece of a watch, which he will keep on making all his life, than his ancestors had to have to make the whole watch.

These considerations do not rest on theoretical reasonings alone. We some time ago fortified them also by anatomical arguments. Studies of the skulls of human races have shown us that while among savages the heads of different individuals vary but little in their dimensions, the differences in our civilized societies are formidable. From the upper to the lower ranks of society the anatomical gulf is as immense as the psychological gulf, and the advance of civilization is constantly making it wider. Since, then, the differences among men of the same race become more and more extended as the race rises in civilization, we conclude that the higher the civilization the more considerable will be the intellectual diversities among individuals of the race. No doubt the mean level will also rise.†

* Theoretically, the differentiation between individuals should follow a kind of geometrical progression, and consequently accentuate itself with extreme rapidity. It is, however, less rapid than the theory indicates. The reason of it doubtless lies in the observed fact that the families of superior men—scientific and literary men, artists, statesmen, etc.—seldom endure. Their descendants disappear rapidly by degeneration, or at least soon return to the crowd. There seems to be a mysterious law constantly tending to eliminate or reduce to the mean intellectual type of a race all the families which depart very greatly from it. This is so, perhaps, because a superiority in one direction has to be acquired at the cost of an inferiority, and consequently a kind of degeneracy, in another. A great man is most frequently an ill-balanced man; and cerebral unbalancing, however little accentuated it may be, is as hard to perpetuate by reproduction as an anatomical monstrosity. Societies also seem condemned, like individuals, not to pass a certain level.

† Most of the thoughts embodied in this article, especially the theory of the progressive differentiation of races, individuals, and the sexes with the advance of civilization, are the

The study of all civilizations proves, in fact, that all progress has been accomplished by a small number of the higher minds. The mass has done nothing more than profit by the advance; it does not even like to see it extended, and the greatest thinkers or inventors have often been martyrs. Yet all the generations, the whole past of a race, bloom out in these fine geniuses. They do not appear by chance or miracle, but represent a long synthesis. To favor their birth and growth is to favor the birth of a progress by which all mankind will be benefited. If we should allow ourselves to be blinded by our dreams of universal equality, we should ourselves be the first victims of it. Equality can only exist in inferiority. To bring about a reign of equality in the world, it would be necessary gradually to pull all that gives value to a race down to the level of what in it is lowest. It would require ages to raise the intellectual level of the lowest peasants up to that of the genius of a Lavoisier, while a second and the stroke of the guillotine is sufficient to destroy such a brain. But while the part of superior men in the development of a civilization is considerable, it is not quite what it is generally believed to be. Their action, I repeat, consists in synthetizing all the efforts of a race; their discoveries are always the result of a long series of prior discoveries; they build an edifice with stones which others have previously hewn. Historians fancy they must couple the name of a man with every invention; yet, among the great inventions which have transformed the world, like those of printing, gunpowder, and electric telegraphy, there is not one of which it can be said that it was created by a single man.

Of similar character is the part which great statesmen have played. They could without doubt destroy a society or disturb its evolution, but it is not given to them to change its course. The genius of a Cromwell or a Napoleon could not perform such a task. Great conquerors might destroy cities, men, and empires by sword and fire, as a child could burn a museum filled with treasures of art, but this destructive power should not subject us to illusions respecting the grandeur of their achievements. The work of great political men is durable only when, like Cæsar or Richelieu, they direct their efforts according to the demands of

result of my own researches. The reader who may be interested in the subject will find them developed in the following works, or memoirs, which have been published at different times: "Recherches anatomiques et mathématiques sur les Lois des Variations du Volume du Crâne" (*couronné* by the Institute and by the Anthropological Society of Paris); "Étude de 42 Crânes d'Hommes célèbres de la Collection du Muséum de Paris" (Bulletin of the Anthropological Society of Paris); "L'Homme et les Sociétés, leurs Origines et leur Histoire," vol. ii; "De Moscou aux Monts Tatras, Étude sur la Formation d'une Race" (Bulletin of the Geographical Society of Paris); "L'Anthropologie actuel et l'Étude des Races" ("Revue Scientifique"); "La Psychologie comme Élément de Classification des Individus et des Races" ("Revue Philosophique").

the moment; the true cause of their success is, then, generally long anterior to themselves. The really great men in politics are those who anticipate the demands that are going to arise, the events for which the past has prepared, and point out the way to be followed. They, also, like the great inventors, synthetize the results of a long previous work.

Of what, in the eye of philosophy, is history, as the books tell it, composed, except of the long recital of the struggles endured by men to create an ideal, adore it, and then destroy it? And have such ideals any more value in the eyes of pure science than the mirage of the desert? There have been, however, great enthusiasts, creators of such mirages, who have profoundly transformed the world. They still from their tombs hold the minds of multitudes under the sway of their thoughts. While not mistaking the significance of their achievements, let us not forget that they would not have succeeded in accomplishing what they did if they had not unconsciously incarnated and expressed the dominant ideal of their race and their time.

It is, in fact, ideas, and consequently those who incarnate them, that lead the world. They rise at first under vague forms, and float in the air, gradually changing their aspect, till some day they appear under the form of a great man or a great act. It is of little account, as determining the force with which they shall act, whether they are true or false. History teaches us that the most chimerical illusions have excited more enthusiasm among men than the best demonstrated truths. Such illusions are only shadows, but nevertheless have to be respected. Through them our fathers were hopeful, and in their heroic and heedless course they have brought us out of barbarism and led us to the point where we stand to-day. Mankind has expended most of its efforts, not in the pursuit of truth, but of error. It has not been able to reach the chimerical aims it was pursuing; but in pursuing them it has realized a progress that it was not seeking.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

Mr. Gardiner C. Hubbard shows a good record, in his presidential address to the American Geographical Society, of American contributions to the extension of geographical knowledge. Our country "has contributed its quota of martyrs in the frozen North, and has led the way into the torrid regions of Africa." It has laid the foundations of the new science of the geography of the sea, by the discoveries of its explorers in ocean currents, the topography of the sea-bottoms, and deep-sea life, in which Americans were first to engage. "The exploring vessels of our Fish Commission have discovered in the deep sea, in one single season, more forms of life than were found by the Challenger Expedition in a three years' cruise." We have also led the way in founding the "geography of the air," or the science of storms, etc., and are still keeping at the front.

THE STONE AGE IN HEATHEN SWEDEN.

By W. H. LARRABEE.

ONE of the peculiar features of modern historical study is that it is to a very large extent dependent upon the examination of the monuments which the people of the past have left and the articles of use and ornament that are found among their ruins. When the nations constituting objects of research were civilized and had writing, as in Egypt and Mesopotamia, the information afforded by these relics is extremely valuable, and furnishes records of events and illustrations of the life of the peoples more definite and accurate than can be obtained from books. The accounts and pictures they bear were a part of the contemporary life, and have such a relation to written history as in the eye of law courts the evidence of the *res gesta* has to a minute made up after the event. With peoples who had not writing and arts, the relics give hardly any evidence respecting events, and only scanty and incoherent testimony of the conditions of their life. The further back we go in the investigation the less satisfactory does the knowledge imparted by them become. But they are all that we have by which to inform ourselves respecting the life of primitive man.

Relics of human life antedating all written monuments have been found in nearly all countries where the search has been carried on by excavation, and often occur superficially where they can be seen without particular search. The investigation of such relics has been made most systematically in the Scandinavian countries, and it was there that the division of prehistoric times into three periods was first made. Thus in Sweden the use of iron was universal in the ninth century A. D., and had been so for a long time. Investigation of the antiquities of the country has shown that previous to the Iron age there was another long time when iron was not known, and weapons and tools were made of bronze; and that before the beginning of the "Bronze age" the country had been inhabited by people who had not the use of metals, and were obliged to employ such materials as stone, horn, bone, and wood. This was the "Stone age." We can conceive, says the Rev. F. Woods, how incomplete is the evidence respecting the primitive life afforded by these relics of stone and bronze, by reflecting that while furniture, stuffs, and clothes made out of such perishable materials as wood, bone, leather, cloth, etc., formed incomparably the greater part of the belongings of the heathen Northmen, it is "only by an exceptional conjunction of specially favorable conditions" that such materials have been able to survive.

The relics of the Stone age in Sweden, and incidentally in Scandinavia generally, are described, and the testimony they give to the kind of life the people lived is set forth in the first part of Dr. Oscar Montelius's "Civilization of Sweden in Heathen Times" (London and New York, Macmillan & Co.), from which, and the Rev. F. Woods's introduction, the facts and illustrations in this article are derived.

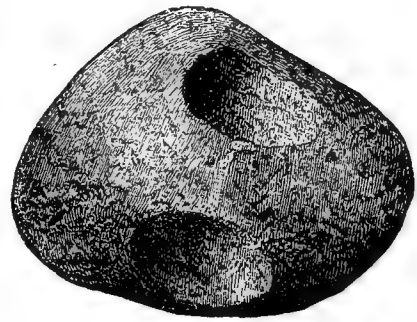

FIG. 1.—HAMMERING-PEBBLE.

FIG. 2.—FLINT ARROW-HEAD.

Our only clew to the antiquity of human settlement in Scandinavia is derived from the evidence afforded by certain finds of a habitation of some southern parts of the region by a people of the Stone age at a time when firs were still the prevailing trees there. Since then the forests of fir-trees have died out and made way for great forests of oaks, "which covered the land till they in their turn succumbed to the now prevailing beech woods."

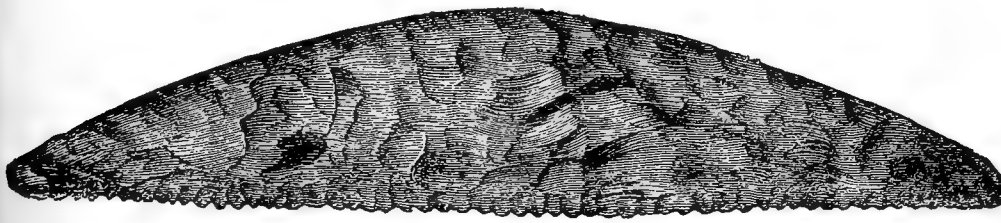

FIG. 3.—LUNATE FLINT SAW.

Traces of population at a somewhat later but still very early date are found in the "kitchen-middens"—enormous collections of shells, with bones, bearing marks of having been eaten from, and remains of fireplaces and instruments—which are scattered along the sea-coasts.

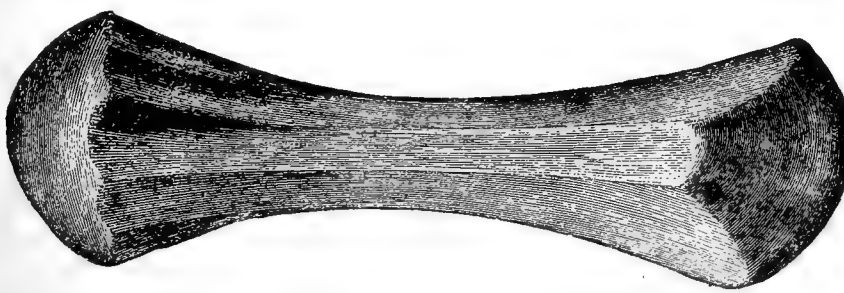

FIG. 4.—POLISHED GRINDSTONE, WORN BY USE.

The tools with which the Northmen during the Stone age produced their wooden works, and which are found at their old resorts, were mainly knives, saws, borers, chisels, and axes or hatchets. They were made out of flint, chipped into shape by

stone hammers, of which many specimens have been found. Sometimes hollows were cut or ground out in the hammering-pebbles (Fig. 1), in order to secure a firmer grip for the fingers. The manner in which such a pebble could be used for the work was demonstrated to an Englishman some time ago by an Indian arrow-maker in California. The long and narrow barbs in the fine arrow-heads (Fig. 2) and saw-teeth (Fig. 3) were obtained probably by the pressure of a bone tool, such as is still used by some American tribes. Holes were bored, where needed, by twirling a stick, hard pressed upon, against the spot where the perforation was to be. It took a long time, but primitive men had time. Most of the tools were only chipped, while others were polished or ground. The grind-stone was usually a suitable block of sandstone, or else a thick piece of the same material. One of these pieces, which has been worn down in the middle by use, is represented by Fig. 4. Handles, if the instruments were provided with them, were inserted into

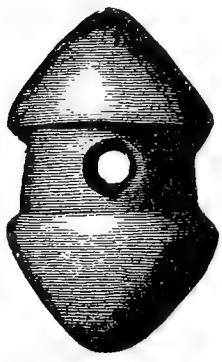

FIG. 5.—AMBER BEAD.

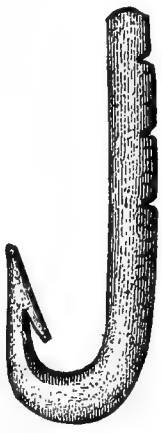

FIG. 6.—BONE FISH-HOOK.

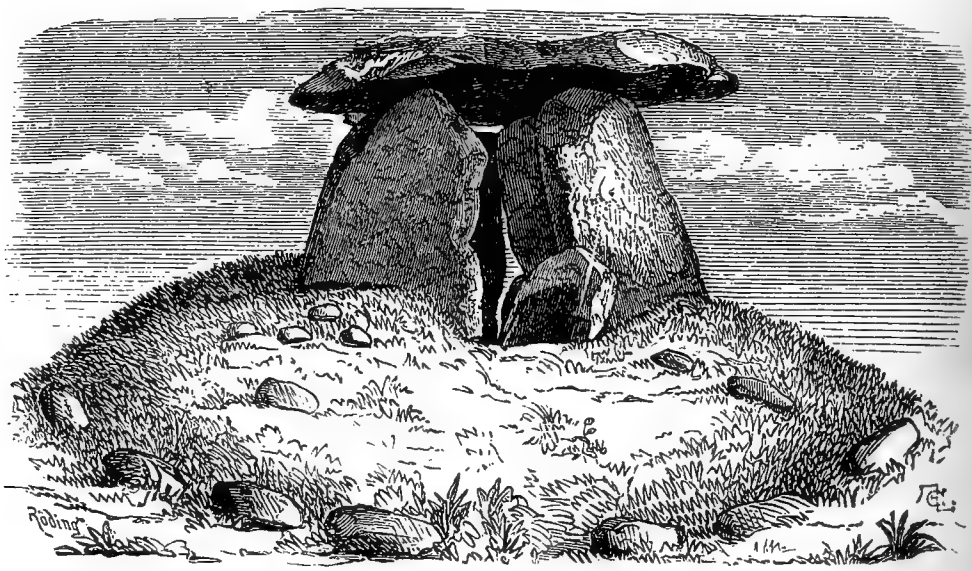

FIG. 7.—DOLMEN AT HAGA, ON THE ISLAND OF ORUST.

holes bored by the tedious process which we have mentioned, or were attached in grooves by splitting the end of a stick and binding it around by cords. Clumsy implements these, even at the best, but some beautiful works remain that were executed with them; and a Danish gentleman recently, for experiment, had some trees felled and all the work necessary for building a small

house, with doors and windows, carried out exclusively with axes and other implements of flint.

At first the people are supposed to have made such clothes as they wore of skins and hides; at a later period they became acquainted with woven stuffs of wool; and the lake-dwellers of Switzerland cultivated flax. For ornaments they had beads of amber (Fig. 5), the teeth of animals, and articles of bone. Awls and needles were made of bone, and an instrument resembling a comb, made of the same material, is supposed to have been used, just as instruments of the kind are employed by the Eskimos, in cutting out the leather threads for sewing. Fishing and the chase supplied the chief means of subsistence, and probably, during the earlier part of the period, the only means. Hooks (Fig. 6) were made of bone, or of bone with the point and barb of flint. Harpoons

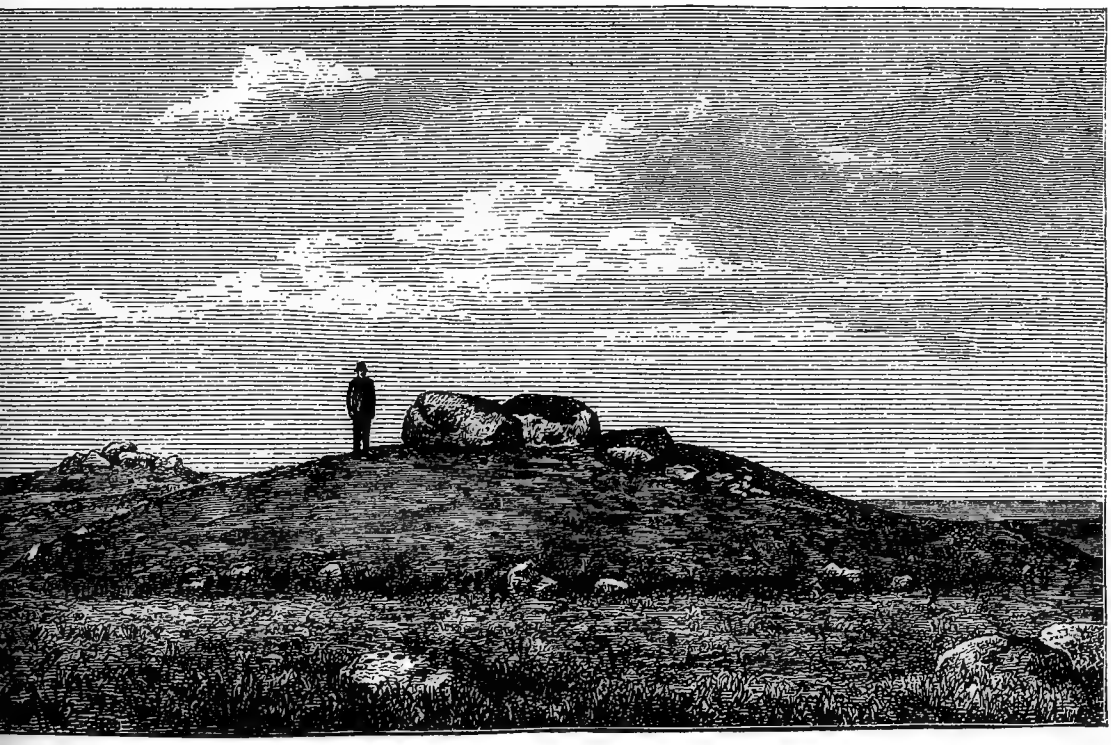

FIG. 8.—TWO PASSAGE-GRAVES AT LUTTRA.

and fishing-spears were also in use, and the lake-dwellers had nets. The people had boats, for remains of fish that can only be caught in deep-sea water have been found in the middens. The earliest boats were probably "dug-outs," though none of those now known can be referred to the Stone age. Domestic animals were kept, for their bones have been found in the passage-graves. The Swiss pastured their cattle and tilled the ground, raising flax, three sorts of wheat, and two-cornered and six-cornered barley. We have no direct proofs of tillage in Sweden during the Stone age, but certain facts seem to show that it was not unknown to them; and this view has been confirmed by the discovery of a stone hand-

mill belonging to the period. Caldrons of clay have holes bored in the upper part, by which the vessel was probably hung over the fire for cooking. Vessels were decorated with straight lines. A horn axe assigned to this period bears two engraved representations of animals.

Except the pile-houses of the Swiss lakes, we know nothing of the dwellings of the Stone age. Prof. Montelius thinks the conjecture is allowable that the people lived in tents made of hides, or in hovels of wood, stones, and turf. Prof. Nilsson has traced a resemblance in form between what are called the "passage-graves" of Scandinavia and the homes of the arctic races in America and Europe. That the Stone-age men had fixed dwelling-places "appears from their often magnificent tombs, which seem to point to the beginning of an organized society, and the combined industry of a small community or of a whole tribe." These tombs are described as "dolmens" (Fig. 7), "passage-graves" (Fig. 8), and "stone cists" (Fig. 9). Of these, the dolmens were the earliest; the passage-graves are a little later; the

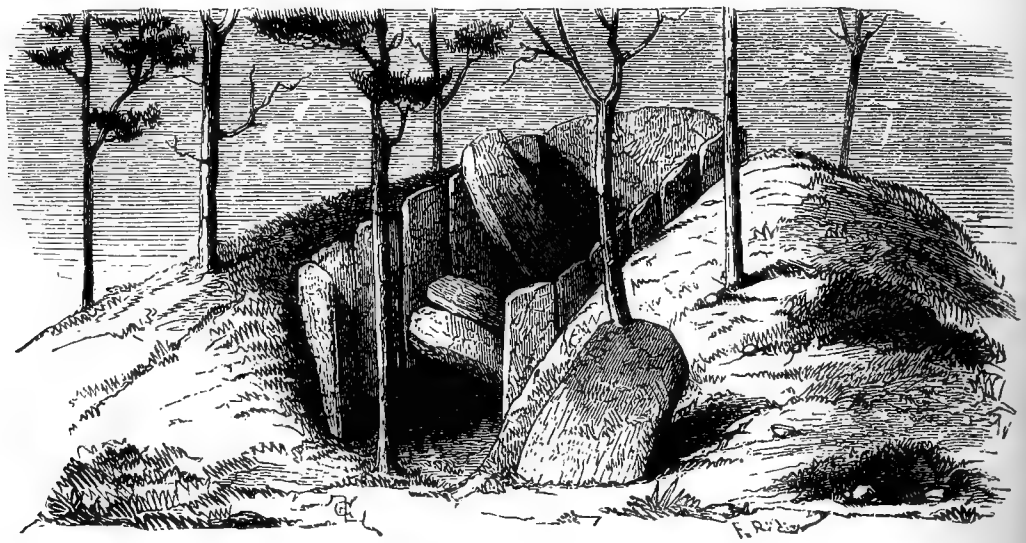

FIG. 9.—STONE CIST NEAR SKOTTENED.

uncovered stone cists are later still; and the cists covered with a barrow belong to the time of transition between the Stone and Bronze ages.

"During the Stone age," says Prof. Montelius, "bodies were always buried unburned, in a recumbent or sitting position. By the side of the dead body was usually laid a weapon, a tool, or some ornaments. We often find in graves of this period earthenware vessels, now filled only with earth. The care bestowed upon the last resting-place of the departed certainly betokens a belief in a future life; but the things placed by the side of the dead seem to show that that life was believed to be merely a continuation of the life on earth, with the same needs and the same pleas-

ures." Offering-stones, with little cup-shaped holes, are sometimes found on the roof-stones of graves of the Stone age. They are now popularly called "elf-mills," and are still regarded as holy; and, it is said, offerings are still secretly made in them.

That the Stone age lasted for a very long time in the North is proved, among other things, by the fact that this period reached a far higher development there than anywhere else in Europe. At what time it began in Sweden we can not even approximately determine; but everything seems to show that it ended rather before than after 1500 B. C., and, therefore, about three thousand five hundred years before our time. In many countries of the east and in the south of Europe the Stone age came to an end long ago; while in some parts of the New World this stage of civilization has continued to our own day.

ELECTRICAL WAVES.*

By SAMUEL SHELDON, Ph. D.

SINCE the time when Maxwell occupied himself with the theory of electricity, perhaps even since the time of Faraday, it has been generally accepted by most physicists that electricity is a phenomenon resulting from oscillations of the luminiferous ether. However, with the exception of a few experiments on inductive capacities, etc., instigated by Maxwell's "electro-magnetic theory of light," no direct experimental verifications of this hypothesis had been made until the latter part of last year, when Prof. Hertz, of Carlsruhe, Germany, commenced a series of experiments on the interference of electrical waves. In all, six articles have been published—two in Band 31 and four in Band 34 of the "Annalen der Physik und Chemie." The earlier articles are of a qualitative character, while the later are quantitative. The former are of less interest than the latter, because the phenomena are less striking and are not so decisive as a proof. They are substantially as follow: The secondary electrodes of a large Ruhmkorff coil consist of two brass rods whose ends are surmounted with brass balls. The two rods are in the same straight line, and separated from each other by a short air-space of about seven millimetres in length. This is the general form of discharger in a Ruhmkorff. From either of these electrodes is led a wire, which connects with a rectangularly bent wire, which, however, is not completely closed, but is cut in some portion, and each of its ends surmounted by brass balls.

* Read before the Mathematical Physical Club of Boston and Cambridge, December 17, 1888.

If, now, the Ruhmkorff be excited, the following phenomena result: If the point of contact between the conducting wire and the rectangle be moved along the latter, it will be found that, for most places, a spark passes between the balls of the rectangle, which varies in intensity, and at one place entirely disappears. This place, if we suppose the opening in the rectangle to be in the middle of one end and both balls to be of the same size, is in the middle of the other end. If, now, while no spark is passing in the rectangle, an insulated conductor be brought into connection with either ball, the sparks again appear. These, again, may be caused to disappear by moving the point of contact toward the manipulated terminal. The same effect would also be produced if, instead of changing the point of contact, an equal insulated conductor were touched to the other ball.

The length, resistance, and quality of the conducting wire have no influence upon the sparks; neither does the resistance or material of the rectangle affect it noticeably: e. g., one half of the rectangle being made of thick copper wire and the other of very fine German-silver wire did not alter the phenomena. Another conductor being brought in contact with the joint between the conducting wire and the rectangle has no influence.

The size of the rectangle has a great influence upon the size and length of the spark between its terminals; the larger giving, within certain limits, always the longer spark.

The air distance of the Ruhmkorff discharger is of great importance; under five and more than fifteen millimetres proved to be infelicitous.

Hertz's explanation of these phenomena is the following: At the moment when a discharge takes place between the terminals of a Ruhmkorff coil, in the whole circuit, and in all conductors in contact with it, powerful wave disturbances are agitated, which follow each other in such infinitesimal portions of time that the time which is required to travel with enormous velocity even a short wire is appreciable. These waves, arriving through the conducting wire at the rectangle, divide and traverse simultaneously both branches. If both sides are electrically symmetrical, the two wave-branches arrive at the balls of the rectangle in exactly the same phase, but oppositely directed, and interfere; there can then be, of course, no spark. If, however, they are not symmetrical, as when the contact is not in the middle, they do not interfere totally, but a spark passes. As the contact moves around the rectangle, the spark at its terminals will be less or more powerful as the interference is more or less total.

The electrical symmetry depends not alone upon the length of the wire, but upon its self-induction coefficient and its capacity.

The formula which expresses the relations is one from Lorenz ("Annalen der Physik und Chemie," vii, p. 161):

$$T = \frac{\pi\sqrt{PC}}{A},$$

where T = time of oscillation of the electrical wave, P = the self-induction of the conductor concerned, C = its electrostatic capacity, and A = velocity of electrical propagation, which is assumed to be that of light. It will thus be seen that each conductor has its own proper time of electrical oscillation and wave-length.

If, now, the capacity of one side of the rectangle be increased, the time of oscillation of the waves on that side will be also increased. This will increase the wave-length, and equilibrium can be established by adding the same capacity to the other side, or by changing the point of contact.

For the reason that the only variables in the time of oscillation are the self-induction and the capacity, the resistance and material of the rectangle have no influence on the phenomena. Because the capacity of each half of the rectangle is chiefly that of the balls at its terminals, the employing of fine wire for one half can produce no noticeable effect.

That the size of the rectangle should have such an influence is to be expected up to certain limits—that is, until the total length of the sides is one wave-length or a multiple of the same. Then the waves could be made to arrive at the terminals in opposite phases, and would give the largest sparks.

Were this the only proof which Hertz could give of interference, a great deal of doubt might be cast upon its conclusiveness. Would not one naturally expect that, if both sides of the rectangle were of the same length and had the same capacity, the potential on both balls would be the same, and no discharge could take place; or, when of different capacities, the charging and discharging following each other so rapidly that the same quantity of electricity would tend to pass through a section of each side of the rectangle, and would thus necessitate a discharge?

But Hertz's quantitative experiments are more satisfactory. In order to understand them, a few preliminary phenomena must be described. These relate to what he calls the principle of "resonance." As any sound resonator, having its own proper wave-length, can be set in vibration by a vibrating body of the same or multiple time of vibration, so we might suppose that any electrical conductor could be set in vibration by a neighboring electrical wave disturbance of proper time of oscillation. This supposition is verified by experiment.

The apparatus and arrangement are very similar to those in the previous experiment. However, instead of the two outer brass balls on the Ruhmkorff discharger, two hollow zinc spheres of

thirty centimetres diameter were substituted, and these were movable along the rods. As these constitute the electrical ends of the discharger, the same may be altered in length by the total diameter of each by simply letting the rods project into the cavity of the spheres. The time of oscillation of the waves in the Ruhmkorff can thus be altered. The brass balls of the rectangle were provided with a micrometer adjustment, so that the length of spark which passed might be measured. The connecting wire was in these experiments dispensed with, and the rectangle was mounted on insulators in front of the Ruhmkorff discharger.

With this arrangement Hertz carried out a complete set of observations, in each of which the effect of a regular series of changes in one of the variables was investigated—e. g., the time of oscillation of the primary discharger would be regularly increased by changing the capacity or self-induction, and for each change the length of spark in the rectangle would be measured. One series in detail will suffice for our purpose.

Suppose, at the beginning of the experiment, that the time of oscillation of the rectangle is smaller than that of the Ruhmkorff discharger, and the spark is one millimetre long. If now we hang two hooks of wire on each ball of the rectangle, the capacity is increased, and we get a spark of three millimetres. Add two more equal hooks, and the spark is five millimetres. Add two more, and it falls off to three millimetres again. If this process be continued, the spark will alternately reach a maximum and minimum, and the natural inference is that the time of oscillation of the rectangle is nearest that of the Ruhmkorff discharger when the spark in the former is at a maximum.

Perhaps it is most striking to place the micrometer at the maximum spark distance, and then, by constantly changing the capacity of either conductor, cause the spark to disappear and reappear. Should small spheres be used, instead of wires, for changing the capacity, we would then have a direct means of determining the wave-length.

These sets of experiments led Hertz to conclude that the principle of resonance is as true for electrical waves as for sound waves, and he employs it for his quantitative work.

The arrangement of apparatus is as follows: To the outer ends of the Ruhmkorff discharger are attached two plates, whose planes are vertical and embrace the line of direction of the discharger. Back of one of these is mounted on an insulated stand a similar plate of the same size. A wire leads from the inner central edge of this to a point on a level but just back of the air-space of the discharger. It then turns in a curve to a point about thirty centimetres directly over the discharger, and then continues in a straight horizontal line some sixty metres. The end is left free,

and, if now the Ruhmkorff be excited, a series of stationary electrical waves will be formed in the wire. To detect these we employ the principle of resonance. A wire whose time of oscillation has been determined and found to be nearly equal to that of the primary conductor is bent into a circle, and the ends are brought close together. This is then brought close to the long wire, and held so that its plane embraces the latter. A fine display of sparks will be seen to accompany the Ruhmkorff discharge.

If this proof circuit be approached to the extreme end of the long wire, no sparks will be seen. The wire has at its end, in fact, a node the same as a stopped organ-pipe has. As the air in the pipe is undisturbed, so the potential of the wire end is unchangeable. As we recede from the end, the sparks grow longer, but finally disappear again. Here is another node. We measure the distance between the two and cut the wire so that its total length shall be a multiple of this length, and then we proceed to find all the nodes, and mark them by paper riders. If we measure each of these distances and take the mean, or measure the whole length of the wire and divide by the number of nodes, we have a value for the wave-length of the conductor. In Hertz's experiment this value was 2·8 metres. From this value, and the time of oscillation reckoned from the self-induction and capacity, he gets the velocity of propagation of electrical disturbances as two hundred thousand kilometres per second. This result Hertz prints in bold-faced type, and puts it as a climax of all his work. This is truly wonderful. If we consider that the calculated value of the time of oscillation depends upon the assumption that the velocity of electrical wave propagation is the same as that of light (three hundred thousand kilometres per second), and this circuitous calculation of the same thing gives two hundred thousand kilometres per second, we can hardly give Hertz the credit of extremely accurate work. However, Hertz has made a great advance in physical science. Since Weber introduced the absolute system of units, no great advance has been made. Physicists have busied themselves in measuring the various constants, in refining and perfecting the methods of measurement, or in applying principles already known to technical and practical purposes. Hertz, however, has opened a new and unexplored field, which must eventually bring us into a closer acquaintance with the mysteries which we are daily manipulating.

This series of experiments has excited a great deal of attention in English physical circles. Prof. Fitzgerald, of this department of the British Association, laid great emphasis, at the last meeting, on the advance which had been made. Oliver Heaviside has justified his patronymic by publishing a complex mass of mathematical formulæ on the subject. He considers that the waves of

Hertz are of a much more complex nature than the experiments would leave one to infer.

When we remember the effect which electricity has upon the plane of polarized light, it would seem that Hertz's wave-lengths are of an entirely different order from what they should be. How can electrical wave-lengths of one metre be in any way associated with light-waves of less than one billionth of a millimetre? Whatever we have known of the wave lengths of the ether, in radiant heat and light, has always been of that infinitesimal order. Still, should the velocity of propagation of electrical waves be much greater than has been supposed, then with these large wave-lengths the times of oscillation could be of the same order as those of light.

Hertz, however, has a system of stationary waves, and it would seem that no direct calculations could give a correct value for the time of oscillation. This can be shown by moving a long trough of water. By holding one end in the hand, suitable impulses can be given so as to produce any desired wave-lengths. Should Hertz be wrong in his conclusions, still the impulse which he has given in this direction is sure to fructify. It is possible that induction may be found to be a phenomenon of pure wave-motion, and that it can be likened directly to radiation. Could we then carry the comparison still further, and say that a conductor is an opaque medium; that a dielectric is transparent—then we would likely soon be constructing electrical lenses, would be detecting electrical refraction, diffraction, and possibly be constructing an electrical spectrum. Doubtless, if not this, some similar thing will develop, and no young physicist need then say that all the things in physics have already been discovered and measured.

THE WASTES OF MODERN CIVILIZATION.

By FELIX L. OSWALD, M.D.

I.

VARNHAGEN VON ENSE, the German Macaulay, characterizes the shams of our latter-day civilization in the remark that "a constant improvement in the luster of the varnish has kept up with the progressive dry-rot of the timber."

The historian thus denounces the increasing political corruption of his age, but his aphorism admits of a much wider application. The increase of prudery masks the decadence of the virtue it tries to simulate; modern courtesies of speech too often conceal the baldest egotism; callous inhumanity is glossed over with sentimental cant.

But the justice of Varnhagen's indictment is perhaps most forcibly illustrated in the time and labor saving contrivances of modern civilization, as contrasted with the enormous waste incident to the evils of life under abnormal circumstances.

The apparent shiftlessness of animals and savages is often due to their confidence in the spontaneous bounty of Nature. Apes will nibble and fling away dozens of wild figs for one they eat, well knowing that the forests will continue to produce millions of similar fruits. Nomads exhaust the pastures of a whole river-delta, and then drive their herds farther inland, having found by experience that, before the return of spring, the coast-land meadows will have recovered their luxuriance.

We pity the ignorance of the Circassian peasant who wastes his time and energy by plowing his highland farm with an implement resembling a crooked fence-rail; but together with other old-fashioned things that barbarian has retained his primitive confidence in the trustworthiness of his natural instincts, and consequently devotes every square yard of his field to the production of palatable and nutritious vegetables.

"Whatever is natural is wrong," was for centuries the shibboleth of our spiritual taskmasters, and that doctrine has borne its fruit in the reckless disregard of our natural intuitions. The shocking taste of a poisonous weed or liquid is generally accepted as a *prima facie* proof of its wholesomeness, and many millions of acres, plowed and harrowed with highly improved apparatus, are wasted on the production of not only useless but positively pernicious harvests. Our prohibition orators bewail the vast area of arable soil wasted on distillery crops, but in the eyes of science the alcohol-habit is only a special form of the stimulant-vice, which, in the course of the last fifty years, has assumed more gigantic proportions than in the most bibulous era of pagan antiquity. The official statistics of the liquor traffic generally allow one bushel of grain for two gallons of spirits, and three bushels for one barrel of beer. By that estimate, the distilleries of the United States alone consumed in the last few years an annual average of thirty-five million bushels of grain, the breweries at least twenty millions. The aggregate of that wasted farm-produce would have made more than a billion four-pound loaves of bread, or nearly a hundred loaves for every household in North America. Placed side by side, the bushel-measures containing that grain would form a chain equal in extent to the circumference of the earth. But the area of the land thus "tilled to bring forth a harvest of misery, crime, and disease" is only a fraction of the total portion of arable fields cultivated to subserve the various forms of the stimulant-vice. Tobacco, tea, coffee, pulque, and opium, together with all the toxic stimulants prepared from tree-

fruits and edible roots, devour the toil of many million laborers and the productive value of at least one million square miles. The fertility of that enormous area is thus not only wasted, but turned from a blessing into a concentration of curses. Mankind, indeed, would gain by the result if the fruitful fields of that poison-harvest were wholly withdrawn from human use; but if even only half their surface were devoted to the production of wholesome food, pauperism would disappear before the blessings of an unparalleled abundance—an abundance far exceeding the prosperity of the happiest provinces of pagan Italy or Moorish Spain. Adding the indirect benefits resulting from the decrease of disease and crime, it is no exaggeration to say that half the weight of human misery would thus be lifted from the scale of weal and woe.

Our political economists would be scandalized by studying the free-and-easy financial methods of ancient empires whose rulers often permitted a large percentage of the public taxes to cling to the pockets of ill-controlled collectors; but the live-and-let-live carelessness of those potentates was associated with a belief in the justice of the general claim to earthly happiness, and the evils of absolutism were mitigated by the liberality of the absolute Cæsars. Every city of the Roman Empire had its free wrestling-ring and foot-race course; every provincial metropolis a free circus, with accommodation for many thousand spectators. Free baths were thought as indispensable as free public fountains of pure drinking-water. Holidays were multiplied to satisfy the needs of an increasing population deprived of the rustic sports of their ancestors. Every community had its weekly and monthly festivals. In Greece even the hostilities of civil wars were suspended to insure free access to the plains of Corinth, where the Olympic games were celebrated with a regularity that made their period the basis of chronological computation for a space of nearly eight hundred years. When Rome became the capital of the world, the yearly disbursements for the subvention of free public recreations equaled the tribute of a wealthy province. As a consequence, discontent with the rule of such autocrats was so rare, that the peace of an empire equal in extent to the entire area of modern Europe could be preserved with a standing army of less than one hundred thousand men.

The modern alliance of canting hypocrisy and bullying despotism has tried a different plan. Enjoyments are reserved for aristocrats by the grace of the orthodox Deity, while the worship of sorrow is enforced on millions of toilers, whose desire of recreation is suppressed as a revival of impious worldliness. The Cæsars silenced the clamors for liberty with free bread and free circus games; the Czars silence them with the knout; but those cowed victims of knout and cross can not be expected to die in

defense of their oppressors; and the conscious impossibility of relying on the enthusiasm of volunteers obliges every ruler of fifty faithful square miles to surround his throne with a bulwark of dehumanized machine soldiers, who, in obedience to the mandate of the uniformed chief machinist, would shoot their own fathers or bayonet their own children. A territory which once could be easily managed with twenty legions, each of four thousand men, has now to be bullied into submission by standing armies aggregating from five million and a half to six million conscripts. The expenses of maintaining that apparatus for the perpetuation of orthodox despotism cost the nations of Europe a minimum of $625,000,000 a year, and withdraw from agriculture an amount of labor which otherwise would suffice to support her population in spite of intermittent droughts.

Our elaborate code of by-laws for the suppression of holiday recreations can still be circumvented by the resources of opulence, and the well-known hopelessness of any other expedient has stimulated a race for wealth which does not hesitate to attain its object at any risk of social or sanitary consequences. The number of infants which the superstition of the Ammonites sacrificed to Moloch is a mere trifle compared with the multitude of children now devoted to a far more cruel fate by being literally drudged to death in crowded factories to enable a millionaire to save a few dimes on his weekly pay-roll and add a few per cent to the exorbitant rate of his yearly profits. In times of general scarcity the market has been drained of its scant supplies by speculators trying to coin gain from the distress of their fellow-men and risking, after all, to be foiled by the decay of their hoarded stores or their destruction by fire or flood. Quack nostrums, which not one intelligent man in a hundred would privately hesitate to pronounce infinitely worse than worthless, are sold by ship-loads and car-loads to disseminate disease and the seeds of the stimulant-vice, and the saints who contribute thousands to insure the theological soundness of the Quaggalla Hottentots do not care enough for the physical health of their own countrymen to whisper a word against the lawfulness of the infamous traffic.

Nearly two thousand years ago Pliny and Columella denounced the folly of destroying the highland forests that shelter the sources of fertilizing brooks and the nests of insect-destroying birds. "Sacred groves" were not limited to the land of the Phœnicians. The Celtic and German Druids protected the forests of their native lands; and even the barbarous Huns seem dimly to have recognized the climatic influence of arboreal vegetation, since we read of their chiefs enacting laws for the protection of the mountain-woods in the lower valley of the Danube.

The mediæval reign of Antinaturalism, however, inaugurated

that reckless destruction of forest-trees which by its consequences has turned many of the most fruitful regions of ancient Europe into almost irreclaimable deserts. Rational agriculture became a tradition of the past; the culture of secular science was fiercely denounced from thousands of pulpits; improvidence, "unworldliness," and blind reliance on the efficacy of prayer were systematically inculcated as supreme virtues. A warning against the consequences of that infatuation would have been answered by the prompt anathemas of the miracle-mongers; but it would be a mistake to suppose that their rant imposed on any independent thinker, even of that ghost-ridden age. "When I consider the value of the least clump of trees," says Bernard Palissy, a persecuted dissenter of the sixteenth century, "I much marvel at the great ignorance of men, who, as it seems, do nowadays study only to fell and waste the fair forests which their forefathers did guard so carefully. I would think no evil of them for cutting down the woods, did they but replant again some part of them; but they care nothing for the consequences of their wastefulness, nor do they reck of the great damage done to their children which come after them." ("Œuvres complètes de Bernard Palissy," p. 88.)

The folly of the insane bigotry which left such protests unheeded was only too soon demonstrated by its natural consequences. When the highlands of the Mediterranean peninsulas had been deprived of their woods, the general failing of springs turned rivers into shallow brooks and brook valleys into arid ravines, which at last ceased to supply the irrigation canals by which the starving farmers hoped to relieve their distress. Vast tracts of once fertile lands had to be entirely abandoned. And while the summer droughts became more severe, winter floods became more frequent and destructive. The steep mountain-slopes, denuded of their vegetable mold, sent down torrents of snow-water, turning rivers into rushing seas and inundating their valleys in spite of protecting dikes. Hill-sides which once furnished pastures for thousands of herds were torn up by ever-deepening ravines and reduced to a state of desolation as complete as that of a volcanic cinder-field. Harbors once offering safe anchorage for the fleets of an empire became inaccessible from the accumulating deposits of the diluvium which had been swept down from the torrent-rent mountain-slopes, while a detritus of coarse sand and gravel covered the fields of the intermediate valleys.

On the shores of the Adriatic alone 250,000,000 cubic yards of highland soil are thus yearly deposited in the form of pestilential mud-banks. A million square miles of uplands in southern Europe and western Asia have become almost as arid as the mountains of the moon. The Rhône, the Loire, the Ebro, the Guadalquivir, the

Euphrates, and the Orontes have completely depopulated many districts exposed to the devastations of their yearly floods.

In America the same cause has begun to produce the same effect. Not in Mexico alone, but within the boundaries of our own republic, the progress of reckless forest-destruction has made inundations an annual calamity, and has so impoverished the soil of the denuded area that extensive tracts in the terrace-lands of the southern Alleghanies now resemble the *despoblados* of worn-out Spain. The loss resulting from the consequences of that improvidence far exceeds the benefit of labor-saving machinery—so much so, indeed, that the waste of vegetable mold, in our Eastern cotton States alone, more than outweighs the profit derived from the improvement of all agricultural implements used on this continent.

HOME-MADE APPARATUS.

By JOHN F. WOODHULL,

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IT is a duty every teacher owes to his pupils to explain to them, or help them to find out for themselves, the causes of the natural phenomena which occur daily before their eyes. Yet to undertake to teach pupils about natural objects without allowing them to *see, handle, hear, taste,* or *smell* them—i. e., to come in contact with them by means of their senses—is like trying to teach music to a man who was born deaf, or color to a man who was born blind. Although it is pretty generally conceded that the teaching of the physical sciences *ought* to be accompanied with illustrative experiments, it is rarely done in the public schools, even in the larger high schools.

The science teacher in the public schools appears to be in a state of mind which might be described as hopeless. He knows that it is idle to look for well-equipped laboratories in the public schools. He knows, also, that even if he could hope for laboratories and apparatus, he certainly can never expect a course of study which will permit of sufficient time for laboratory work. Therefore, finding it wholly impracticable to carry out his convictions, he is in a state of hopelessness. He despairingly falls into the old way of assigning lessons from the text-book. Subjects so full of interest as the natural sciences are thus converted into useless drudgery.

The problem is, *How shall we make it practicable to teach science in the public schools experimentally?*

The first difficulty in the solution of this problem is that school

boards have not the means wherewith to purchase apparatus to any great extent. This fact has led some firms to manufacture what might be called *demonstration* apparatus, much cheaper and simpler in construction than that hitherto used, and therefore vastly superior for illustrating principles, although not sufficiently refined for making accurate measurements; like a story told for illustration by a public speaker, short and to the point, but not embellished so much as to divert the mind from the argument. This is a step in the right direction, but it does not solve the problem. The apparatus is still so expensive that it will be a long time before school boards will be able to purchase it.

Driven by necessity, therefore, which frequently proves to be the mother of invention, the teacher must seize upon familiar objects which chance to be at hand, and, with slight changes perhaps in their construction, use them as apparatus with which to illustrate the principles of his science. Oftentimes he will find that this simple, *home-made* apparatus is far better for illustrating scientific principles than that which has held sway in laboratories for years. Its great merit lies in its simplicity. The student's mind is confused by a complex piece of apparatus. He loses sight of the principle which you would teach in his perplexity to solve the riddle of the machine. Again, this home-made apparatus has special merit in the eyes of the school trustee who sees that with an expenditure of five cents something has been made which usually costs five dollars.

The second great difficulty in the solution of our problem is that school courses, as they are now planned, do not allow adequate time for experimentation. It may seem strange to say that one can make his own apparatus and experiment with it in less time than is required to use the old-fashioned apparatus, and yet we positively and emphatically state this. For example, the principles taught by the so-called "fountain *in vacuo*" are much more quickly illustrated by a bottle with rubber stopper and tubing, as shown in Gage's "Elements of Physics," page 3, Fig. 3. In this case the lungs are used as an *air-pump*. If the same bottle and tubing be arranged as shown in the above-mentioned text-book, page 59, Fig. 40, the lungs may be used as a condenser, and the bottle will supply the place of a *condensing chamber*. Contrivances by which all the experiments may be performed which usually require air-pump and condenser are as simple as those mentioned above. The common-school teacher who has difficulty in securing air-pump and condenser may rejoice in the thought that he has a pair of lungs which may be made to supply the place of both, and are less liable to get out of order. They will not require him to spend his Saturday afternoons in oiling them and fixing valves.

The time required to get ready the old-fashioned apparatus makes it utterly impossible for a teacher in a public school to use it. Again, the time required for the manipulation of it in the class, causes the pupil's mind to wander to other thoughts than that of the principle which is to be illustrated. Add to this the fact that home-made apparatus is so suggestive of scientific principles that, while the student is making it, his mind is constantly learning something new, and we have ground for the statement that *home-made apparatus economizes time sufficiently to make it practicable to teach science experimentally in the public schools.*

Perhaps the chief argument in favor of home-made apparatus is what might be called the manual-training argument—i. e., the argument of its educational value to the student who constructs it. It is always noticeable that the student who makes his own apparatus is not only liable to get a better comprehension of the principles which it illustrates, but his mind is thereby stimulated to inquire into many kindred principles.

The third great difficulty in the solution of our problem is often stated in this way: Teachers in the public schools have not sufficient skill to do this work. The reply is, (1) that it requires less skill to illustrate principles with home-made apparatus than with that which has been the awe and admiration of pupils and teachers alike for ages, and (2) that patience and a love for the work are far more essential qualifications than that which is usually called skill.

To summarize the arguments for home-made apparatus:

1. It teaches the principles better than the cumbersome and expensive forms of apparatus can. Pupils, as a rule, are not machinists and do not understand a complex machine.

2. The student takes a more lively interest in it and understands it better because he makes it himself.

3. All schools may possess it because of the slight expense involved.

4. It is applicable to the lower grades because of its simplicity.

5. It is applicable to subjects which have not hitherto been taught experimentally.

The last argument has special reference to physiology. It has been customary to speak of physics and chemistry as the experimental sciences, but there seem to be equally good reasons why physiology should be taught by experiments also. The processes of respiration, circulation, action of muscles, formation of voice, digestion, and many others admit—nay, demand—illustrative experiments, and the advantages of home-made apparatus are quite as apparent in this field as in the realm of the physical sciences.

THE DEFENSIVE ARMOR OF PLANTS.

By M. HENRY DE VARIGNY.

WHILE, as Darwin and his successors have established, plants are dependent to a considerable extent upon insects for the means of securing the fertilization of their seed, they are also liable to be eaten by them, and are in great danger from the voracious appetites of other animals. They are not, however, wholly without defense against these attacks, but are provided with armors of various kinds, by the aid of which they offer a more or less effective resistance to them. These methods of defense have been the subject of special investigation by Prof. E. Stahl,* of the University of Jena, whose work, "Pflanzen und Schnecken" (June, 1888), presents a most interesting chapter in the history of the vegetable struggle for existence.

While every plant has its enemies more or less numerous and dangerous, the number as a whole is not generally considerable. Some attack the young plant, others the adult; some one part of it, some another. They would, perhaps, be more numerous were it not for the effectiveness of the means of defense that the plant can present against them. These means are various, but without them vegetable species would disappear very quickly. The protection conferred by them is evident, but an enemy more or less is much for a plant. It is sometimes a question of life or death. The phylloxera alone has been competent to destroy the vine in France; and, if ruminants should add their attacks to those of insects against the thyme or euphorbia, those kinds would soon disappear. In some cases, as of thorns or nettles, the armor is easily discovered; in other cases it is internal, chemical, or toxic. The protection is evident, whatever its nature may be. The question arises whether it is fortuitous or the result of a selection among plants. We can hardly doubt what the answer should be. Selection has certainly played a considerable part in the matter.

* Prof. Stahl's study is not the only one that has been made in this line, although it is perhaps the only experimental one. M. L. Erréra, of Brussels, presented a short memoir to the Royal Botanical Society of Belgium in 1886, in which he pointed out how experiments and observations could be carried on in reference to the subject. He drew up a table in which he classified the means of defense presented by plants as follows:—*Biological characters:* Plants at stations not easily accessible or with organs difficult of access, social plants, vassal plants, bullying plants (simulating dangerous species). *Anatomical characters:* Hard, cutting, or piercing organs, calcification, silicification, nettle-hairs, thorns, etc. *Chemical characters:* Acids, tannins, volatile oils, bitter properties, alkaloids, and glycosoids. M. Erréra adds a table of plants known to him which present one or another of the characteristics thus described. But his design was simply to show how great an interest the study might be made to afford. His views are confirmed by Prof. Stahl's researches.

M. Stahl's experiments were made in his own garden and in the woods in the neighborhood, and bore direct reference to the attitude of snails toward the plants. The questions were asked, What plants do snails prefer; what ones do they avoid, and why do they avoid them? The results of his study may be verified by almost any one. Several species of snails were observed; including special feeders, those which live wholly on mushrooms, and omnivorous snails, which, while preferring certain species, eat more or less of all kinds of plants, and sometimes accommodate themselves to animal food.

Pieces of mushroom were offered to the snails, a part of them fresh, others after having been macerated in alcohol, dried by evaporation, and washed. The different species varied in their behavior toward the food. The omnivorous snails would not eat, or would only touch the fresh pieces, but readily devoured those which had been treated with alcohol; but a special feeder ate the fresh pieces and left the others. Hence the author concluded that there exists in the fresh mushroom a substance soluble in alcohol that attracts some animals and repels others. It must not, however, be believed that the special feeders can only live on particular food, for they are capable of accommodating themselves to other kinds when it is necessary. That the ingredient soluble in alcohol was the essential element of the food was proved by the special feeders, which avoided the macerated and dried food, but returned to it when it had been soaked again in the alcohol by which that ingredient had been abstracted.

Some light is cast upon the bearing of this experiment by reflecting on the enormous quantities of food which the omnivorous snails in a state of nature require. A vine-snail or a slug will eat a quarter or a third of its weight of carrot or potato in twelve or twenty-four hours. Although their needs are but slight, they can hardly find enough to assuage their hunger, on account of the mechanical or chemical defenses which most plants offer against them. Thus, the garden snail causes immense destruction of the filbert-leaves in the spring; but it would cause more if these leaves did not contain certain chemical substances, for it eats them more greedily after they have been treated with alcohol. Though this sort of protection is only relative, it will appear very considerable when we reflect upon the abundance and fertility of some species of snail.

Examining a garden near Jena after a warm rain in April, of forty-four snails of the species *hortensis, fruticum,* and *arbustorum,* ten were found upon living plants, while the thirty-four others were eating dead leaves. These three species, therefore, most usually attack dead plants. *Helix pomatia,* on the other hand, was observed almost exclusively upon living species. Ex-

periments in which this species, with *Helix hortensis* and *Limax agrestis*, a voracious all-feeder, were put in presence of several plants having strong odors and pronounced flavors, showed that their tastes as toward living plants were very different. These experiments tend to show that the living plants are protected to a greater or less extent by the presence of some constituent disagreeable to the snails, which we may regard as a defensive armor to them. The dead parts of the plants were preferred, although as a rule dried vegetable is less alimentary than fresh, because the disagreeable substance had been removed or weakened by evaporation. Other experiments show that this kind of armor is, as a rule, the most effective.

When a drop of the juice of sorrel, garlic, saxifrage, or nasturtion is put upon the tegument of a snail, the animal manifests pain and exudes abundance of its mucous secretion; yet it is not thus affected by a drop of water. When snails avoid plants marked by such juices, we have a right to regard the plants as defended by a chemical armor. The offensive substance may also be important to the nutrition of the plant, but that is not the question we are dealing with here. Many plants are evidently lacking in this means of defense; for, of some plants, all the animals experimented upon have been found to prefer fresh to dead parts. Others are never touched by them, whether living or dead. Hence we may conceive that an infinite variety may exist in the degrees of chemical armoring between total absence of protection and complete protection.

Plants containing perceptible tannin are disagreeable to nearly all animals. Only swine will eat acorns as if they regard them as food. Other animals reject them, except when they can not get anything else. Leguminous plants containing tannin in weak proportions are eaten by horses and cattle, but snails are not fond of them. But the garden snail, which lets fresh clover alone, will eat it freely after the tannin has been extracted with alcohol. It is also probably tannin that inspires snails with respect for vetches, saxifrage, and stone-crop. Many water-plants, likewise, strong in tannin, are respected by water-snails, while the treatment with alcohol converts them into savory dishes for the same animals. Other plants, like dock, sorrel, and begonia, contain oxalic acid in notable quantities, and are obnoxious to them when too freely mixed with their food. It is worthy of remark that if carrot, of which snails are fond, is soaked in solutions of tannin or oxalic acid, they will avoid it in proportion as it is strongly impregnated with the offensive substance.

Strongly acid substances are often found on the surface of the leaves of plants. M. Stahl casually perceived that a leaf of *Œnothera* caused a very pronounced acid sensation on contact with

the tongue, which was due to the presence of a superficial acid. On examination he found the same property present in other plants of the *Onograceæ* and *Papilionaceæ*. The acid is secreted by numerous one-celled cylindrical hairs. It consists of a mixture of oxalic, acetic, and malic acids, and, being very disagreeable to slugs and snails, constitutes an efficacious protection against their ravages. A simple contact of its tentacles or teguments with the secretory hairs is enough to cause the animal to draw back and go somewhere else to indulge its cravings. But if the leaves are washed, and the hairs cleansed of the acid secretion, they will be eaten at once.

Many plants are furnished with strong and pungent ethereal oils or similar substances. Prof. Tyndall thinks that these essences help to protect the plant against excessive heat. Without disputing this, M. Stahl finds that they are also efficient in defense against animals. This was proved with respect to rue, calamus, peppermint, dictamnus, and crane's-bill; and snails would at once turn out of the way to avoid a crushed leaf of the latter when placed in their road. Bitter leaves were avoided when fresh; when dead, even those of the gentian were relished, although the fresh ones were rejected by very hungry animals. The expressed juices were very disagreeable to them. The bitter was evidently the unpleasant quality, for the plants in question were free from tannin.* The liverworts, according to W. Pfeffer's researches, contain fat substances, the function of which is unknown, but to which Mr. Stahl ascribes a protecting agency. It is certain that, though they are easily accessible to all animals, they very rarely present any traces of having been attacked by them; and land-snails respect them in a very marked manner. Even after fourteen days of fasting, *Helix hortensis* could not resolve to eat the thallus of *Pellia*. But there are genera (*Lunaria* and *Marchantia*) of which the less delicate snails will consent to eat a little. When the thalluses are treated with alcohol, the mollusks accept them readily; and there are some, like *Plagiochila*, that they will even eat fresh, in spite of their disagreeable smell, because of the much sugar that is in them. But most plants of the order are avoided, because of the unpleasant taste and smell given them by their

* M. Stahl did not particularly concern himself with alkaloids, although they must have played a considerable part in defense in some of the plants that he experimented with. On this point we may refer to some of M. Erréra's conclusions, as given in the paper of himself and Maistrian and Clautrian (Brussels, 1887) on the "Localization and Importance of Alkaloids in Plants": "The alkaloids can hardly be regarded as other than the waste of protoplasmic activity. In fact, it has been proved by experiment that they can not serve as nitrogenous food to plants, and are toxic even to the plant that produces them. . . . The recent researches of Armand Gautier in the animal kingdom bring a strong confirmation to these views. It may be said that a few grammes of an alkaloid protect a plant against the devastations of animals as effectually as the strongest thorns."

fats. It is not always easy to determine of what other uses disagreeable or toxic chemical constituents may be to the plant; the point that concerns us in this discussion is, that they protect it from being eaten, and of this there can be hardly any doubt.

M. Stahl's study of the mechanical defenses of plants is no less interesting than that of their chemical armor. Many of the weapons of this character are obvious and well known; but some of them are more difficult of discovery, while a great variety prevails among them. In the large majority of cases the mechanical defense consists of a hardening of some parts of the plants, which may be general, so as to form a kind of carapace, or local, in the production of hard special organs, such as hairs, thorns, or needles, making it harder for animals to reach the plants. Sometimes the mechanical weapons are associated with chemical qualities, as in the nettle, crane's-bill, *Primula sinensis*, blessed thistle, etc. They either serve to prevent or impede the access of snails and slugs, to make it harder for them to take hold of the alimentary part, or to cause pain during the eating.

Hairy plants certainly offer more obstacles to snails going about on them than do glabrous plants. If we place a snail upon a comfrey-plant, it will find itself very uncomfortable, unable to get any hold on the leaves, and continually brought to a stop by the disagreeable contact of the hairs with its tentacles; and a free snail or slug will be hard to find on this plant. Other hairy plants possess immunity in less marked degrees; and M. Stahl's conclusions from his experiments as a whole are that chemical armor is more efficient than hairs. In some cases downy plants were preferred, while chemically armored species were always respected. So, when glabrous and downy species of the same family were tested, downy ones were eaten, while smooth ones were left alone. Hence, the hairs afford only an inefficient defense. M. Stahl accounts for this by supposing that, while the smooth plants are protected by disagreeable chemical constituents, the hairy plants are without this armor, or else present attractive qualities of odor or taste, against which their hairs are only an imperfect set-off.

Some plants are defended by the calcification of their superficial cells. The snails would not eat the leaves of *Erysimum cheirantoides* (treacle-mustard) when fresh, or even when treated with alcohol, but attacked them readily after the carbonate of lime had been dissolved out by acetic acid. The same was observed with other plants having a similar property. The grasses are protected against attacks from many animals by the silicification of the walls of their cells, without which the new enemies that would be added to supplement the assaults of their present foes would make an end of the whole family. This may be tested

by offering to snails full-grown leaves and young, tender ones of the same grass. The latter will be taken and the others left. But if, by a method of cultivation proposed by Sachs, we make a normally siliciferous plant grow where it can get no silica, it will be devoured at once.

Some plants, that were avoided after treatment with alcohol as well as before it, were found to contain a gum which the alcohol failed to remove, and which stood between the snails and the edible substance. Among these were linden, althea, cactuses, and gummy roots. Another series of plants, including an *Arum*, narcissus, leucojum, and the balsam touch-me-not, which contain no tannin or gum or substances of disagreeable taste or smell, appeared to be protected by raphides. Tabernæmontanus recognized in 1587 that the leaves of these plants produce a violent sensation of burning in the bronchial tubes, and that it is not due to soluble products or juices, but to the raphides, which are abundant in their tissues. This is proved by the fact that the filtered juice of the pounded leaves does not produce the burning sensation, while the residue on the walls of the filter, and the pounded leaves themselves, produce the characteristic sensation that is felt after chewing the fresh leaves. It is also confirmed by the fact that if the leaves of *Arum maculatum*, for example, are treated with dilute hydrochloric acid, which dissolves the raphides, animals will readily eat them, while they let alone leaves treated with alcohol, even when they have been steeped in sugar-water. In the case of the squill, snails avoid the outside of the scales, which are rich in raphides, and eat the inner sides, which are free from them. So in the narcissus and orchids, and various other plants, there are parts protected by raphides which are objectionable to snails, and other parts free from them that they eat. But, while raphides protect against some animals, they do not against all. Birds and ruminants do not object to the plants containing them; and even snails manifest different degrees of aversion to them. In a similar manner to these plants with raphides, some species of iris are protected by crystals of oxalic acid. It is very probable that the kinds of armor that we have named are available for protection against other animals than snails. But investigation on this subject has not been sufficiently advanced to permit of definite conclusions or generalizations.

Of the kinds of defense named, a minority of the plants studied by M. Stahl possess but one; many are endowed with two; and some with three—as, for instance, *Oxalis* (oxalic acid, tannin, and hairs); *Circæa* (bitter hairs, tannin, and raphides); *Smilax* (thorns, raphides, and poisons); *Aloe* (leaf-teeth, raphides, and bitter substance); and *Pontederia* (crystals of oxalate of lime, raphides, and tannin). In fact, considering the number of ene-

mies against which a plant has to contend to maintain its existence, their defenses are more numerous than we would suspect, and more important than we might at first believe.

In analyzing M. Stahl's results, we perceive that some families possess, as a whole, similar methods of protection: the grasses, sedges, and horse-tails, silicification; the rough-leaved orders, hairs; the *Amaryllideæ*, *Asparageæ*, orchids, and *Onagraceæ*, raphides; the gentians, bitter substance; the rose family, geraniums, legumes, and heaths, tannic acid; the nightshades, alkaloids; the labiates, ethereal oils; mosses, mechanical means (by silicification); and liverworts, chemical means, and one genus of them, *Riccia*, mechanical means also.

Different genera in the same family sometimes present quite diverse means. Among the lilies are genera (*Scilla* and *Ornithogallus*) having raphides; others, alliaceous compounds; lilies, tulips, and crown imperial, poisons. There are also differences between the species of the same genus; thus, one species of *Sedum* is protected by tannin, and another by an alkaloid. And in the same plant there are often very notable differences between the leaves, fruit, and root.

M. Stahl asserts that he has not found a single phanerogamous species, living in a wild condition, that is not armed in some way against slugs and snails. Such armor is wanting only among cultivated plants, or, rather, among some of them. It appears as if at the moment when man cultivates a species of plant, or takes it under his protection, using all possible means to facilitate its existence and remove its enemies, the plant gives up its own means of maintaining the struggle, surrendering its defensive armor at man's invitation. The common lettuce is a striking example of this fact. It is a favorite viand, as all know, of the *Gasteropods* of the garden. Nothing protects it against their attacks, and its smooth, tender, and succulent leaves make it a ready prey to them; yet it is the descendant, modified by cultivation, of the *Lactuca scariola*, which has chemical constituents so distasteful to snails, and so constant, that they will not eat it even after it has been treated with alcohol.

The defensive armor of plants is most frequently situated upon their surface, or where the attack begins. This is particularly the case with the mechanical weapons and such chemical ones as tannin, special juices, etc.

When we consider how varied are these armors of plants and how generally spread they are among all the orders, and that without them some species would not be able to exist, it is hard to deny that there is some special adaptation in them, or to suppose that they are merely accidental. The case is undoubtedly one of natural selection; and the fact that the protection is gained

sometimes in one way and sometimes in another, is not unfavorable to this hypothesis. It is with plants as with animals. One animal endures by means of his agility, another by his thick skin; another by this kind of defense, and another by that. The field opened by M. Stahl is one that has as yet been but little explored. It promises much that is novel, and bids fair to afford a new and most interesting chapter in the history of natural selection.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

BLOOD-VENGEANCE AND PARDON IN ALBANIA.

By HERR J. OKIE.

THE Albanians are accustomed to train ganders for fighting, for which purpose they feed them with such herbs as contribute most to the development of a pugnacious disposition. When one among them thinks his goose's courage has been sufficiently developed, he sends out a herald to go through the village uttering a challenge for any townsman having a gander which he is ready to pit in a combat to bring him to the ring for a match.

Such a challenge was sounded in the village of Unter Rogiza in the later days of August of last year. It was answered by a wealthy Albanian, who at once betook himself with his goose to the place where such spectacles were exhibited. His antagonist was already in waiting, with about a hundred on-lookers. The match had gone on for about two hours, when one of the champions began to fail. His owner wanted to help him, but the proprietor of the conquering goose would not permit it. Irritated by this, the losing owner raised his gun and shot the other man down on the spot. The spectators of the tragedy were so astonished for the moment that no movement was made to arrest the murderer, and he fled to the mountain. The friends of the murdered man instituted a pursuit of him, which was kept up for several hours, the murderer running up and down the hills, and his pursuers following him closely. Finally, when he saw that he could not escape, he turned toward the village and took refuge in the house of his victim. The dead Arso was lying in the room, and his mother beside him was weeping and lamenting the death of her only son. The murderer set his gun in the corner and said: "I am in your house; give me *bessá* (oath of protection), for they are going to kill me." He continued repeating these words till the old mother gave him the *bessá*. When his pursuers came up to the house, the mother of the dead Arso stepped to the door and waved a handkerchief toward them as a sign that no one should

enter. The pursuers scattered, only the father of the deceased remaining in the yard. When they had all gone away, he went into the room where the murderer of his son was sitting by the mother, with a part of her mantle thrown over his knee.

"Go out of the room," she called to him; "I have given him my oath!"

The old man, without speaking, set his gun in the corner, kissed his son's cold forehead, and went out to make preparations for the funeral. At sunset, while the people of the village were busied with the affairs of their inner households, and even Arso's relatives were engaged each in his own particular duties, the old lady took her charge by the hand and led him out upon the mountain. As soon as she had seen him at a safe distance she told him: "Now my oath is fulfilled; you must look out for yourself after this!"

The obligation of the *bessá* had terminated; now followed the pursuit of vengeance. The more industriously the family of the murdered man sought for retribution, the more earnestly the friends of the murderer exerted themselves to obtain pardon. This state of affairs continued through two months.

At last the whole circle of the murderer's relatives met and decided to ask the father of the murdered man to remit the blood-penalty to the murderer. For this they all rose—the women taking their infants from the cradle and carrying them along—and went in a body to Arso's father. In front of the company marched the murderer, his head veiled with a linen cloth, and the gun with which he had committed the murder hanging from his neck, muzzle down. Behind him walked two of his particular friends, and after them the rest of the family procession. As they came near the house of the avenger, they all cried out as with one voice, "*Aman! aman!*" (pardon); and continued the petition till noon. The father of the murdered man, without seeming to notice them, consulted with the members of his family whether he should, according to the customary law of the country, shoot the murderer at once or give him pardon. It was decided to pardon him. The father advanced toward the expectant company. The murderer knelt, ready to accept life or death, while the rest of the procession renewed their petition for pardon. The old gentleman took the murderer's gun and discharged it into the air; then lifted the cloth from his head and kissed him, in token of pardon. Then he kissed the other male members of the family procession, took the murderer by the hand, led him into the house, and set him in the son's place. The affair was concluded by a three days' feast in the avenger's house.—*Translated for the Popular Science Monthly from Das Ausland.*

MR. MALLOCK ON OPTIMISM.

By W. D. LE SUEUR.

AS, in olden time, a certain Lars Porsena, of Clusium, swore by the great gods that his friends the Tarquins, who had been expelled from Rome for gross misconduct, "should suffer wrong no more," so, in our own day, Mr. Mallock, of "Is Life worth Living?" seems to have sworn a great oath that the beliefs which the republic of modern thought has for good cause expelled from its borders shall by his powerful arm be restored to their old tyranny over human life. He therefore brings up his forces, draws lines of circumvallation, and prepares to conquer and capture the whole host of liberal thinkers, and either put them logically to the edge of the sword or force them back into the ancient slavery. The enterprise is not lacking in audacity, and, to do Mr. Mallock justice, he seems to be a writer of no little courage and of infinite jest. His sword-practice is always brilliant; and, if he could only induce his opponents to stand exactly where he makes his passes and slashes, there is no question that he would do for them completely enough. As it is, we see the gleam of the weapon; but, somehow or other, the foe does not fall, and we begin to perceive that he was never quite in the line of the strokes.

In furtherance of the purpose above indicated, Mr. Mallock has contributed two apparently powerful articles to the "Fortnightly Review"—one on "The Scientific Bases of Optimism," and the other on "Cowardly Agnosticism." We shall briefly examine the first of these to-day, and, perhaps, with the editor's kind permission, may take up the second at a later date. "Optimism," in Mr. Mallock's view, is the essential creed of all the modern schools of thought, whether Unitarians or Deists, followers of Spencer, followers of Matthew Arnold, or followers of Auguste Comte. All of these, whatever some of them may say to the contrary, really unite in worshiping Humanity; and Mr. Mallock undertakes to show them how foolish their worship is, and how mutually contradictory are the ideas on which it is founded. Let us take a brief but careful survey of Mr. Mallock's argument.

"The religious doctrine of Humanity," says this agile writer, asserts that the facts of history have a meaning, that they follow a certain rational order, and that, taken as a whole, they have been, are, and will be always, working together—though it may be very slowly—to improve the kind of happiness possible for the human being, and to increase the numbers by whom such happiness will be enjoyed. To affirm this, however, is, by implication, to affirm that a natural element in human character is

sympathy, and that not only is this feeling far stronger and wider than has usually been supposed, but it is capable even now, when once the idea of progress has been apprehended, of inspiring the individual to work for the progress in which he shares, and is sure to acquire, as time goes on, a strength incalculably greater. It is because the religion of humanity takes (as he says) such a cheerful view of things in general that Mr. Mallock rechristens it "the creed of Optimism." All the holders of that creed believe, we are told, "that the human lot has something in it which makes it, in the eyes of all who can see clearly, a thing to be acquiesced in, not merely with resignation but devoutness." This is the idea which Mr. Mallock undertakes to dispel by showing (1) that the doctrine of a steady progress in human affairs is not proved; (2) that sympathy is not the powerful emotion that optimists take it to be; (3) that admitting progress to be a reality, and sympathy to be all that it is claimed to be, the thought of the miseries humanity had endured in the past would poison all the satisfaction resulting from its improved condition in the present and its brilliant prospects for the future; (4) that the more we dwell upon the practical perpetuity of the human race the more is individual influence dwarfed in comparison; (5) that it is difficult to imagine what form or character the happiness we anticipate for our posterity can take, seeing that the absence of pain is merely negative in its character, and that the idea of an abundance of creature comforts is not one that can give pleasure to any human being capable of any high conception of life; finally, (6) that if we are to see any meaning in life we must follow a light which is not that of science—the light of theological faith.

Such is the argument of our opponent, supported throughout, it must be admitted, by more or less aptly chosen instances and an abundance of plausible rhetoric. The question is, How does it affect, how does it touch, any vital issue of the present time? Is it true that there exists in the world to-day a "creed of optimism" held in common by a number of otherwise divergent schools of thought, and that the elements of that creed are as described by Mr. Mallock? To this question we venture to give a negative answer. It is quite possible that individuals here and there may have constructed for themselves some such metaphysical creed as the above; but to say that any large number of representative thinkers of our time could be got to take their stand on the propositions formulated and criticised by Mr. Mallock is to state what we are confident is not the case.

The situation to-day is simply this: A theological creed which had descended to our age from very early times has been found, when examined from the historical point of view, to be as little proof against criticism as the moral, political, and scientific ideas

of the same period. The considerations which moved our ancestors to belief do not and can not move us; and, therefore, so far as the theology in question furnished an interpretation of the world or a guide to conduct, men who can not now accept it are compelled to look around for other canons, other sanctions, other modes of arriving at truth. The thinkers of this age have not deliberately made this situation for themselves. The change has come, upon the whole, very gradually; and human beings are every day being born into an atmosphere in which the ideas that were current in the earlier centuries simply can not live unless in some manner artificially protected. The difference between our time and the former age consists mainly in this, that educated men have now something like an adequate idea of what knowledge is, and of what proof is, and that they have got into the way of asking for proof before they yield belief. That this was not formerly the case—that men believed for the most fantastic and ridiculous reasons—could be abundantly proved if necessary; but surely it is not necessary. The task, then, which is assigned by dogmatic theology to this generation is to believe without those aids to belief which the more habitual supernaturalism of our more ignorant ancestors supplied. Some try to do it and succeed, making ends meet by ways and means best known to themselves. Some try and do not succeed; and some feel dispensed from trying at all. Monotheism it must be remembered was not a special revelation to mankind. There are good grounds for the belief that, in every case it has resulted from the consolidation of an antecedent polytheism; while polytheism itself has been a delusion forced upon men's minds by the countless activities in nature which they have been powerless to explain to themselves in any other way. The time has come at length when, as an explanation of nature, monotheism itself has lost its virtue; not because there are not many dark problems still to be solved, but because monotheism is recognized as rather the assumption of a solution than a solution. Men, even those who view things in this light, may still be theists, but intelligent men at least are not theists merely because they can not understand everything in nature. Their reasons are of a different order.

Instead, therefore, of there being anything in the condition of men's minds to-day or in the average philosophy of the time to provoke ridicule or hostile comment, there is much that calls for every allowance and consideration. The science, the history, the philosophy, the political and social organization of the past are discredited. Its theology is discredited, too, and men are engaged in a strenuous effort to lay new foundations and rear worthier superstructures in every department of thought. The workers, happily for themselves and for the world, are not all brigaded and dra-

gooned by the voice of authority, and therefore they are not all working on the same lines; but they are *working*, and their sincere labors will not be in vain.

The question, however, at present is whether the various liberal schools referred to by Mr. Mallock stand committed to the new dogmatic system which he has described. The first thing that strikes a careful reader of his article is that he has not given a single quotation from any leader of modern thought indicating acceptance of the views in question—a thing which it would certainly have been easy to do if these views were, as he maintains, fundamental with them all. It is an illusion into which a man easily falls, whose own thought has run in dogmatic lines, to suppose that others must have constructed for themselves a philosophical or logical framework of equal rigidity. The truth can not, therefore, be too often repeated that the essential mark of modern thought is the taking of the world just as it is, and the reduction of all theories more or less to the rank of working hypotheses. Whether the changes in human affairs support the theory of a great secular drift toward better conditions is a question to be decided simply according to the evidence, which can hardly under any circumstances be of a demonstrative character in the full sense. The simple fact that men have the power of rationally adapting means to ends is enough to prompt to effort and inspire hope, for in this power lies the key to the highest possibilities of advancement. He who knows can, and, as long as this is the case, the path of knowledge will be the upward path. Knowledge, to be sure, is sometimes abused. Why? For want of more knowledge. There may come periods in the history of a people when the virtue of such knowledge as they possess has become exhausted, and when in the rude school of experience they may have to learn other practical lessons as the necessary condition of further advance; but how all this may be is a matter for which no individual man is responsible, and one who should wait to devise a practical philosophy for himself until he had cast the horoscope of humanity would not be wise. The late Mr. Arnold thought he had discovered clear traces of "a power, not ourselves, that makes for righteousness"; but he did not wait for the formulation of that discovery, if such it was, before striving to order his own life on principles of righteousness. And if some one comes forward and points out, as one critic at least of Mr. Arnold did, that whether "the power" is making for righteousness or not depends upon the stage of a nation's development, there being periods when the general forces make rather for unrighteousness, no one is obliged, even though he may regard the criticism as pertinent and well-founded, to abandon his previously adopted plan of life.

If, therefore, Mr. Mallock would really make the position of an independent, non-theological thinker of the present day untenable, he must show, not that the theory of progress in general is without logical support, but that, taking the world as it is known to us, there is no support outside of theology for intellectual or moral effort. Let Mr. Mallock show that, because we can not share his views in regard to the government of the world, we can not desire the good of our neighbor or draw the distinction which the poet draws between "a higher and a lower," and we shall at once acknowledge our situation to be a very serious one. It is simply because he can not show anything of the kind that he adopts his present tactics, which are to saddle on the liberal schools doctrines which they do not hold, and then to attack those doctrines with his heaviest logical ordnance. In regard to the doctrine of progress, Mr. Spencer is perhaps the most authorized exponent of modern ideas, and how far he is from maintaining it in anything like an absolute form may be gathered from his works at large and very conclusively from the eighth chapter of the first volume of his "Principles of Sociology." A quotation or two may be permitted: "If, on the one hand, the notion that savagery is caused by lapse from civilization is irreconcilable with the evidence, there is, on the other hand, inadequate warrant for the notion that the lowest savagery has always been as low as it is now. It is quite possible, and, I believe, highly probable, that retrogression has been as frequent as progression. . . . Of all existing species of animals, if we include parasites, the greater number have retrograded from a structure to which their remote ancestors had once advanced. . . . So with super-organic evolution. Though, taking the entire assemblage of societies, evolution may be held to be inevitable as an ultimate effect of the co-operating factors, intrinsic and extrinsic, acting on them all through indefinite periods of time; yet it can not be held inevitable in each particular society or even probable. . . . Direct evidence forces this conclusion on us. Lapse from higher civilization to lower civilization, made familiar during school days, is further exemplified as our knowledge widens."

Any candid person can judge from these passages how far Mr. Spencer must be from basing any theory of human conduct upon the abstract notion of the progress of the human race. His moral system, as is well known, has nothing to do either with a general theory of progress or with the sympathetic interest which individual men may take now or hereafter in the fortunes of humanity at large. If we turn to another writer of very "advanced" opinions, but whose standpoint differs materially from Mr. Spencer's —Dr. Maudsley—we find that he too lays no great stress upon the idea of progress, and very fully recognizes the many evidences

of retrogression which history and natural history alike present. "It admits of no doubt," he says in one place, "that a law of degeneration is manifest in human events; that each individual, each family, each nation, may take an upward course of evolution or a downward course of degeneracy. Noteworthy" (he adds) "is the fact that, when the organism—individual, social, or national—has reached a certain state of complex evolution, it inevitably breeds changes in itself which disintegrate and in the end destroy it."* Turn now to Mr. Leslie Stephen, a writer as free from all theological prepossessions as either Mr. Spencer or Dr. Maudsley. Far from making the assumptions which Mr. Mallock attributes to the whole liberal school, he criticises some of those assumptions in terms that resemble very closely those used by Mr. Mallock himself. For example, he tells us that, while speculations in regard to a future Utopia for human society "may be useful in defining an end toward which all well-wishers to their fellows may desire to act," such speculations are nevertheless rash, and do not solve the difficulty for us, inasmuch as "the knowledge—if we could attain the knowledge—that our descendants would be better off than ourselves would not disprove the existence of the present evil." Pushing the objection further, he says: "We can not tell that progress will be indefinite. It seems rather that science points to a time at which all life upon the planet must become extinct, and the social organism may, according to the familiar analogy, have its natural old age and death." †

There is no use in taking up space with further citations. The fact is, we would not, at this moment, know to what writer of the several schools of thought referred to by Mr. Mallock we could turn, to find that dogmatic assumption of progress which he says is characteristic of them all. What characterizes them all is a manly determination not to despair of the fortunes of humanity because the former monopolizers of spiritual authority have suffered an abatement of their prerogatives and now expend a large portion of their energy in anathematizing the tendencies of the age. What further characterizes them all is a conviction that morality and happiness must have sources independent of human institutions and abstract philosophies, and that, certainly, neither demonstrable falsehoods nor unverified theories of any kind can be their absolutely necessary conditions. Mr. Leslie Stephen expresses this well when he says: "It may be said that the whole history of the world and its inhabitants represents a problem of stupendous magnitude. . . . We work out the problem by living, or rather we work out our own little bit of the problem. We are utterly incompetent to grasp the whole or to rise above it, and say why such and such data must have been

* "Body and Will," p. 238. † "Science of Ethics," p. 444.

given, and what will be the further stages of the process. But when we once recognize the fact that the problem is being worked out, we see that an answer is actually given in some degree by the very facts before us. That is really the nature of the change in the point of view implied in the acceptance of the evolution theory." *

Having thus shown to how large an extent Mr. Mallock has drawn upon his imagination in regard to the importance assigned in modern ethical theories to the idea of progress, it is easy to show that what he has said on the subject of sympathy is equally destitute of foundation. The emancipated modern thinker tries to take stock of human nature as it is: the age for constructing ideals of a purely imaginative kind has passed. We want to ascertain just how much sympathy there is in average human nature, so that we may know what we have to depend on. We want to discover also how far the quantity now existing admits of increase. Auguste Comte studied this question closely; and, far from unduly magnifying the sympathetic element in human nature, he continually speaks of it as being very weak in comparison with the egoistic, and therefore requiring all the re-enforcement we can give it. His whole system is an elaborate effort to draw out sympathy and make it more widely and powerfully operative in human affairs. For this purpose his followers think it right and profitable to dwell much upon the history of the human race, and to bring into strong relief the organic dependence of the individual upon society at large. Many who, perhaps, would not care to acknowledge any obligations to Comte, are to-day doing the same thing—so much so that the prominence given to the thought of society as an organic whole, infusing its own larger life into its individual members, may be said to be an especial note of the present age. If it be asked what object there can be in quickening sympathy between a man and his fellows, the answer is, the promotion of more harmonious social action, resulting in economy of force and increase of happiness. Upon this point Mr Mallock seems to be all astray, owing doubtless to the too abstract manner in which he chose to treat the question. He seems to think that the whole effect of sympathy is confined to the mental representation of others' pains and pleasures. He forgets, apparently, that it has its natural outcome in action; and that, except as a basis for action, there would be no useful purpose in cultivating it. This is the true and obvious answer to his paradoxical contention that an increase of sympathy could not make for happiness, seeing that if, on the one hand, it enabled us to enter more heartily into the joys of others, it would, on the other, bring home to us more poignantly their sorrows. We can

* "Science of Ethics," p. 34.

not increase sympathy with mankind at large without strengthening the sense of duty and prompting to deeds which—whether they take the form of promoting happiness or averting misery—will themselves be a source of blessedness to the doers. What is wanted is simply such a development of sympathy as will best subserve the interests of society; and Mr. Mallock's idea that a power of sympathy sufficient to prompt men to lead virtuous lives would also be sufficient to fill them with anguish at the thought of all the past sufferings of mankind, is altogether fanciful and hollow.

An assumption which vitiates much of Mr Mallock's reasoning on this whole subject is that right conduct is, in the human sphere, a kind of rare and frail exotic, requiring the services of a theological gardener and the warm, heavy-laden atmosphere of some ecclesiastical hot-house in order to live at all. But that is a view which we are under no obligation to accept, and which the facts of life are very far from suggesting. Why should the relations of man with man be, in their own nature, everlastingly wrong? Surely there is sunlight enough, and air enough, and earth enough, and water enough, for a good many of us to live together on this earth in peace and concord and mutual helpfulness! Surely men have need of one another, and it is difficult to imagine how they could long work together without the development in their minds of the conception of justice. In point of fact, the idea of justice is in the world and has been in it in one form or another for many ages. The task that is set before us to-day, with our widened experience and deepened reflection, is to realize that idea more and more perfectly in all social relations. Why should we wish to do it? Because we know that justice is good, and because our sympathies, aided by a certain diffused feeling of self-interest, prompt us to strive for the perfecting of society. But, apart from all voluntary or deliberate effort, the idea of justice acts as a powerful leaven in the society into which it enters, and we may hope that by and by it will leaven the whole lump. When Mr. Mallock says that "the problem is to construct a life of superlative happiness," he makes a complete misstatement so far as any problem contemplated by the thinkers he criticises is concerned. Theologians promise a life of superlative happiness in another world, but non-theological reformers are more moderate in their expectations. What the fortunes of the human race may be in the far-distant future they do not undertake to predict. They may sometimes, like the poet, dream their dream of good; but, if so, it is a good such as the conditions of human nature and its environment are capable of supplying. It is hard to understand how Mr. Mallock could bring himself to make such a statement as that just quoted. Admitting that theo-

logians attack the problem of "constructing a life of perfect happiness," does it follow that the liberal thinkers of the present day must follow them on that ground, like the magicians of Pharaoh, imitating, to the best of their considerable ability, the miracles of Moses and Aaron? It would be much to Mr. Mallock's benefit if he could only be persuaded, once for all, that the distinguishing mark of the whole evolutionary school is that they take the world as they find it, and expect no more from it than it is adapted to render. If human history as a whole is predestined to be a failure, that is none of their affair; they are not in the business of insuring worlds or universes or even civilizations. All they can say—and this they do on the ground of experience—is that, taking the world and the human consciousness as they are, there seems to be one line of conduct which best subserves human interests; and which, therefore, they will both follow themselves and recommend to others. That line consists in practicing the lessons that Nature and history have taught us, using our faculties for the acquisition of real knowledge and our powers of foresight for a wise adjustment of present action to future needs and results. If the man who is filthy spurns this humble, unpretentious philosophy, and determines to be filthy still, he must be allowed to exercise his preference, as he has done under other dispensations. Wisdom will still be justified of her children, though the gospel of science should be hid to them that are lost.

Mr. Mallock is much concerned over what the future of humanity will be if his principles do not prevail. He can not "feel any pleasure in the thought of a Humanity 'shut up in infinite content,' when once it had secured itself three meals a day, and smiling every morning a satisfied smile at the universe, its huge lips shining with fried eggs and bacon." Well, if the time should ever come when humanity has nothing to be satisfied with save abundance of food and a good digestion, Mr. Mallock's delicately chosen image may be in some measure realized; but why it should be necessary to imagine such a future for society, merely because knowledge is growing and superstition waning, it is not easy to say. Why should not "knowledge grow from more to more," and yet "more of reverence in us dwell," so that—

> ". . . mind and heart, according well,
> May make one music as before,
> But vaster"?

It is hard to conceive any reason except such as might be supplied by the petulance of a disappointed partisan. Mr. Mallock would fain persuade us that, save on his principles, life is not worth living; but, despite his elaborate argumentation, the modern world, while departing ever more widely from his favorite

principles, goes on living and enjoying life. Hence these tears, and these savage diatribes against an imaginary dogmatic optimism on the part of his opponents. To him they perhaps seem optimists, as not sharing his pessimism; to their own apprehension they are simply children of their age, listening to its teachings with earnest attention and trying to utter the message they receive.

What, after all, would Mr. Mallock have us do? He says that there is no evidence of any meaning or of any general progressive movement in human history—none that "would be accepted either in physical or philosophical science." Yet he wants us to believe on some *a priori* ground, which he is prepared to present, that life *has* a meaning and *does* exhibit progress. If we will only accept the light that he offers, we shall see that "life is full of august meanings"; but that light, he plainly tells us, is not the light of science. In the same way he offers to invest with infinite significance and value any little services we may render to humanity—services which, considered simply as offered by man to man, would not be worth taking into any kind of account. The method in this case is to bring our offering to Christ, who "judges it by the effort and the intention." The altar of humanity, then, is not a sanctifying altar; and men must be assured of a high rating for their sacrifices before they will be content to make them. "The love of humanity without faith to enlighten it, and nothing to justify it beyond what science can show, is as absurd as the love of Titania for Bottom." The reply to this is that long before what Mr. Mallock speaks of as "faith" was known in the world the nobler spirits among men had a love for humanity, and were further ennobled, not made ridiculous, by their love. From the commencement of history, indeed, down to the present day, there has been but one way of being noble, and that has been by caring for one's fellow-men. That way some have found out in an eminent degree, and multitudes in a lesser degree, without any aid from theological fancies. In the present day, when the laws of social development and the true relations of individual life are so much better understood than formerly, there ought to be, and there is, much more to nourish in individuals a rational regard for the general welfare. The love of Titania, whether for Bottom or for Oberon, supplies no apt illustration here, since the case is not one calling for romantic love, but simply for loyal devotion to a recognized source of good—to that higher life of society without which the individual life would wither and starve.

Mr. Mallock's terms are too hard. Much as we might wish to read those "august meanings," much as we might wish to feel that our gifts to humanity received instant recognition and sympathetic appraisement, if it is a question of reinstating the Tar-

quins of ecclesiasticism, we must forego those visions; we must look within for our reward. Better to face a sterile universe than submit to a spiritual tyranny. But to us the universe is not sterile, nor is life without meanings which might almost be pronounced "august." The theological solution of the problem is simply an adjournment: the next world is to clear up the mysteries of this. The scientific solution may be summed up in the word "adaptation." There is a law in things which slowly reveals itself to careful observation; and just as that law is read, learned, marked, and obeyed, does human life grow in value and more and more carry its own justification within itself. "It doth not yet appear what we shall be" is a saying very applicable to the future of our race upon the earth. Supposing it possible that religion should in the future take the form of an earnest study of the laws of life and of morality, personal and social, who can forecast the glory that might yet be revealed in this despised humanity of ours? And who would not feel, in presence of such a transfiguration, that it was "good for us to be here"? If anything will thus transfigure society, we venture to affirm that it will be science pursued in a religious spirit—that is, regarded as a ministry of truth and good to mankind. There is a force available here that is at present little understood. It may possibly never be understood by more than a few: no one can answer for that; but it is impossible not to hope that some day, for a religion based on relics and texts, on myths and traditions, on dogma and ritual, on barren erudition at one end of the scale, boisterous sentiment at the other, and infinite mystification throughout, may be substituted one founded on the truth of nature and directed with undivided aim to the perfecting of humanity. Already we see, here and there, how much of pure happiness the right adjustment of human relations can create; and we do not see why the law, by virtue of which such happiness is produced, should not become more widely known and more faithfully observed. It is the habit of the self-styled orthodox to fling all the failures of the universe at our heads, as if we had produced them, or were at least specially responsible for explaining them. The habit is an idle one: the responsibility is not ours; but now that the light of scientific—that is, of verifiable—truth has come into the world, we do hold ourselves responsible for bearing witness to it, and causing it to shine as widely as possible. And, as we are not answerable for the past, neither do we assume to control or predict the future. We see merely a duty in the present, a duty the performance of which will bring peace, tranquillity, and security. This is not optimism, but it is in every man's power to make it a religion.

SAVAGE LIFE IN SOUTH AMERICA.

By Captain JOHN PAGE,
OF THE ARGENTINE NAVY.

THE Gran Chaco derives its name, according to Charlevoix, from those great Indian battues, or collections of wild game, which, surrounded by a cordon of fire and hunters, were gradually driven to a given center. It is a vast central tract of country lying between the southern tropic and 29° south latitude, bounded on the north by Brazil and Bolivia, on the south by the Argentine province of Santa Fé, on the east by the Paraná and Paraguay Rivers, and on the west by Santiago del Estero and Salta. It contains about one hundred and eighty thousand square miles, or considerably more than the superficies of Great Britain and Ireland. About one third part of this vast area belongs to Paraguay, but the exact demarkation of the limits between the Argentine Republic, Bolivia, and Paraguay has still to be made, although between the first and last of these countries an arrangement was entered into through the arbitration of President Hayes, of the United States, which must necessarily be called satisfactory. The Gran Chaco has been called, particularly in allusion to the low-lying Paraguay section, the "*Oceano firme*," or solid ocean. In fact, owing to the comparatively limited means of communication, it was formerly considered too vast for an undivided control, and the Argentine part was constituted into two territorial governorships—one called the Chaco Austral and the other the Chaco Central. A third section is that belonging to Paraguay, part of which, along its northern side, is disputed by Bolivia, and goes by the name of Province of Azero. The Chaco Austral is the most favored in natural riches of these three great sections, and has extensive primeval forests.*

The principal water-courses of these territories are the Pilcomayo and Bermejo, which are undoubtedly destined to become highways of commerce. The waters of these rivers differ in color, those of the Pilcomayo being dark and sometimes brownish, and those of the Bermejo red, as its name indicates; both are narrow

* Mr. Clements Markham said, in the discussion on Captain Page's paper, that the Gran Chaco was a most important region, lying between the plateaus of the Andes on one side, and the great fluvial highway of riches. In the Quichua language "chacu" meant a hunt, but under the government of the Incas of Peru the word was used for that festival when they surrounded and numbered their flocks. It was a counting of wealth. Hence the *Hatun chacu*, or *Gran chacu*, was so named by the Incas, because those vast, forest-covered regions to the east of their mountain homes were a source of wealth to them in wild animals, precious drugs, and the highly prized harvests of coca. In the distant future the channels which flowed from the homes of the Incas across the Gran Chaco were destined to bring down the produce of the Andes to markets beyond the Atlantic, but that time had not yet arrived, although the speaker believed it was near at hand.—Editor.

and tortuous, and both run in a general southeast direction, preserving a remarkable parallelism throughout their course, at a distance of about one hundred and eighty miles. Their depths and general characteristics correspond, and they are frequently obstructed by narrow argillaceous beds and fallen trees. The waters of both rivers are drinkable, but hard and unsuited for washing. The Bermejo brings down an enormous amount of sediment, which is deposited with such extraordinary rapidity that it must be considered a peculiarly strong feature of the mechanical work of the river, by which its geological formations are made and unmade. This swift precipitation of its detritus, which it replaces by an increasing abrasion of the banks, goes on in the Bermejo, even when at its height and when in the exercise of its greatest carrying-power, with a speed equal to the square of its normal current. I have seen this river eat away an entire point of land, and by way of compensation deposit, just a turning below, an amount of detritus sufficient to form a similar promontory, which in one season of low water became covered with a thick and luxuriant growth of red willow. The Pilcomayo is to a great extent unknown, and in one section that is quite unknown is invested with a mythical halo in the shape of a tradition that it disappears. An apparent disappearance is a phenomenon which seems to have taken place with some rivers. The upper Paraguay, as I have witnessed, has been known to flow, as if absolutely lost for many miles, beneath a matted covering of living and dead vegetation several feet in depth. In the year 1858 one of these growths, under the influence of an extraordinary inundation, broke loose and drifted two thousand miles, down to Buenos Ayres, where it brought up, with many wild animals and reptiles that had taken refuge there from the almost universal deluge. The Pilcomayo is not affected in this way, and I believe that it not only does not become lost, but that there are no insuperable obstacles to its navigation. At the point where it is supposed to be lost, it begins a very erratic wandering—after running a few miles to the southeast, it suddenly turns to the north, leaving several minor branches looking in the opposite direction. It then returns as rapidly to its general southeast course, and, while subject to overflows, the main body of it flows on in a natural bed uninterruptedly to its mouth.*

* Colonel Church remarked, in the discussion, that the Argentine Republic seemed to be divided into two sections—that of the Pampas, without forest, and that of the Chaco, which was a forest-covered country. Curiously enough, the rains of the Chaco district did not occur during the rainy periods of the Pampas district; but from November to May there was a veritable downpour, and the country became flooded, filled with lagoons, with here and there an island or small hill. At the head-waters of the Bermejo there was on such occasions a lagoon forty leagues across. It was a very difficult problem to him how the Pilcomayo and the Bermejo could ever be usefully navigated. The former, one hundred and eighty leagues above its mouth, filtered itself through a sandy swamp one hundred

Several attempts have been made to explore this river. The story of one that was undertaken under the Bolivian Government has been told with such exaggerations as almost mark it a work of fiction, by Lieutenant Van Nivel. A tragic interest attaches to the expedition of Dr. Crévaux, of the French Geographical Society, who undertook to work along the banks of the river. The party were enticed inland by the savages and murdered. A later Bolivian expedition of one hundred troops, accompanied by a French traveler, M. Thouar, were harassed but not actually attacked by the savages, and, after wandering considerably out of their course, succeeded in reaching the Paraguay, having traversed the Chaco in a southeast direction more or less along the river, but without in any manner elucidating its geography.*

miles in diameter, while above this swamp it was filled with falls, rapids, sand-banks, and snags. The bed of the latter oscillated backward and forward to the extent of thirty or forty miles, carrying with it great trunks of trees of very hard wood, the specific gravity of which exceeded that of water. The rainy season was succeeded by one so dry that animal life almost perished for lack of water. There was a distance of twelve hundred and fifty miles along the Bermejo to its mouth in which it received but one branch.—EDITOR.

* Dr. Crévaux, already distinguished for his work in exploring the boundary of Guiana and Brazil, was commissioned to endeavor to reach the opposite side of the Amazon Valley by way of the upper Paraguay. At Buenos Ayres the members of the local Geographical Society interested him in the idea of tracing the course of the Pilcomayo. So, instead of ascending the Paraguay, he went by railway to Tucuman, crossed the Bolivian border on the 16th of January, 1882, and made his way to Father Doroteo's mission, San Francisco, on the Pilcomayo. At about the same time a military expedition sent against the Toba Indians of the Chaco to punish them for some depredations had returned, bringing seven children as prisoners. It was deemed best to send a messenger to them—a Toba woman named Galla or Petrona, who had lived for some time at the mission—to learn how they would receive the explorers. The messenger did not return, but, as was afterward learned, instigated the Indians to murder Dr. Crévaux and his companions. The party, numbering twenty persons, without waiting longer, started on the 19th of April. On the 27th of the same month they were all massacred but one.

M. Thouar started from Santiago in May, 1883, on hearing that the Tobas held as prisoners two survivors of the Crévaux expedition. Following Crévaux's steps from Tarija and the advanced post of Caiza, he reached the scene of the massacre and founded there toward the end of August the colony Crévaux. He learned, from a number of the aborigines whom he interrogated, that none of the Crévaux expedition survived; but, not satisfied with what the Indians affirmed, he plunged into the unknown region and undertook with fifty Bolivian soldiers to descend the Pilcomayo in the midst of the hostile tribes. His party, which was weakened from time to time by desertions, descended the right or Argentine bank of the river, plunged through deep, brackish marshes, narrowly escaped a surprise by two thousand Indians, repelled an attack by eight hundred of them, found further traveling through the swamps impracticable, and crossed over to the other side of the river; and, finally, in October, having reached the beginning of the great delta of the Pilcomayo, gave up the attempt to follow the river further, and took the shortest course for the Paraguay, which they reached after a month's journeying in great suffering. M. Thouar returned to the exploration in 1885, and, starting from the southern part of the delta, went up by land eighty leagues to the place where he had left the Pilcomayo on his former expedition, and thence descended the river in a canoe to its mouth. After this he was engaged by the Bolivian Government in two attempts to find a route for a wagon-road

The Bermejo River in 1869–'70 became deflected from its ancient course and actually wandered about for a long time before finding a new bed. It formed for the time being an island nearly two hundred miles in length by an average of fifteen miles in width. This change of bed in our times enables us to understand the mechanical work which this and the Pilcomayo rivers have carried on for many centuries, resulting in the production of the rich alluvial lowlands of the Gran Chaco. It is an interesting fact that the Bermejo in this as in other changes of less magnitude has manifested a tendency to swerve to the eastward sufficiently marked to suggest the idea of some physical cause.

The Bermejo, like the Pilcomayo, has been the object of many expeditions to open up its waters to navigation. Between 1853 and 1858 my father, Captain Page, under the auspices of the United States Government, explored the fluvial system of the Rio de la Plata, and, with the assistance of a staff of competent officers, made extensive collections in botany and natural history, which were deposited at the Smithsonian Institution. He made track surveys of all the rivers so far as he examined them, and established wherever he went those positions which are the standards to this day used in the cartography of those countries. In the course of these explorations he twice entered the Bermejo and once the Pilcomayo, ascending the former to a distance of nine hundred miles by river course, and turned back, paradoxical as it may seem, on account of the excess of water which had flooded the country, fearing that his steamer, in case of a sudden fall, the course of the river being unrecognizable, would be left stranded in the interior. This was the only expedition up the Bermejo undertaken with purely scientific views. Its results are embodied in the book, "The La Plata, Argentine Confederation, and Paraguay."

The author was commissioned in 1885 to examine the Bermejo and report upon its navigability. He started on the 25th of June. The way for the first three hundred miles from the mouth of the river was interrupted by obstructions caused by the wrecked vessels of former exploring expeditions; the falls of Yzo, a sharp incline of some two feet in the mile over about that extent, which causes the water to run swiftly and eddy around and look formidable to the uninitiated; and the argillaceous bars. The most formidable barrier of the last class was overcome by fixing a chain-drag with four pickaxes fastened uprightly in it, which was drawn forward and backward over the clay, marking a scratch

from Sucre, in Bolivia, to Puerto Pacheco on the Paraguay. Both projected routes proved impracticable from want of water, and M. Thouar is said to be satisfied that the only feasible route from Bolivia to the Paraguay lies by way of the Pilcomayo.—EDITOR, *from "La Nature."*

which the water in a few hours washed out into a navigable channel.

At about three hundred miles above the mouth of the Bermejo the author entered the Teuco, or the channel opened by the erratic waters of that river when they departed from their original bed. In many places along the old bed successive annual floods have covered with rich deposits the low-lying lands, leaving the tops of large trees peering above the surface. It would be impossible for the least sentimental not to admire and feel the influence of those rich woods, clothed in perpetual verdure, the trees entwined by the Paraguay jasmine, with its delicate white and blue flowers, whose fragrance is perceived as you run along the banks, and covered with other climbers, parasites, and orchids in great variety. There is a certain richness of growth in these wilds, filled with the native pineapple, which is unlike the rankness of the Brazilian tropical vegetation, so suggestive of jungle fevers. A Mr. Plaisant, in 1854, by direction of the Minister of Commerce of France, made an analysis of the woods of Paraguay, which practically may be said to be identical with those of the Chaco, and he concluded that they might be advantageously employed to take the place of those used in Europe for cabinet work. Many of them are certainly very beautiful; the *tatané* (*Porliera hygrometrica*) compares favorably with the bird's-eye maple; the *palo rosa*, the Guayacan *Cesalpinea melanocarpa*, a variety of *Lapachos*, the *urundey*, *curupáy*, and *cumpayná*, the *quebracho*, with a hundred others, all of hard, indestructible wood, when used in the earth or water, and which would hold their own with any of the woods of Europe or Asia. Mr. Plaisant classified thirty-nine species of superior quality, useful for naval construction and cabinet work, exclusive of a great number which had special applications for medical and domestic use. Most of the trees I have enumerated are actually used in Argentina in great quantities for ship-building, fencing, telegraph-lines, and railway sleepers. The three species of *algarroba* produce the long locust-pod, a staple article of food with the Chaco Indians, who pound it up and make it into a very sustaining bread. They also brew from it an intoxicating beverage, under the influence of which they become dangerous. The pod is very fattening food for cattle and horses, having a great percentage of saccharine matter. The presence of the *algarroba* is an indication of high land not subject to overflow. The *alba* species is employed extensively in the manufacture of hubs and furniture; its bark is good for tanning purposes, and a majority of the window and door frames of the older houses of Buenos Ayres are made of it. The "palo santo," holy wood, or lignum vitæ, is seen in quantities north of the twenty-sixth parallel. Its wood, which is extensively

used for blocks and bushings, is so full of resinous matter that it will burn like a candle.

Among the useful plants is the *caraguatá,* of the family of the *Bromeliaceæ,* which grows generally within the range of the forests, and from which the Indian obtains a strong fiber useful for many domestic purposes. It is said to be the fiber known to European manufacturers as Batista Ananá. The *caraguatá* has also a faculty of catching and retaining water, whereby the Indians are afforded means of slaking their thirst in seasons of drought. Among a hundred edible wild fruits may be named the *chañar;* the *vinal;* the *guayabo,* a fine fruit; the *ubagay,* a passion-flower, which gives a large but rather insipid fruit; and the *manduvira,* a wild almond. Several *Lacteas* produce a fine fruit, and the woods are full of the wild pineapple.

The exploitation of the timber industry has occupied several thousand people, and has been the means of reducing to a *quasi*-civilization many hundreds of the aborigines. This has led to the development of the Austral Chaco along the borders of the Paraná, where are now many small towns and large agricultural colonies, prosperous beyond their own hopes, and connected by rail and telegraph. Two of these colonies are owned by Englishmen; and the word of the proprietor of one of them is given that the Indians are of the best laborers, being the most docile and steady, although a trifle more indolent than the civilized workmen. As I continued my ascent of the Bermejo, with but little other interruption than was occasioned by the draught of my vessel, I always found large masses of Indians at the low passes, which are indeed their fishing-grounds; at these points, which were numerous in the upper Teuco, they would wait, evidently in expectation of some catastrophe or something giving them a chance to make an attack. They were usually on these occasions made up with their war-paint, and many of them decorated with ostrich-feathers, but they generally kept their arms out of sight, though doubtless handily within reach; and they would come to us with articles for barter, consisting of dried fish, necklaces, a few bows and arrows and war-clubs, the skins of wild animals, and the animals themselves. I was never attacked, though often threatened.

It is a safe prediction that this region has a great future, possessing as it does an equable climate, tempered by the prevailing southeast and southwest winds, with just enough of the warm and relaxing weather to give a zest to the enjoyment of the other kind and stimulate vegetable growth; a climate which throughout the whole extent of its territories suits admirably the sons of southern Italy, and in its southern section has been proved to suit the hardier men of England and the United States. The soil is

good, and compares well with the lands of southern and western Buenos Ayres, having in its favor, for agricultural purposes, a far better climate; and is adapted to the growth of cotton, tobacco, the castor-oil plant, the olive, barley, sorghum, Indian corn, rice, the manioc, and many other products of temperate and intertropical climates. Cattle thrive in all the Chacos, attaining an extraordinary development in size, especially among the Indian herds, where they depend exclusively upon the grasses and wild fruits such as the palm and locust. The grasses are varied and abundant, and include many of the species highly thought of in Buenos Ayres, which is the pre-eminent cattle-growing section just now of the Argentina.—*Abridged for the Popular Science Monthly from the Journal of the Royal Geographical Society.*

SKETCH OF LAVOISIER.

ANTOINE LAURENT LAVOISIER was born on the 26th * of August, 1743, and suffered death by the guillotine on the 8th of May, 1794. His family, descended from a postilion in the royal stables in the previous century, had gradually risen in estate. His father, styled in the standard biographies a "wealthy tradesman," is described by M. Grimaux, in the "Revue des Deux Mondes," as a graduate of the law school, and advocate and attorney in the Parliament of Paris. The family had also considerable wealth on the mother's side. Lavoisier's father was thus able to provide his son with good instruction, and interested himself in doing so. The youth was sent to the Collége Mazarin, where he was remarked as a brilliant pupil and a diligent student. Science at once became the prominent object of his studies. After leaving the college he took a course in law, and was admitted as an advocate in 1764. At the same time he began those studies by which he became eminent in many branches of science. He pursued mathematics and astronomy with the Abbé La Caille; botany with Bernard de Jussieu; mineralogy and geology with Guettard; and chemistry with Rouelle. At twenty years of age, while he seemed to give the principal share of his attention to mathematics, he became interested in meteorology, and began a series of barometric observations, which were continued through his whole life.

So interested did Lavoisier become in his studies that he was ready, in his twentieth year, to give up general society and confine

* So it is given in the "Biographie Générale" on the authority of J. Lalande, and by M. Edouard Grimaux, who writes on the authority of original manuscripts and correspondence in the "Revue des Deux Mondes" for December 15, 1887. Other biographers give the 16th of August.

the circle of his associates to his teachers and fellow-students; and, pleading that his health required it, he put himself upon an exclusive milk diet. Some of his friends seem to have believed that his health was really giving way; and M. de Troncq, sending him a dish of gruel, advised him in 1763 to be temperate in his studies, and to believe that "a year longer on the earth is worth more than a hundred in the memory of men."

Among his particular friends was Guettard, who had been admitted to the Academy as a botanist in 1743, but had afterward devoted himself to geology and mineralogy. He had already traveled in France and other countries in the interest of a plan he had conceived for making geological maps, upon which the kind of soil, mines, and quarries should be indicated by special marks. In connection with Guettard, Lavoisier made extensive excursions during three years through different parts of France. At the same time he studied the gypsum of the environs of Paris, concerning which he presented, in 1765, the first of the valuable series of memoirs with which he was to enrich the journals of the Academy of Sciences during nearly the next thirty years. His investigation included the varieties of the mineral and their solubility in water, and the cause of the setting of plaster, which he was the first to explain.

The Academy having, in 1765, offered a prize of two thousand livres for an essay on "the best means of lighting at night the streets of a large city, combining clearness of illumination, facility of service, and economy," Lavoisier resolved to compete for it, and began at once a series of experimental studies on the subject. In order to make his vision more sensitive to slight differences in the intensity of light, he hung his room in black, darkened it, and confined himself within it for six weeks, without permitting himself to look upon daylight for an instant. The two thousand livres were divided by the Academy among three competitors, who had incurred considerable expense in their experiments, while it gave a special distinction to Lavoisier's memoir by awarding the king's gold medal to the author, for which a public session was given.

The geological excursions with Guettard were resumed immediately after the conclusion of this transaction. The intervals of leisure were given to reading, studying, and making notes; among the fruits of which was an inquiry into the matter of fire and the nature of its elements. At first Lavoisier fancied that air was only water reduced to vapor, or rather water combined with the matter of fire; but this gave way at once to the conception of an atmosphere having an existence of its own and containing the fiery fluid and water in solution. Guettard's plan for a mineralogical atlas of France having been adopted by Minister Bertin, Lavoisier was

invited to accompany him in a tour in the interest of that work to Lorraine and Alsace. Among the fruits of this journey was an extended memoir on the analyses of mineral waters, which was not, however, published during Lavoisier's life. The work of publishing the atlas on the original plan proving to be a larger one than the government was ready to sustain, Guettard retired from it, and Monnet, who was no friend of Lavoisier's, took his place. He used Guettard's and Lavoisier's material, added something of his own, and ignored Lavoisier, while recognizing Guettard, in his credits.

Other results of Lavoisier's earlier work were papers "On the Pretended Conversion of Water into Silica" (in which a prevailing error was refuted), "On a Species of Steatite," "On a Coal-Mine" (in conjunction with Guettard), "The Analysis of the Gypsums of the Environs of Paris," "Thunder," the "Aurora Borealis," "The Conversion of Water into the Condition of Ice," and "The Strata of Mountains" (general observations on the modern horizontal strata which have been deposited by the sea, and on the conclusions that can be drawn from their disposition relative to the antiquity of the terrestrial globe). The last was not published till 1789, when it appeared in the "Memoirs of the Academy."

Lavoisier was nominated in 1768 to succeed Baron in the Academy of Sciences, by Lalande, who proposed him on the ground that he had knowledge, talent, and activity, and possessed a fortune, which, relieving him from the necessity of embracing another profession, would enable him to be very useful to science. His principal competitor was Jars, an eminent metallurgist. Lavoisier was chosen, but the final decision rested with the king, and his minister decided that Jars should have the seat. Out of deference to the views of the Academy, a new position of adjunct chemist was provisionally created for Lavoisier, with the understanding that on the occurrence of the next vacancy in chemistry he should go in without a new election. The vacancy occurred through the death of Jars in the next year.

Desiring, as the biographers pleasantly express it, to place himself on a financial footing in which he could pursue, independently, investigations involving costly expenditures, Lavoisier sought and obtained in 1768 a position as one of the farmers-general (of the revenue). He conscientiously performed the duties of his office; instituted reforms in taxation by removing useless duties, and earned the gratitude of the Jews of Metz by freeing them from an odious impost. M. Grimaux represents him as performing the duty of making regular tours of inspection, with which he associated the study of the features of scientific interest which the places he visited might afford. The work of this office brought

him into association with farmer-general Paulze, whose daughter he married, and who went with him to the scaffold. In 1776 Turgot made him inspector-general of powder and saltpeter. In this capacity he made great improvements in the manufacture, so that, while he put a stop to forced official searches for saltpeter in the cellars of private houses, he quadrupled the product of the salt, and so increased the explosive force of gunpowder that the French brand became as much superior to the English as it had been inferior.

Lavoisier's great work consisted in the discovery of the true functions of oxygen and the nature of combustion; the determination of the relations of the solid, liquid, and gaseous states of matter; and in many other observations that embodied the germs of what have become since the leading principles of chemical science. Oxygen was detected at about the same time by Priestley, Scheele, and Lavoisier; but the phlogistic theory of combustion possessed the minds of chemists, and, although Eck de Suchbach and Jean Rey had already dimly discerned the truth, no one had paid any attention to their discoveries, and Lavoisier was working on what was to him, and substantially to the world, virgin ground. "Fixed air" and "combustible air" had been speculated upon, and "the air that is left after combustion" had attracted attention. But the phenomena of this kind, inconsistent as they were with the phlogistic theory, had not been sufficient to overthrow it. The first germ of Lavoisier's theory on these matters was embodied in a sealed packet which he deposited with the Academy in 1770. Recognizing that the calcination of metals could not take place without the access of air, and that the freer the access the more rapid the calcination, he "began to suspect," as he expresses himself, that some elastic fluid contained in the air was susceptible, under many circumstances, of fixing itself and combining with metals, and that to the addition of that substance were due calcination and the increase in weight of metals converted into calxes. From this thought came, after much groping with erroneous conclusions, the idea that air is a compound containing a vital part and another part, and that it is the vital part that is absorbed. The behavior of charcoal when burning in oxygen pointed to the nature of that substance and to the true theory of combustion. This new vital substance, which, uniting with metals, formed calxes, and with other substances generated acids, he called *oxygen* or the acid-producer; the air that was left after combustion was *azote*, or lifeless. The inflammable air which, combining with oxygen, was found to form water, was called *hydrogen*. Upon these facts, and with a few other names of known substances, Lavoisier constructed the system of chemical nomenclature which, after having undergone many modifications to conform to

new discoveries, still rules. The "muriatic radicle" gave Lavoisier some trouble, for he could find no oxygen in muriatic acid, and his experiments upon it with oxygen resulted in the production of a neutral substance which must be its calx; and so he called chlorine oxidized muriatic acid. Such mistakes were natural in the early days of chemistry. The decomposition of volatile alkali, or ammonia, by Berthollet, led to the suggestion which Lavoisier gave out with great modesty, that many earths, still regarded as simple, might be compound; and that their apparent indifference to oxygen should be attributed to their being already saturated with it.

On the nature of gases and vapors, which had not been understood before, Lavoisier asserted, in a memoir published in 1777, that most bodies were capable of existing in three different states —those of solids, liquids, and vapors, or aëriform fluids. The terms airs, vapors, and aëriform fluids express only a single form of matter—a class of bodies infinitely extended; and this principle "gives the key to nearly all the phenomena relative to the different kinds of air and to vaporization." While heat tends to change volatile bodies into vapor, the pressure of the air has a contrary effect; and "the tendency of volatile bodies to evaporate is in direct ratio to the heat to which they are exposed, and inverse to the weight or pressure brought to bear upon them." Lavoisier's memoirs on heat, expansion and contraction under changes of temperature, and latent heat, show an insight into the accepted principles. He discussed with much sagacity the question whether heat is a fluid or a force; and it would not be hard, for one who is determined to look for it, to find in his essays on this subject a prevision of the current constitutional chemistry. Lavoisier's later labors were physiological. They include papers on the production of carbonic acid in respiration and the office of the lungs in the process, in which the present theory is proposed as a secondary hypothesis, and on cutaneous transpiration. In his physiological studies, M. Dumas has found that he had arrived at a remarkable anticipation of modern views concerning the relations of organic to inorganic nature.

Lavoisier carried his energy into several other fields, and made his mark in all. He cultivated an estate of two hundred and forty arpents in the Vendôme, and in nine years doubled its production. His name is associated with a number of propositions looking to the public welfare or economical reform. In 1789 he presented in the National Assembly a report of the "Caisse d'Escompte," to which he had been attached for one year. As commissioner of the treasury he proposed in 1789 a new plan for the collection of imposts, which he elaborated in a special essay entitled "The Territorial Wealth of the Kingdom of France," a work which, accord-

ing to M. F. Hoefer, in the "Biographie générale," gave him a place in the front rank of the economists of his time. He participated in the work of the commission on a new system of weights and measures. As treasurer of the Academy he set the accounts and inventories in order, and discovered some forgotten funds of the institution, and made them available. "In short, Lavoisier was to be found everywhere; and his facility and zeal, equally admirable, were adequate for everything."

On the 2d of May, 1794, twenty-eight of the farmers-general, of whom Lavoisier was fourth on the list, were accused in the Convention of conspiring with the enemies and against the people of France. On the 6th of May they were all condemned to death, and on the 8th were executed together. Lavoisier and his friends hoped that his great scientific eminence and the undoubted useful character of his career might be brought to bear to save him. Some efforts were made to exert such influence. Lavoisier himself drew up a memoir of what he had done for the Revolution. The Bureau of Consultations presented a detailed report on his labors. A deputation of the *Lycée des Arts* visited him at the *Conciergerie*, bearing "to Lavoisier, the most illustrious of its members," a testimonial of its admiration.

Lavoisier left no children. He is described as having had a pleasing, intellectual face, and having been of large figure and of pleasant, sociable, and obliging disposition.

His most important works were: "Opuscules physiques et chimiques" ("Physical and Chemical Worklets," 1774), "Méthode de Nomenclature chimique" ("Method of Chemical Nomenclature," 1787), "Traité élémentaire de Chimique" ("Elementary Treatise on Chemistry," 1789). A complete edition of his works, published by the French Minister of Public Instruction, 1864–'68, included these books, fifty-eight memoirs communicated to the Academy of Sciences between 1770 and 1790, and numerous notes, letters, and reports relating to the various affairs in which he was engaged. He had himself begun to prepare a collection of his works, the completed portions of which were published by his widow in 1805 in two volumes entitled "Mémoires de Chimie."

Consumption, according to Dr. Irving A. Watson, prevails in all parts of New Hampshire, but is apparently influenced by topographical conditions. It is more prevalent at a low elevation with a maximum soil moisture than in the higher elevations with a less moist soil. The season has only a small influence upon the mortality from the disease; the mortality is considerably greater among women, and no age is exempt from it; but the least liability to contract it exists between the ages of two and fifteen, and the greatest between twenty and thirty. The death-rate is relatively much the larger among the foreign-born.

EDITOR'S TABLE.

THE JOHNSTOWN DISASTER.

AMONG the published sermons of the Rev. John Wesley is a famous one on "The Cause and Cure of Earthquakes." The cause of earthquakes, according to the eminent divine, was national unrighteousness, and their cure would be found to lie in national reformation. It was, in his opinion, of slight importance to know what physical causes or conditions were concerned in the production of earthquakes; seeing that, when the Almighty proposed to use them for purposes of national chastening, they would always be forthcoming; and when he willed to hold them in abeyance they would not happen. In the case of railway and steamboat accidents we have often been pointed to alleged Sabbath desecration by the railway and steamboat companies as the underlying causes of the calamities. Speaking generally, there have never been lacking those who could interpret every grave occurrence in such a way as to reveal their own familiarity with the special designs of Heaven. In the face of such explanations any reference to secondary or mediate causes seemed superfluous, if not profane. Lord Palmerston incurred much theological odium for suggesting that thorough sanitary measures might be more effectual than prayer in averting cholera from Great Britain; or that, at least, it might be well to try such measures before appointing a day of national humiliation. Down to the present time it has been customary, throughout a large part of society, to let the theological view of all personal bereavements dominate the natural. From one point of view the effect of this has been beneficial; from another it has been quite the opposite. It has been beneficial as affording, in effect, a vindication of the natural order of things and disposing men's minds to resignation and fortitude. It has been the opposite of beneficial in diverting attention from the proximate causes of painful visitations, and so far diminishing the sense of personal responsibility in connection with such things. That mankind would much earlier have acquired the power of combating the various forms of disease successfully, had theological prepossessions been absent, no candid and reasonable person could well deny.

The effect of the Johnstown disaster will be, if we mistake not, to bring into needed prominence the two ideas of the supremacy of natural law and the dependence of human life upon a wise adjustment by society itself of means to ends. No other *general* lesson is deducible from the sad circumstances of the case. Whatever may have been possible in John Wesley's time, it is hardly possible to-day for any leader of opinion to maintain that the disaster should be regarded as a divine dispensation. The preacher of the Brooklyn Tabernacle himself, who in most matters generally manages to express the most belated view, has openly refused to interpret this calamity as a sign of divine anger; being able, as he states, to affirm of his own knowledge that many of those overtaken by sudden death were among the best people in the country. Then let the lesson which the facts so powerfully teach be taken to heart. Not by righteousness of life, not by religious zeal, not by personal piety or devotion, not by anything that does not directly bear on the dangers to be averted or the benefits to be secured, will human life be protected from ill or enriched with good, so far as the order of things in the physical world is concerned. The prayer that is efficacious is the prayer that stimulates to work; and the work that is efficacious is that which is guided by

observation and reason. In one of the dispatches received by "The New York Times" from the scene of the disaster it was stated that some persons who had been rescued from the flood only to find themselves sole survivors of their families had abandoned all faith in Providence, and had emphasized their change of mind by casting away their Bibles. This affords an illustration of a kind of faith that never should have existed. These persons had evidently cherished the idea that, if they tried to live religiously, Providence would see that they did not suffer from the effects either of their own or of others' carelessness; and that natural agencies of a destructive character would in some mysterious way be instructed to pass them over, even while causing havoc all around. This expectation having been falsified by facts, their faith in the divine government is not only shaken but destroyed. Their standpoint is manifestly a less reasonable and noble one than that of the patriarch Job, who in the depth of his trouble could exclaim, "Though He slay me, yet will I trust him."

Herein lies a lesson for the clergy and for all teachers of youth. The only stable faith is one that reposes upon the order of nature, or at least that fully accepts that order, and is therefore prepared for all that may flow from it. The man who supposes that by any pious observances he can, to even the smallest extent, guarantee himself or his household from fire or flood, from pestilence, famine, or any form of physical disaster is virtually a fetich-worshiper. The pact he strives to make with the power he recognizes is of the nature of a private bargain, according to the terms of which exceptions to the general working of natural laws are to be made whenever his individual interests seem to require it. That man, on the other hand, has a rational faith which will never be put to shame, who, accepting the general scheme of things as something fixed, and preparing himself for all that may necessarily flow therefrom, strives to make the best possible life for himself and others. Such a man does not expect security if the conditions that guarantee it have not been fulfilled. He knows that pestilence *will* "come nigh his dwelling" unless sanitary measures are enforced in the neighborhood. He knows that vigilance is the price not only of civil liberty but of freedom from all the avoidable ills of life. He sees that the laws of life rightly observed are the source of abundant happiness, and that all that is needed to make life increasingly worth living is greater insight into the natural order of things, and a due inclination of the heart to do the things which the book of the law prescribes. It seems too much almost to hope that any adequate compensation can be found for so stupendous a disaster as that at Johnstown and in the valley of the Conemaugh; but the suffering and loss it has entailed will not have been wholly in vain if we can bring ourselves to regard the calamity as a great national object-lesson in the paramount necessity of placing human life under the safeguards that science is prepared to supply, and in the duty that devolves upon every individual in the community to contribute his own quota of reflection and action to the general welfare. One man, by a policy of masterly inactivity, re-established the falling fortunes of the Roman state: who knows what one man, by a resolute activity founded on common sense, might have done to avert one of the greatest calamities of modern times?

MENTAL GROWTH FROM MANUAL TRAINING.

THE new class of schools which includes in its course of study exercises for the hands has been much misunderstood, even by some who have undertaken the charge of such institutions. The phrase "manual training" in the names of these schools has conveyed the impression that hand-work is not only their

distinctive but their dominating feature. The true aim and the intellectual character of these schools are admirably presented in the article on "The Spirit of Manual Training," by Prof. C. Hanford Henderson, which opens this issue of the "Monthly." As Prof. Henderson shows, there is no school whose plan is so free from one-sidedness as the manual training school. "The specific purpose of such schools," he says, "is to offer an education that includes as far as possible all of the faculties. Its favorite maxim is, 'Put the whole boy to school.' Its mode of carrying out this purpose is the very practical one of occupying the time in any way, formal or informal, that will best lead to the end proposed." The chief danger which besets such a school is that of becoming a shop, and producing artisans rather than developing men. There are many who are not aware that any other effect follows from the training of the hands than the power to make certain articles. But not a finger can be consciously lifted unless an impulse is first sent to that finger from the brain. The bungling motions of unpracticed hands are due to the imperfect control of an undeveloped brain, and the gradual acquirement of the power to move the hands to just the right extent, in just the right direction, and with just the right amount of force, is accompanied by a proportionate development in the brain. The increasing sensitiveness of the eye to detect slight deviations from a perfect square, vertical, or circle carries with it a general ability to see accurately, and to rightly interpret the visual impressions presented to the mind. Manual training has also a higher influence. The boy takes a pride in his work, and, in overcoming the difficulties of his successive tasks, he develops the virtues of perseverance, self-reliance, and honesty. These schools are still in a formative stage, and doubtless imperfections and errors may be found in the character of any particular institution; but if the spirit which Prof. Henderson reveals shall dominate the manual training school, its book-study and its shop-work promise to form the best system of all-around educational development that has yet been devised.

BRUNO'S STATUE AT ROME.

THE erection at Rome of a statue to Giordano Bruno, who on the 17th of February in the year 1600 was publicly burned in that city for the heresies alleged to be contained in his philosophical writings, is a noble act of justice to the memory of a great and much-injured man. It is more than this, however, for it bears emphatic witness to the determination of the Italian Government and people to range themselves on the side of the widest freedom in speculation, and thus to place their whole civilization under the auspices and guidance of the modern spirit. It is satisfactory that, amid not a few partial signs of reaction, we have this great and formal vindication of the principle of intellectual liberty on the part of one of the leading nations of the world. When we read of the thousands of telegrams of sympathy sent to the Pope in connection with this event, we can not help wondering how the sympathizers, who, it may be presumed, all enjoy a fair measure of civil liberty in the countries throughout which they are scattered, would themselves like to be in the hands of a power that could bring them to the stake if their opinions were not of the pattern which that power chose to approve. From the modern point of view the execution of Bruno was simply the cold-blooded murder by ignorant fanatics of a man immeasurably their superior in knowledge and intellectual power; and who, by his refusal, in the face of death, to recant his opinions, proved himself possessed also of the highest degree of moral heroism. He was accused of atheism in his day, but his system of thought was pantheistic rather than atheistic. He believed that the

universe had an animating soul, which was diffused through every form of material existence, giving to each the powers and properties it was found to possess. He was a warm upholder of the Copernican system of philosophy; for adherence to which Galileo also suffered at a later date. He believed that the universe was of infinite extent and embraced an endless multitude of worlds. In a word, he had broken the fetters of ecclesiastical dogma, and had entered on a career of original speculation and research. No wonder he was considered a dangerous man, and that first the prison, and finally the stake, were his portion. Times, however, have greatly changed; and he who was led as a criminal to death for having dared to think for himself and uttered his thought, is now placed high on the honor-roll of the forerunners of modern liberty and civilization, and is gratefully remembered by thousands of intelligent men and women the world over.

LITERARY NOTICES.

THE ICE AGE IN NORTH AMERICA, AND ITS BEARING UPON THE ANTIQUITY OF MAN. By G. FREDERICK WRIGHT, D. D., LL. D., F. G. S. A. With an Appendix on "THE PROBABLE CAUSE OF GLACIATION." By WARREN UPHAM, F. G. S. A. With 147 Maps and Illustrations. New York: D. Appleton & Co. 8vo, pp. xviii and 622. Price, $5.

THE publication of "The Great Ice Age," by James Geikie, fifteen years ago, and of its second edition, revised, two or three years later, presented to the general reader a comprehensive and very interesting account of the Glacial period, the latest completed chapter of geologic history. In this, as in so many other portions of the geologic record, the most important recent contributions to knowledge have been gathered on this continent; and Prof. Wright, widely known for his extensive observations and fruitful investigations in glacial geology, has here set forth, in an attractive popular style, the vast array of evidence that an ice-sheet formerly overspread the northern half of North America, stretching southward to Nantucket, Martha's Vineyard, and Long Island, to the cities of New York, Cincinnati, and St. Louis, and on the Pacific coast to Seattle and Vancouver Island.

Conclusive proof that the drift deposits, bowlders, and striæ found upon all the country farther north are due to the agency of land-ice seems to be supplied by the terminal moraines which were recognized only about a dozen years ago by Clarence King in the Elizabeth Islands on the south coast of New England, by Cook and Smock in New Jersey, and by Chamberlin in Wisconsin. Since then Prof. Wright has devoted every vacation and leisure day to the fascinating study of the drift, and has personally examined and mapped large portions of the glacial boundary along its extent across the eastern half of the United States, from Nantucket and Cape Cod through New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Missouri, Kansas, Nebraska, and South and North Dakota. This boundary traverses valleys, hills, and mountains, with surprising disregard of the contour, often rising or falling one thousand feet or more within short distances in crossing the Alleghany ranges.

Not content with these investigations, Prof. Wright went three years ago to Alaska, and there spent a month in observations of the Muir Glacier, which enters the sea at the head of Glacier Bay, terminating in water about six hundred feet deep, and rising above the water in a vertical cliff of ice a mile long and two hundred and fifty to three hundred feet high. The author's measurements showed that this glacier is pushed out into the bay at an average rate of forty feet per day, moving thus many times faster than the comparatively small glaciers of the Alps, though not surpassing the motion of Greenland glaciers, which similarly end in the sea, being there broken into icebergs and floated away.

Portions of Prof. Wright's exploration of the glacial boundary were done for the Geological Surveys of Pennsylvania and of the United States, the terminal moraine through Pennsylvania being traced by him in company with the late Prof. Henry Carvill Lewis. During these surveys, and in the visit to the Muir Glacier, many very instructive photographs were taken, which appear

as engraved illustrations in this volume. The author also presents very fully the results of the labors of others, both in the United States and in Canada, as Agassiz, Dana, E. and C. H. Hitchcock, Newberry, Le Conte, Lesley, White, Chamberlin, Salisbury, Todd, Gilbert, McGee, Shaler, Davis, Stone, Russell, Upham, A. and N. H. Winchell, Claypole, Spencer, Whitney, Sir William and G. M. Dawson, Bell, Chalmers, and many more, often quoting from their reports and memoirs, and reproducing their illustrations and maps. The work is thus a compendium, well brought up to date, of the already voluminous literature of this wonderful geologic winter of our globe.

Glaciers now exist, as described in this volume, on the Sierra Nevada, on Mount Shasta, in the Selkirk Range, and in great numbers and extent northward to Mount St. Elias and Unalaska. In the chapter on the glaciers of Greenland, a map shows the route of Nordenskiöld in 1883, and of Dr. F. Nansen last year upon the ice-sheet that covers its interior, extending in a vast monotonous expanse which rises gradually to elevations in its central portion six thousand to ten thousand feet above the sea. The further description of glaciers in other parts of the world, and of the antarctic ice-sheet, prepare the reader for the discussion of the signs of former glaciation in the now temperate regions of North America and Europe.

The striation of the bed-rocks, the striated pebbles and bowlders of the drift, sections of till and of stratified drift and loess, the characteristic topography of kames, terminal moraines, and the oval hills of till called drumlins, are very clearly described, with excellent illustrations from photographs. The boundary of the glaciated area from the Atlantic to the Mississippi is shown in a series of six maps; and a general map showing the glacial geology of the United States delineates, besides this southern limit of the North American ice-sheet and drift, the successive terminal moraines formed at times of halt or readvance of the ice during its retreat and final melting, the courses of the glacial striæ and transportation of bowlders, the driftless area of southwestern Wisconsin and portions of adjoining States, the modified drift deposited in valleys of southward drainage from the ice-sheet, and the boundary of the glacial Lake Agassiz which was held in the basin of the Red River of the North and of Lake Winnipeg by the barrier of the ice while it was being melted away.

Important changes in the drainage of the country, caused by the ice-sheet and its drift deposits, are noticed in considerable detail. In the same way that Lake Agassiz was formed, outflowing by the glacial River Warren along the course of the Minnesota and Mississippi Rivers, the Great Lakes of the St. Lawrence were held by the receding ice-barrier at levels much higher than now, similarly outflowing over the lowest points in their southern water-shed to the Mississippi; and these ancient lake-levels are still found distinctly marked by beach ridges and deltas of gravel and sand. Another very interesting glacial lake was formed in the basin of the Ohio River by the temporary dam of the ice-sheet, which at its time of maximum area extended across this river at Cincinnati, carrying its morainic drift into the northern edge of Kentucky. "These glacial deposits south of the Ohio," according to Prof. Wright's observations, "are such as to make it certain that the front of the continental glacier itself pushed, at some points, seven or eight miles beyond the Ohio River; and it is altogether probable that for a distance of fifty miles (or completely around the eastern, northern, and western sides of the Kentucky peninsula formed by the great bend of the river) the ice came down to the trough of the Ohio, and crossed it so as completely to choke the channel and form a glacial dam high enough to raise the level of the water five hundred and fifty feet —this being the height of the water-shed to the south." Traces of the former existence of this Lake Ohio are found along a distance of about four hundred miles in the valleys of the Ohio, Alleghany, and Monongahela Rivers and their tributaries. At the present time the abundant lakes, and the waterfalls on streams, throughout the glaciated area, so remarkably contrasted with their general absence farther south, are due to irregularities in the deposition of the drift and to its obstructions of the preglacial drainage.

A chapter is devoted to the flight of plants and animals during the Glacial pe-

riod, species from far north having been driven southward by the severe climate and accumulating ice, as is shown by remnants of a flora and fauna like those of the arctic regions, which have managed to continue their existence since the Ice age on the tops of mountains in temperate latitudes. Many peculiarities in the distribution of forest trees, made known by the researches of the late Prof. Asa Gray, also find their only adequate explanation in these vicissitudes of climate.

Northwestern Europe was covered by an ice-sheet about half as extensive as that of our own continent, and the author gives on a single map a comparative view of the glaciated areas of both. Another map shows the course of the terminal moraines recently traced by Lewis in Ireland, Wales, and England, and by Salisbury in Germany, each of whom had much previous experience from work on glacial geology in the United States.

Treating of the cause and date of the Glacial period, Prof. Wright rejects the astronomic theory of Croll and Geikie, which attributes the severe climate to conditions dependent on the eccentricity of the earth's orbit between two hundred and forty thousand and eighty thousand years ago. Instead of this, the post-glacial erosion of the gorge below the Falls of Niagara and of that extending eight miles on the Mississippi from Fort Snelling to the Falls of St. Anthony at Minneapolis, similar erosion by streams tributary to Lake Erie, changes in the shores and deposits of dune sand about Lake Michigan, and other observations, afford much shorter measures of the time since the departure of the ice-sheet, agreeing in their testimony that it was no longer ago than seven to ten thousand years. Prof. Wright is also disposed to doubt that there have been two distinct Glacial epochs in America, and believes that the facts thus far obtained are capable of explanation on the theory of but one epoch, with the natural oscillations accompanying the retreat of so vast an ice-front.

The last two chapters review the evidences of man's presence in America and Europe during the Glacial period, specially describing the important discoveries of palæolithic implements in glacial gravel deposits near Trenton, N. J., by Abbott; near Claymont, Del., by Cresson; in the Little Miami Valley, Ohio, by Metz; and at Little Falls, Minn., by Miss Babbitt. But doubts remain concerning the authenticity of the famous Calaveras skull and stone implements denoting a higher state of development than that of palæolithic man, reported as occurring in the lava-covered gold-bearing gravels of California, which, if obtained there in the undisturbed gravel, would give to our race a considerably greater antiquity than is otherwise known.

In the appendix Mr. Upham contributes "an explanation of the causes of the Glacial period, which, in this application of its fundamental principle, seems to be new, while in its secondary elements it combines many of the features of the explanations proposed by Lyell and Dana and by Croll. Briefly stated, the condition and relation of the earth's crust and interior appear to be such that they produce, in connection with contraction of the earth's mass, depressions and uplifts of extensive areas, some of which have been raised to heights where their precipitation of moisture throughout the year was almost wholly snow, gradually forming thick ice-sheets; but under the heavy load of ice subsidence ensued, with correlative uplift of other portions of the earth's crust; so that glacial conditions may have prevailed alternately in the northern and southern hemispheres, or in North America and Europe, and may have been repeated after warm interglacial epochs." Mr. Upham believes that the earth's crust floats in a condition of hydrostatic equilibrium upon the heavier liquid or viscous mobile interior, or layer enveloping the interior, subject, however, to strains and resulting deformation because of the earth's contraction. But such oscillations seem not inconsistent with the doctrine that the earth's interior is solid, with a degree of mobility like that of ice in glaciers. Whether the formation of the Himalayan mountain-range has been contemporaneous and correlative with the Glacial period, and the Appalachian uplift with the Carboniferous and Permian glaciation of portions of the Eastern hemisphere, as is here suggested, must probably require many future years of observation and study to determine.

All who have read the earlier work of Prof. Geikie, or listened to Prof. Wright's

lectures on this subject before the Lowell Institute in Boston, and the Peabody Institute in Baltimore, will welcome this elegantly printed volume as the most elaborate and complete presentation of this marvelous geologic period. The broad and critical knowledge which the authors have gained through long field-work, the admirable literary style with which the complex facts are grouped and explained, the abundant illustrations by engravings and maps, and the copious index making the volume a convenient manual, will be sure to incite many to observe for themselves the records of the Ice age in the vicinity of their own homes.

THE FISHERIES AND FISHERY INDUSTRIES OF THE UNITED STATES. By GEORGE BROWN GOODE and a Staff of Assistants. Sections III, IV, and V. Washington: Government Printing-Office. Four Vols. Pp. 176, 178, 808, 887, with Plates and Charts.

THIS great work is designed to give a complete survey of all that relates to our fisheries, and includes in its portly volumes a vast amount of information on every branch of the subject. This information is presented, moreover, in a way to attract readers, notwithstanding its discouraging voluminousness, and invite them to keep on. The first part of the present installment, Section III, is devoted to a description of the "Fishing-Grounds of North America," and is edited by Richard Rathbun. The term "fishing-grounds" is defined to apply to "those areas of the sea-bottom which are known to be the feeding or spawning grounds of one or more species of edible fishes, and which afford fisheries of greater or less extent." The most important of our fishing-grounds are located off the eastern coast of North America, between Nantucket and Labrador; the most distant fields lying in Davis Strait off the coast of Greenland. These, with the other fields of the eastern coast down to Mexico, are described, under thirteen local or special headings, by Joseph W. Collins and Mr. Rathbun; the sea fishing-grounds of the Pacific States coast, by President Jordan; those of Alaska, with their resources, by Tarleton H. Bean; those of the Great Lakes, by Ludwig Kumlien and Frederick W. True. In addition, President Jordan furnishes a discussion of the "Geographical Distribution of Food-Fishes in the Several Hydrographic Basins of the United States." The text is supplemented by thirty-two "ocean temperature charts." Section IV comprises an account of "The Fishermen of the United States," by Prof. Goode and Mr. Collins, including the classification of their nationalities, their distribution, delineations of their mode of living, character, habits at work, intelligence, tastes, and other qualities. A feature of special interest is the section on the part played by "fishermen as investigators." In Section V, the "History and Methods of the Fisheries" are related in two very large volumes. The review of this part tends to take the form of an enumeration rather than an analysis. Nineteen authors are represented in the different papers. The accounts cover the history of the several fisheries described; their beginning, growth, or decay, and present condition; the methods pursued at the different grounds where each fishery is prosecuted; processes of preparation for the market; applications of the fish; statistics of returns and value; inquiry into the agencies which have affected the prosperity or existence of the fishing stations as such; and a variety of such other information as may help to a clear and comprehensive view of the condition and prospects of fishing enterprise. The first volume relates to food-fishes; the second to marine mammals, reptiles, and invertebrates which are used for food or other economical purposes. The special subjects are the halibut, cod, haddock, hake, mackerel, menhaden, herring and "sardine," Spanish mackerel, millet, red snapper, salmon, whale, blackfish and porpoise, Pacific walrus, seal and sea-otter, turtle and terrapin, oyster, scallop, clam, mussel and abalone, crab, lobster, crayfish, rock lobster, shrimp and prawn, leech and trepang, and sponge fisheries, industries, and trades; with special chapters on "The Shore Fisheries of Southern Delaware," the "Havana Market Fishery of Key West," "The Pound-net Fisheries of the United States," and "The Fisheries of the Great Lakes." In nearly every chapter may be found illustrations on the depreciation or destruction of fish-beds once extremely valuable and prolific, of the manner in which we have allowed great resources to go to waste through the reckless prosecution of speculative enterprises. One

volume of the series is an atlas of two hundred and fifty-five plates.

A Treatise on Co-operative Savings and Loan Associations. By Seymour Dexter. New York: D. Appleton & Co. Pp. 299.

The author has aimed, in preparing this treatise, to furnish information concerning the class of associations described in the title, in a form in which it shall be accessible to all desiring it; to explain clearly the principles on which the typical association is founded; to describe variations from the type; to furnish a complete and safe guide to persons wishing to engage in such associations; to correct certain false notions concerning some matters of financial management in them; and to publish the best statutes of the several States concerning them, recommending particularly the New York act of 1887 and the laws of Massachusetts. While co-operation has existed under various forms and for many purposes, the efforts in the special shape considered in this book have been more uniformly successful than in any other. The associations formed for the purpose have had various names—building and loan associations, building associations, mutual savings and loan associations, homestead aid associations or co-operative banks. The name given them by Mr. Dexter includes all the others, and is believed to describe them more accurately than any other name. The benefits derived from them are all included under the general description that they encourage savings. This they do by affording a safe place of deposit, convenient, but out of the reach of pressing temptations to spend; that the ultimate object of the saving, to provide a home, is made practicable through them; that through them an opening is offered for the investment of small sums that might otherwise be frittered away; and that they afford convenient facilities to their members wishing to negotiate loans. A chapter is devoted to the delineation of the typical association; another chapter to a sketch of the growth and spread of the organizations and accounts of their conditions in the several States—which is imperfect as a history because it has been impossible as yet to get full information on the subject. The development of the scheme on which the associations are conducted is reviewed, with the modifications it has undergone, and "the best scheme" is determined; and this review is followed by directions for the organization of an association under the New York act of 1887, and also under that of 1851, and by instructions in the keeping of the association's accounts—this being, in fact, the exposition of a particular system of book-keeping. In the appendix are given the laws of New York, Pennsylvania, Massachusetts, and Ohio respecting the associations, and forms for a constitution and the papers required in the transaction of their business. The book supplies satisfactory information on a subject in which there is wide-spread interest, and answers well to the familiar description that it responds to a want of the times.

Annual Report of the Geological Survey of Arkansas for 1888. Vol. I. By John C. Branner, State Geologist. Little Rock: Press Printing Company.

Operations under the present survey were begun in 1887. When the first report was made, they had been carried on for so short a time that only a meager statement could be published; hence the result of most of the work that has been done from the beginning will be given in the four volumes of the current report. The present volume, after a brief general account of the work done during the year, is occupied with the report of Dr. T. B. Comstock, assistant geologist, upon his preliminary examination of the mineral resources of the western central part of Arkansas, with especial reference to the production of the precious metals. The second volume will give the results of the combined work of the United States Geological Survey, and the Geological Survey of Arkansas, upon the Mesozoic geology of the State. The third volume will relate to the coal regions; and the fourth volume will contain miscellaneous and local reports. Dr. Comstock's work, as described in the present volume, relates to Pulaski, Saline, Hot Spring, Garland, Montgomery, Polk, and Scott Counties, and parts of Yell, Pike, Howard, Sevier, and Franklin Counties. The observations recorded were made in 1887 and 1888 in all the important places in the State where mining or prospecting for gold and

silver were or had been carried on, and were also directed to a certain extent to the occurrence of the baser metals. After describing the surface geology and the mines of the counties named with considerable fullness, the author summarizes his conclusions that there is but little reason to believe that any workable deposits of gold occur in the State. The promise is better, though not brilliant, for silver; and much of the profit to arise in the working of the silver ores is likely to ensue from the presence of other metals, chiefly lead and zinc, with which the silver ores are closely linked. Other metals looked for were copper, which does not probably exist in deposits that can be profitably worked; tin, of which there is one slight indication; nickel and cobalt, of which one "claim" is mentioned that "deserves development"; manganese, which exists in considerable amount; iron, in ores the quantity and quality of which do not appear to have been definitely determined; and miscellaneous products, such as graphite, silica powder, pyrites, and mineral paints. A list of the minerals of western central Arkansas, and a chapter on the location of mining claims, complete the volume.

A Handbook of Cryptogamic Botany. By Alfred W. Bennett, F. L. S., and George Murray, F. L. S. London and New York: Longmans, Green & Co. Pp. 473. Price, $5.

This work fills an important gap in our botanical literature, for, while we have, on the one hand, numerous elaborate monographs dealing with special families or groups of cryptogams, and, on the other, our general treatises on botany give a sketch of the cryptogamic series, there is no book in the English language devoted to presenting the main facts of cryptogamic botany as they are known at the present time. The first subdivision treated is the vascular cryptogams, including fossil forms, and embracing six classes. In this subdivision and the *Muscineæ*, the classification adopted by the authors follows generally accepted principles. In the Thallophytes, however, where, on account of less complete knowledge, there is less general agreement, the systems are numerous, and the authors state that in choosing among them they have made an effort to bring together those organizations which are most nearly related to one another. To this end, while they adopt the *Protophyta* of Sachs as a primary class, they differ from that authority in holding to the older division of the higher Thallophytes into the two great groups of *Algæ* and *Fungi*. Besides those already mentioned, the two small groups, *Characeæ* and *Mycetozoa*, make up the seven chief subdivisions employed in this work. The language of the treatise is clear and smooth, and the authors have striven toward a simple terminology in their department by using such Anglicized forms of Latin and Greek terms as *sporange*, *archegone*, *antherid*, *epiderm*, etc. The text is illustrated by nearly four hundred excellent illustrations; lists of the literature of the several groups, classes, or orders are inserted at the appropriate places; and the volume is adequately indexed.

The Tree of Mythology, its Growth and Fruitage: A Study. By Charles De B. Mills. Syracuse, N. Y.: C. W. Bardeen. Pp. 288.

This work, which is declared to be the fruit of a love for the subject, seeks to ascertain something of the origin, nature, and growth of myth, what it primarily was, and what has come of it. The theme can not, in the author's view, be said to have become obsolete, "when the bale-fires are still kindled, as in Scotland and Norway, on each return of the solstice; when the peasant, as in Germany, still fodders wind and flame in deprecatory offering, and hunts on St. John's night the witches from house and stall; when, as in our own country, the superstitious regard for signs, omens, etc., still holds so strongly even in intelligent and comparatively freed minds, and survivals almost innumerable of old mythological beliefs exercise, to this hour, powerful sway over both opinions and conduct." The origin of myths is sought by the author chiefly in the disposition of childhood, "and so the child-mind of humanity," to view every object about it as having conscious life; as endowed, in some strange or vague way, with personality. Combined with this is a propensity to exaggerate, particularly in matters associated with the religious sentiment. Thus the illusions of mythology grew as the original

appellative sense of words descriptive of objects in nature was lost, and the anthropomorphism and personification became more and more complete. From this general description and origin the author goes on to account for "myths of explanation," "myths arising from metaphor," "heroic legends," "nursery tales," "proverbs, folk-lore," etc., "survivals and reminiscences," "shadow and signification," "didactic and ethical myths," and "symbolism." Finally, he forecasts an "excelsior" for the human mind, when it shall grow beyond "anthropomorphism in reference to Deity?"

The book prepared by *Paul Bert* as an introduction to his "First Steps in Scientific Knowledge" has been translated and issued in this country, with the title *Primer of Scientific Knowledge* (Lippincott, 36 cents). The author says of the present volume: "This new work is carried out in the same spirit as the former and follows the same plan. The book is so arranged that the larger work becomes a review and extension of the subject. The method which consists in presenting to the child during two or three consecutive years the same subjects, in the same order, following the same general arrangement, but with an increasing number of facts and a progressive elevation of ideas, is an excellent one and is now universally adopted." The "Primer" is both more elementary and more practical in character than the "First Steps." It treats of man (his organs and their uses), animals, plants, stones, and the three states of matter, with a few paragraphs on light, sound, electricity, and magnetism. Reading lessons and subjects for composition are given at the end of each section. The book is full of pictures and is provided with a glossary. These two books serve admirably to bring the study of nature into the early education of pupils, where it will do them most good.

A very attractive little book, entitled *Outlines of Lessons in Botany*, is offered by *Jane H. Newell*, for the use of teachers, or of mothers studying with their children (Ginn). The lessons here outlined are suitable for children of twelve years of age and upward. They follow the plan of Dr. Gray's "First Lessons" and "How Plants Grow," and are intended to be used in connection with either of those books. The necessary references are given at the end of each section. These lessons contain directions for getting plants to work upon by raising them from the seed, etc.; also suggestions for leading the pupils to observe and to experiment for themselves. Part I, now before us, deals with the organs of plants and their functions, taking up in succession roots, buds and branches, stems and leaves, and thus affords a basis for classification, which Part II, on flowers, is to develop. A general description of seedlings precedes the chapters on the special organs, and prefixed to that is a brief account of plants and their uses. Only the flowering plants are studied in these lessons. The book has twenty-five illustrations.

Prof. Wentworth's series of mathematical text-books has been increased by the first volume of a work on *Algebraic Analysis*, by *G. A. Wentworth, J. A. McLellan, and J. C. Glashan* (Ginn, $1.60). This work is intended to supply students of mathematics with a well-filled storehouse of solved examples and unsolved exercises in the application of the fundamental theorems and processes of pure algebra, and to exhibit to them the highest and most important results of modern algebraic analysis. It may be used to follow and supplement the ordinary text-books, or as a work of reference in a course of instruction under a teacher. The present volume ends with a large collection of exercises in determinants.

Studies in the Outlying Fields of Psychic Science, by *Hudson Tuttle* (Holbrook, $1.25), is an attempt to explain those occurrences which have come to be known by the name of psychic phenomena. His theory is, that there is a psychic ether which conveys thought as the luminiferous ether conveys light; that every one's thoughts produce waves in this psychic ether, which may be felt by a person at a distance who has the requisite sensitiveness, and that in this way mesmerism, clairvoyance, mind-reading, visions, thought-transference, etc., are made possible. He regards this theory and these phenomena as furnishing a scientific basis for the belief in immortality. The closing chapter is a record of impressions which the author believes he received from the spirit-world. Mr. Tuttle appears to be acquainted

with the physiological explanations of hallucination, the influence of the mind upon the bodily functions, and allied phenomena, and he accepts some and rejects others according as they happen to run with or counter to his speculations. Other results of scientific research he treats in the same arbitrary fashion.

The second volume to appear in the four-volume history of English literature, which is being published by Macmillan & Co., is *A History of Eighteenth Century Literature* (1660–1780), by *Edmund Gosse*, M. A. ($1.75). The first great writer of this period is Dryden, and the other prominent names which come in the scope of the present volume are Pope, Swift, Steele, Addison, Defoe, Richardson, Fielding, Smollett, Johnson, Hume, Goldsmith, and Gibbon, the period ending with Fanny Burney, Junius, and Burke. In regard to the critical opinions expressed in the work the author says: "In every case I have attempted to set forward my own view of the literary character of each figure, founded on personal study. Hence, in a few cases, it may be discovered that the verdicts in this volume differ in some degree from those commonly held. A few names which are habitually found chronicled are here omitted, and still fewer which are new to a general sketch are included. . . . In the final chapter I have stated my theory with regard to the mode in which the philosophical, theological, and political writing of the period should be examined. But I may explain here that it has been my object, while giving a rough sketch of the tenets of each didactic specialist, to leave the discussion of those tenets to critics of the specialist's own profession, and to treat his publications mainly from the point of view of style." The work is provided with an index, and a brief bibliography designed to refer the student to the most accessible text of the chief writers mentioned.

Schiller's Jungfrau von Orleans, edited by *Benjamin W. Wells* (Heath, 65 cents), has been adapted for the class-room by a copious accompaniment of notes and other information. The text is prefaced by an introduction of fifteen pages dealing with the composition of the drama, editions and manuscripts, meter and rhyme, and the divergence of the play from history, and includes some biographical notes on the historical characters in the drama. The text has a clear, attractive look, although the stage directions and foot-notes are in rather small type for German print, which is trying enough to the eyes even when large. Thirty-eight pages of notes—grammatical and historical—are appended.

Prof. *B. Perrin's* edition of *Homer's Odyssey*, Books I–IV (Ginn & Co.'s "College Series of Greek Authors," $1.50), is based on the edition of Karl Friedrich Ameis and C. Hentze, with adaptation to what the editor believes to be the requirements of American college classes. Considerable material has been furnished for the higher criticism of the poem, in which the first four books are of special significance. At the same time, enough assistance of an elementary sort has been provided to enable a good teacher to use the volume in introducing students to the study of Homer. Certain interpretations characteristic of the Ameis-Hentze edition have been retained in the current notes, while the editor expresses in the appendix his preference for other views. On the other hand, he has incorporated in the notes views at variance with those of the German edition. Variations in the manuscript, readings of other editors, and other data appropriate to a text-book of the kind, are given in the appendix.

John Charáxes (John B. Lippincott Company, $1.25) is a tale of the civil war in North America, by *Peter Boylston*, an author whose identity is left indefinite in a prefatory note by his "literary executor." The plot affords room for considerable variety of situation and incident, and the management is lively. The history of the title character is invested with a degree of mystery which adds to the interest and complexity of the story; and a negro woman from the slave-markets of the South, having decided individuality of character, is introduced with some skill.

The Beginner's Reading-Book, by *Eben H. Davis* (Lippincott, 42 cents), starts with short sentences, in both script and Roman type; new words are not arranged in columns on the page, nor does the alphabet appear by itself in the book. The "Teacher's edition" contains a chapter on how to teach reading, in which the teacher is advised to

exercise the pupils in talking about objects, and in reading from the blackboard, before putting the reader into their hands. Pictures of the objects named accompany most of the lessons, and when long sentences are reached they are broken into short sections at natural pauses, each standing in a line by itself, in order that the pupil's mind may not be required to take in too much at once.

Dr. *Mary Putnam Jacobi* has published, under the title *Physiological Notes on Primary Education and the Study of Language* (Putnam, $1), four essays, of which three appeared in "The Popular Science Monthly" for 1885 and 1886, and the fourth in "The Teacher" during 1888. Two of these essays describe "An Experiment in Primary Education," being a record of the method employed in training the intellectual faculties, especially the perception and memory, of a child between the ages of four and six and a half years. The next essay, entitled "The Flower or the Leaf," is a reply to a criticism by Miss E. A. Youmans on the method of teaching a knowledge of plants employed in the afore-mentioned "Experiment." The subject of the paper which concludes the volume is "The Place for the Study of Language in a Curriculum of Education," and embraces a consideration of what special influence language study has upon mental development, what is the age at which this influence should be exerted, and what relative proportion language and other subjects should have in a general curriculum.

One might suppose *The Geography of Marriage* (Putnam, $1.50) to be a survey of the diversified natural features of the state of matrimony. But, under this title, Mr. *William L. Snyder* offers a law-book written in such a popular style as to make it, aside from its subject, attractive and useful to the lay reader. In a score of chapters he compares the provisions of the marriage and divorce laws of the States of the Federal Union as to who may marry, what constitutes a valid marriage, clandestine and runaway marriages, bigamy, divorce, and various other features of the subject, taking occasion to point out the evils arising from the differences among these laws in different parts of our country. Of the two ways of securing a uniform law which have been proposed, he favors concerted action by the States rather than a constitutional amendment giving up the control of this matter to Congress. A summary of the marriage and divorce laws existing in this country, arranged by States, concludes the volume. The index, which covers the general part of the book tolerably, is very meager with respect to this summary.

The fifth volume in the series of "English History by Contemporary Writers" tells the story of *The Crusade of Richard I* (1189–'92), and the materials were selected and arranged by *T. A. Archer* (Putnam, $1.25). There is an ample number of accounts of this expedition, some by contemporary writers who were in Palestine when the events narrated occurred; others by contemporaries who remained at home; and still others by writers of the next generation, some of whom had visited the scenes of the crusade. Accounts of the authors and books from which extracts are taken, and notes on various customs and things of the time, are appended to the volume. Pictures of war-engines, fortresses, etc., illustrate the text. The volume lacks an index.

Mr. *D. H. Montgomery* has made a book which claims to embody *The Leading Facts of French History* (Ginn, $1.25), and is evidently intended to serve either as a text-book or for general reading. It begins with a reference to the cave-men and the latest event which it records is the election of President Carnot. The narrative is popular and picturesque in style, and is enlivened with numerous anecdotes. Many additional bits of information and the pronunciation of all difficult names are supplied in foot-notes. Fourteen maps, mostly in colors, show the changing boundaries of France throughout the history. A list of dates, a genealogical table of French sovereigns, and a list of books on French history, are appended to the volume.

Six Species of North American Fishes, published by the Smithsonian Institution, under the head of "Natural History Illustrations," contains representations of the figures and details of five species of minor fresh-water fishes and the pickerel, as they were prepared under the direction of Profs. Agassiz and Baird, from drawings by A. Sourel, with explanations by President

David Starr Jordan. The publication is made "as a memorial of a project undertaken early in the history of American science, by two of the most eminent naturalists this country has ever possessed."

A full and valuable paper on *The Cave Fauna of North America* is published by Prof. A. S. Packard, from the memoirs of the National Academy of Sciences. It contains descriptions of the caves, with notes on their hydrography, temperature, origin, and geological age; the source of the food-supply of their inhabitants; the probable mode of colonization; with lists of the species inhabiting the better-known caves. This general introduction to the subject is followed by more special articles on the vegetable life of the caves; a systematic description of the invertebrate animals found in them; a systematic list of the cave animals of North America; geographical distribution of the cave species; lists of American and European cave animals and of blind non-cavernicolous animals; anatomical studies; a discussion of the origin of the cave species and genera; and a bibliography. To all these are appended twenty-seven plates of illustrations.

The seventh series of the "Johns Hopkins University Studies in Historical and Political Science" is devoted to social science, education, and government. The first number is a sketch, by *F. C. Montague*, of *Arnold Toynbee*, a tutor at Oxford, and an earnest and practical advocate of political, economical, and ecclesiastical reform, and of measures for improving the condition of the masses, who died in 1883, in his thirty-first year. Accounts are added of "The Work of Toynbee Hall," which is named after him, and in which the effort is made to further what he had at heart, and of "The Neighborhood Guild in New York"—the former by P. L. Gill, and the latter by the Rev. Charles B. Stover. The second and third numbers present the history of *The Establishment of Municipal Government in San Francisco*, by Prof. *Bernard Moses*, of the University of California. The history begins with the foundation of the Spanish *pueblo* in 1776, and is considered in three "somewhat clearly defined periods": those of Spanish settlement and stagnation; of transition, extending from the conquest to the adoption of the charter of 1850; and the third period, ending with the adoption of the charter of 1851. No. 4 is *The Municipal History of New Orleans*, by *William W. Howe*. It begins with the foundation of the town in 1718, and traces the gradual development of the municipal organization and its vicissitudes under the changes of jurisdiction which the Louisiana Territory suffered, with the experiments in charter-making that marked the career of the American city, down to the adoption of the present charter in 1882. To this are added notices of the fire department, Commission of Public Works, and water and gas supply, and accounts of the charitable gifts that have been made to the city, and the voluntary public associations. The sixth and seventh numbers embrace a sketch of *English Culture in Virginia*, by Prof. *William P. Trent*, of the University of the South. The paper consists chiefly of a study of the letters of Francis Walker Gilmer, one of the most active of the Virginia gentlemen of the old school for the advancement of education, who was also considerably distinguished in his day for literary achievements—and an account of the English professors obtained by Jefferson for the University of Virginia.

No. XXV of the *Economic Tracts of the Society for Political Education* (330 Pearl Street, New York) is a pamphlet on *Electoral Reform*. In it the purposes of those persons who are seeking to withdraw the control of the distribution of ballots from partisan manipulators and lodge it with public officers, and to secure a really secret and independent vote, are explained; the objections to their proposed system are answered; the operation of the Australian system is described; and the text of the Massachusetts ballot-reform act and the New York Saxton bill are given in full. No. XXVI of this series is *The Liquor Question in Politics*, by *George Iles*. It deals with the growing and alarming power of the liquor traffic, and with the efforts of various forms to restrain it, gives clear and impartial analyses of the propositions and arguments of the advocates of "regulation" by high license, and of the prohibitionists; and contains summaries according prominence to peculiar features of the more recent anti-liquor legislation in several States. Mr. *O.*

J. Smith, 30 Vesey Street, New York, in a pamphlet entitled *Is all well with us?* assumes that we have not politically degenerated from any standard of our ancestors, but are quite as pure as they; and, admitting the existence and hold of the spoils system, maintains that it is a legitimate and direct fruit of the restrictions imposed in the Constitution of the United States upon freedom and elasticity of legislative action. He believes that, to get rid of it, our form of government must be so modified that the will of the people may find certain and immediate expression in law.

The Teacher's Outlook, edited by *W. G. Todd* (Des Moines, Iowa), is a monthly magazine, devoted to general literature, science, health, and industrial and national affairs. Its peculiar feature is a semi-coöperative plan of publication, under which teachers are invited to become stockholders under certain easy conditions; when they are enrolled on the list of contributors, and are entitled to send one article each year for publication (if it be found suitable), for which they receive another share of stock.

The American Workman, published for *O. M. Dunham* by Cassell & Co., is "an illustrated weekly magazine of practice and theory for all workmen, professional and amateur. Its purpose is to furnish articles, with designs, for various kinds of work, particularly such as an amateur might incline to undertake. The half-dozen numbers on our table contain, on their first pages, articles with views and diagrams on "A Cabinet in Fret-cutting," "A Drawing-room Overmantel," "A Cheap, Strong, and Tasteful Method of binding Pamphlets, Music, etc.," "Wood-Carving," "Saw Filing and Setting," "A Summer Fitment for the Fireplace," etc.; and the other pages are occupied with similar matter.

In *The Story of William and Lucy Smith*, edited by *George S. Merriam* (Houghton, Mifflin & Co.), are presented the life and thoughts of a literary man whose career was distinguished by creditable work through forty years, but who did not acquire fame. "He was a man of genius and rare fineness of nature; the associate in early years of Mill, Sterling, Maurice, and Lewes," of Samuel Warren, and of Grove, author of "The Correlation of Physical Forces." He became a contributor to "Blackwood's Magazine" in 1839, and was regularly represented in its pages—as literary reviewer, and in essays embodying philosophical thought—till his death in 1871. His contributions were mostly anonymous; no collection of his papers was made; and this book is published to exhibit his best work, in dramatic, critical, and philosophical writings. His best and best-known work was "Thorndale, or the Conflict of Opinions," published in 1857; after it was "Gravenhurst, or Thoughts on Good and Evil," 1862. Lucy Smith was his wife, and his mate in the best sense of the word. The book is divided into three parts, covering Mr. Smith's bachelor life, the joint married life of the couple, and Mrs. Smith's widowhood. It bears the character of a tribute of admiration, as well as of literary analysis, and its interest is literary and psychological.

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POPULAR MISCELLANY.

Science-Teaching in Schools.—The report of the Committee of American Naturalists, on a scheme of instruction in natural science to be recommended to the schools, advises that instruction should begin in the lowest grades of the primary schools, and continue through the whole course. It should be chiefly by object-lessons in the lowest grades, but should be more systematic in the high schools; and an elementary, but genuine and practical, acquaintance with one or more departments of natural science should be required for admission to college. The main part of the scientific work should be given in the lower schools to the study of

plants and animals; the botanical instruction beginning with such exercises as drawing and describing various forms of leaves, and advancing to flowers of gradually increasing difficulty. In zoölogy, the most familiar animals, and those which the pupils can see alive, should be studied first, then the common, and finally the more obscure forms. The collection of specimens should be encouraged, and the specimens should be made the subject of object-lessons. Human physiology and hygiene being of immense practical importance, their rudiments should be taught in the grammar and even the primary schools. Rudimentary courses in physics and astronomy should be introduced in the highest grades of the grammar school. Physical geography, phænogamic botany, and human physiology should be included in the classical courses in the high school, and required for admission to college.

The Sun-Dance of the Blackfeet.—The most important sacred festival of the Blackfeet Indians is the sun-dance, which is called also by the whites the medicine-dance. The tradition runs that it originated in the thank-offering of a woman for the recovery of her sick child; accordingly, it is usually instituted by a woman who has come successfully out of some trial. It is generally held when the wild fruit is ripe, in July or August, in a lodge especially constructed for it, and may continue for seven days. The ceremonies have been described by the Rev. John McLean, who witnessed them at the Blood Indian camp in Alberta Territory, Canada. The sacred fire was burning in the sun-lodge, and was used by the people for lighting their pipes. The fuel was supplied exclusively by young men who had performed some valorous deed, such as stealing horses from a hostile tribe, and thought the duty an honorable one. Two bundles of birch-wood brush were placed in the form of a cross on the sacred pole. A bower of brush-wood by the side of the lodge was occupied by the woman who had instituted the ceremony, her husband, and a medicine-man, fasting and praying. Prayers were offered at stated times by virgins. Dramatic representations of heroic adventures were given, and sham fights presented representations of actual battles; these were succeeded by feasts of berries cooked in fat, smoking, and conversation. A young man who had been successful in a horse-stealing expedition came up, in fulfillment of a vow, to make himself a sacrifice to the god. An old medicine-woman cut off one of his fingers, held it up to the sun, and dedicated it to him. Two young men presented themselves to be consecrated for admission to the noble band of warriors. One of them stretched himself upon a blanket on the ground. An old man made a speech over him relating his brave deeds, each incident of which was received with applause and music. Then four men held him while a fifth made incisions in his breast and back. Wooden skewers were inserted in the breast incisions, and connected by lariats with the sacred pole, while an Indian drum was fastened to the skewer in the back. "The young man went up to the sacred pole, and while his countenance was exceedingly pale and his frame trembling with emotion, threw his arms around it and prayed earnestly for strength to pass successfully through the trying ordeal. His prayer ended, he moved backward until the flesh was fully extended, and, placing a small bone whistle in his mouth, he blew continuously upon it a series of short, sharp sounds, while he threw himself backward and danced until the flesh gave way and he fell. Previous to his tearing himself free from the lariats, he seized the drum with both hands, and with a sudden pull tore the flesh on his back, dashing the drum to the ground amid the applause of the people. As he lay on the ground, the operators examined his wounds, cut off the flesh that was hanging loosely, and the ceremony was at an end."

The Selkirk Mountains and their Glaciers.—The Selkirk Mountains are situated in the southern part of British Columbia, west of the main range of the Rocky Mountains, within the great bend of the Columbia, and are crossed by the Canadian Pacific Railway at the height of 4,313 feet above the sea. As seen from the Columbia between the two ranges, they rise in gentle slopes and tiers of foot-hills richly clad in pine forest, and cleft by far-reaching valleys, while the Rockies, on the other side of the observer, tower up "from almost barren benches of white silt, with a sparse sprink-

ling of Douglas firs, in great bare precipices of pinkish-white limestone to rugged mountain forms at once." The level of perpetual snow among them is given by the Rev. W. S. Green, who visited them to examine their glaciers, at about seven thousand feet, and the upper limit of the forest at six thousand feet, while the principal peaks rise to between ten and eleven thousand feet. The starting-point of Mr. Green's excursions was the Glacier Hotel station of the railway, in front of the great Illecewaet Glacier, 4,122 feet above the sea. Seeking some commanding point whence a view might be gained of what lay beyond the upper snow-field, the author reached a little peak on the southern shoulder of Mount Sir Donald, six hundred feet below the main summit (10,645 feet). Hence "we had," he says, "one of the most interesting views it is possible to imagine. Now for the first time we saw what the glacier regions of the Selkirks really meant. From the base of the peak we were on, the great snow-field extended for over ten miles. Beyond it to the southward, and away in unending series, far as the eye could reach, rose range after range of snowy peaks with glaciers in the hollows; peaks and glaciers were simply innumerable. Looking westward and northward, a similar prospect presented itself." Of these glaciers, Mr. Green has mapped the Sir Donald, Geikie (four miles long and one thousand yards wide), Deville, Dawson, Van Horne, Asnekan, and Lily. All the glaciers show evidences of shrinking. Measurements made at the foot of the Great Illecewaet Glacier indicated that the ice had moved along twenty feet in thirteen days.

Mental Powers of Criminals.—The bearing of education on the character and reformation of criminals is discussed by Dr. Hamilton D. Way in a paper on the physical and industrial training of that class, which is published by the Industrial Education Association. The author assumes that "it is a mistake to suppose that the criminal is naturally bright. Moral failure and blunted intellect, as a rule, go hand in hand. If bright, it is usually in a narrow line and self-repeating." The criminal's malpractice has its origin in blunted or non-developed nervous areas, and is indicative of wrong-headedness. Whatever may be said of the motives or incentives that led to crime, the fact remains that the head of the criminal is wrong. The time has gone by in which to argue that to educate the criminal is to make him a more accomplished and successful scamp. "It is through physical and mental training and their composite labor that the slumbering germs of manhood are fructified, maturing under a firm and unrelaxing discipline." The criminal's mind, "while not diseased, is undeveloped, or it may be abnormally developed in certain directions; the smartness resulting therefrom partaking of low cunning and centering about self. He is deficient in stability and will-power, and incapable of prolonged mental effort and application. His intellect travels in a rut, and fails him in an emergency. His moral nature shares in the imperfections of his physical and mental state." A training is advocated by the author that will awaken the slumbering faculties, and thus set the mind in a normal condition. This training had best not be given by persons connected with the prison, for it might thereby be unpleasantly associated with penal features, but by teachers brought in for the purpose. Dr. Way gives an interesting relation of experiments which he has made with prisoners in accordance with these views, the average results of which are very encouraging.

The Advantages of Insensibility.—An English writer has recently suggested that we are wont to give excessive praise to the faculty of sensibility, while we depreciate its opposite, or the want of it, insensibility. It is clear, he maintains, that almost every shade of insensibility has a side of advantage as well as of disadvantage. The world forgets how very much tender sensibility often interferes with the calm judgment necessary for right action and the cool presence of mind which is essential to effective execution. What shall we say of the surgeon or the nurse who is so sensitive that the sight of suffering disturbs the judgment and makes the hand tremble when a steady hand is most essential to efficient work. It is obvious that, for every purpose of alleviating pain itself, a certain measure of insensibility to sympathetic pain is in the highest degree advantageous, if not neces-

sary. The best nurses are the calmest nurses, and they are very seldom the ones who suffer most at the sight of their patients' suffering; and "one of the great advantages which patients feel on entering a hospital is that their sufferings do not come back reflected from the faces of those around them; that the sympathy they excite is only a mild sympathy, and not one which heightens their own pain. . . . Hardly a sufferer exists who is not the better instead of the worse for seeing that those around him are *not* overwhelmed by his sufferings—that, so far as he can go out of himself at all, he may get a little relief by entering into the less overshadowed lines around him, and tasting indirectly another's enjoyments."

A Theory of Volcanic Action.—Mr. J. Logan Lobley explained in the British Association last year a theory of the causes of volcanic action which he had reached while keeping in view forty-two leading and controlling facts. His conclusions are, that the primary cause of the formation of lava is the internal heat of the globe inducing chemical action in subterranean regions when the materials and conditions are both favorable; that since the fusion-point of solids is raised by extreme pressure, the conditions for chemical action may be changed by the removal of vertical pressure or its relief by lateral or tangential pressure; that certain substances are fusible at low or moderate temperatures, and that thus at very moderate depths chemical action may be locally commenced that will extend until sufficient heat is produced to effect rock-fusion; that the cause of the ejection of lava from its source, and of its rise in the volcanic tube, is the increase of bulk consequent upon the change from the solid to the fluid state, aided by the formation of potentially gaseous compounds by chemical reactions among the original materials of the magma; that the ascent of the lava in the volcanic tube may be affected by the weight of the atmosphere and by lunar attractive influence; that the explosive effects of volcanic eruptions are altogether secondary, and are due to the access of sea and land water to fissures, by percolation through cool rocks, up which lava is ascending; that this water, when converted into steam, opens, by its expansive power, rents that admit large flows of sea-water to the lava, occasioning the formation of vents and the greater explosive phenomena of eruptions. The formation of the actual surface volcano and the determination of its position are therefore due to the sea, near which volcanoes are almost always situated. Emissions of lava without explosive effects are from volcanic tubes to which large flows of water have not obtained admittance; and, on the other hand, purely explosive eruptions, without lava-flows, are caused by water reaching lava which fails to rise to the surface of the earth.

Fire-proof Houses in Buenos Ayres.—They build fire-proof houses in Buenos Ayres and Montevideo without thinking of it, and while using all the wood they can afford to; and they use neither iron nor the arch. Trees are scarce in the neighborhood, and timber has to be brought down from the upper waters in hard woods. Being dear, a little of it is made to go as far as possible. The floors and the roofs are supported by joists of hard wood, as among us; across these are laid flat rails of the same, and the spaces between these are bridged over by thin bricks thirteen inches and a half long, with their ends resting on the rails; another layer of bricks is then laid with lime, and generally on this a layer of flat tiles. The doors and windows have no boxes, but simply frames, which are set up when the walls are going up, and built in. There is no lathing, or wainscot, or skirting of the bottom of the walls. A house thus built can not be burned.

Glass-Blowing by Machinery.—A system for glass-blowing by machinery, under which mouth-blowing is dispensed with, has been devised by Mr. Howard M. Ashley. In the machine, the molten metal is delivered into a receptacle called a *parison*, which holds just enough metal to form a bottle. At the bottom of the receptacle is a collar mold, which forms the ring around the mouth. The central portion of the mold—which may be described as a punch within a punch, from the method in which it works up into the molten glass to make the collar—is hollow, and is connected with a reservoir of compressed air. After the collar is molded, the mold is turned upside down, a little air

being at the same time admitted. The metal begins to elongate gradually by gravity, and its fall is regulated. When it has attained the required length, the bloom is inclosed within the two halves of the mold, and the bottom of the mold is also placed in position. At the same moment the air is fully turned on, and the bottle is blown out to the full shape of the mold. The result is a complete bottle of the same thickness of glass throughout, and of perfect form and accuracy in every part. A pair of these machines, with one youth and three boys to serve them, are competent to turn out an average of one hundred and twenty bottles per minute per machine. The capacity of the system is greatly increased in the repeating-machine, which is quadrupled, and operates in a continuous cycle, as follows: while the first bottle is being automatically discharged, the second bottle is being finished, the third one is being punched, and the fourth is being cast—that is, the metal is being filled into the mold by the "gatherer," or server of molten metal.

Do Squirrels play 'Possum?—In a paper on the intelligence of squirrels, with special reference to feigning, communicated to the Royal Society of Canada, Dr. T. Wesley Mills gives two cases of the behavior called feigning, by chickarees or red squirrels, and then proceeds to discuss several views advanced in explanation of this habit. Feigning death has been observed in many different genera of insects, in snakes, fishes, numerous birds, crustaceans, and several mammals. In the case of insects, Preyer would ascribe the so-called shamming death wholly to cataplexy (hypnotism), which Dr. Mills deems highly probable. Couch would explain certain behavior of wolves, foxes, and some other animals, usually set down to deliberate feigning, also by an effect analogous to cataplexy. He thinks their senses are stupefied by surprise, terror, etc., so that they are unable to escape. Dr. Clarke adds to this explanation the idea that the quiet of animals when restrained, in many cases is due to an intelligent perception that struggle is useless. Dr. Mills is convinced that Romanes in discussing this subject has imported difficulties into it which are not in the nature of the case present. First, is it at all essential to "feigning" either death or injury that an animal should have, as Romanes supposes, the abstract idea of death at all? It is to be remembered that in these cases the animal simply remains as quiet and as passive as possible, which is in accord with all an animal's experiences as to escape from danger by any form of concealment. A great part of the whole difficulty has probably arisen from the use of the expression "feigning death." What is assumed is inactivity and passivity, more or less complete. This, of course, bears a certain degree of resemblance to death itself. In regard to the behavior of his red squirrels, Dr. Mills is inclined to think that "by inherited instinct, as well as by all those life experiences which had taught them that quiet and concealment of their usual activities were associated with escape from threatened evils, these little animals were naturally led, under the unwonted circumstances of their confinement, to disguise in an extraordinary degree their real condition, and even to imitate an unusual and unreal one." He has reason to believe also that the hypnotic element may play a part in the apparent feigning of death by squirrels. "It thus becomes manifest," he continues, "how varied and also how complex these cases of so-called feigning may be. The subject is all the more interesting, because it shows that there is much that is common in the psychic life of human beings and that of the lower animals. It places the study of their habits and intelligence on a higher plane, and furnishes new motives for extending our inquiries and attempting to give unity to our conception of nature in this as in other domains."

The Bronze Buddha of Nara.—The old bronze images in Japan are remarkable alike for their enormous proportions, the method of their construction, and the excellent character of the alloy composing them. The largest and most remarkable of them is at Nara, some miles eastward of Kioto, which was erected about A. D. 1100. It is fifty-three feet six inches high and more than twenty-eight feet broad across the shoulders. On its head are 966 curls; and the image is surrounded by a glory or halo seventy-eight feet in diameter, on which sixteen images, each eight feet long, are cast. Two

smaller images, each twenty-five feet high, stand in front of the larger one. The total weight of metal in the main figure is about 450 tons, and this is said to consist of gold, 500 pounds; tin, 16,287 pounds; mercury, 1,954 pounds; and copper, 986,080 pounds. The large images are not cast in single pieces, but are built up of numerous small pieces of irregular shape, which are cemented together by a substance of unknown composition, that takes on the same tarnish as the bronze.

Forestry in the Cape Colony.—No care was taken of the forests of the Cape Colony until 1880, when many valuable tracts had been nearly destroyed. Measures were taken in that year for their future preservation, and the Count de Vaeselot, who had had a large experience in French forestry, was appointed forest superintendent. He divided the forests into districts and these into sections, in which the felling should proceed so that the regrowth of the first section should be given time to develop into mature trees before the axe should be used there again. By this system the entire shutting up of any forest for a time is done away with. The period for the "revolution" of felling is fixed at forty years. The forests severally are watched over by a staff of foresters and inspectors, under whose supervision all cutting goes on, and who attend to the raising and planting of young trees. The Government has established large tracts of plantations and nurseries from which the forests and private holders are supplied; has begun a reafforestation of Table Mountain; and has instituted an "arbor day," which is observed with great enthusiasm.

The "Heaps of Joy" of Saint-Pilon.—Tourists have often noticed little heaps of stones on the higher peaks of Mont Sainte-Baume, Provence. They are called *castellets*, or little castles, and are either composed of several stones forming a sort of rude pyramid, or of one large stone inserted in a fissure of the rocky soil. They are most frequent in the vicinity of the Oratory of Saint-Pilon, where they are found at an elevation of nearly one thousand feet. Dr. B. Féraud has learned that they are also locally called *moulons de joye* (heaps of joy), and that, besides being intended to testify to the successful ascent of pilgrims to the summit of Saint-Pilon, they were frequently designed to propitiate St. Magdalen, to whom prayers are made on the spot for approval of the special maiden whom the worshiper may desire to marry. In the latter case the mound is visited by the builder at the end of a year, and if he finds the stones undisturbed, he considers that the saint approves of his choice; but if the heap is broken up, it is generally regarded as a decisive barrier against the intended marriage. In this superstition Dr. Féraud sees a survival of the ancient usage of erecting stone monuments, such as altars, pillars, menhirs, etc., to commemorate some important personal event.

Sign-Talk in New Guinea.—An exploration was made some months ago by Mr. Theodore F. Bevan of the Philp and Queen's Jubilee Rivers, hitherto unknown affluents of the Gulf of Papua, in southern New Guinea. In the course of his voyages the traveler met several bands of natives who had apparently never before seen white men, intercourse with whom brought out some curious characteristics and capacities of the sign-language. At Attack Point, on the Aird River, the progress of the party was opposed by some sixty nude Papuans, who, after a little hesitation, bore down upon them, "alternately splashing the water into the air and beating time with their paddles against the sides of their canoes, also shooting volleys of arrows at us. . . . This attack was decided in our favor, without any bloodshed, by a judicious use of the steam-whistle and a few shots fired wide and high." The savages were painted, decorated with feather head-dresses in addition to other ornaments, and wore white groin-shells to partly conceal their nudity. At Tunui, on Philp River, the natives dressed their persons and canoes in green boughs in manifestation of their friendly feelings, and were responded to by the whites with dumb motions and words likely to be recognized by them. The next step from this side was to bind a slip of Turkey-red cloth, a piece of sharpened hoop-iron, and one or two trifles upon a wooden batten, and let it drift down-stream. "One native, bolder than the rest, paddled after this parcel, and, after cautious inspection, appropriated it, and donned the red cloth as

a covering for his frizzly hair. On another visit from the natives, one was horrified at seeing salt beef in a cask, and another was terrified at seeing his own ugly reflection in a mirror. They had become tired of the white men by this time, and signified it by waving their arms down-stream. "One very old and wrinkled man rubbed his nose and pinched the tip of it, and rubbed the pit of his stomach. Another signified by signs the act of cutting off the head and arms, using the words 'oorar' and 'badinar.'" With a tribe called Kiwa Pori, in the delta of the Queen's Jubilee River, one of the signs was to hide their lowered heads in their hands and then to draw their hands down ever cheeks, mouth, chin, neck, breast, and abdomen. These men were of unusually fine stature, and dark bronze in color; but, though with well-nourished and muscular frames, "their retreating foreheads and heavy eyebrows gave them a sinister expression." One tribe always spoke the name of the sun in a whisper, with finger pointing upward and averted gaze. In a deserted hut, which exceeded the others of the village in size, was found fixed up in front a "taboo," consisting of a painted mask resting on a large circular wisp of sago-palm fiber and rattan, with pendent streamers of the same fibrous material; while half-way down the floor of the hut were bones of fishes and small deer suspended from streamers. All of the new tribes wore nose-pencils, distended the lobes of their ears, and smoked sun-dried tobacco by means of bamboo tubes. The canoes of all the tribes were dug-outs, with either a bank of mud or a small boy squatting in the prow and opposing his back to the incoming water. Some of them were very large. In one, twenty-nine men stood up to paddle.

Polishing Telescopic Objectives.—The shaping and grinding of telescopic objective lenses are operations requiring great care and delicacy in execution. In polishing, softer powders and softer tool-surfaces must be used than in grinding. Of all the substances that have been used for the face of the polisher, pitch, or the natural bituminous deposit from Archangel, which was first employed by Sir Isaac Newton, is, according to Mr. Howard Grubb, still the best. It has the important qualities of perfect inelasticity and a property of subsidence. Cloth can not give a perfect surface, because it is apt to round off the edges of the pits left by the grinding-powder, and to polish their bottoms as well as the real surface of the lens. Pitch wears away the surface evenly, and does not take hold of the pit-bottoms till the whole is ground down to a level with them. Although pitch, by boiling, can be made so hard that an impression can not be made on it with the finger-nail without splitting it in pieces, it will, even in this condition, if laid on an uneven surface, in time subside and take the form of whatever it is resting upon. This property, by virtue of which it may be considered technically a liquid, is taken advantage of in the manipulation of the polishing process to produce a surface exactly even and true. It appears to be peculiar to pitch, some of the resins, and ice; although it has been observed, in a vastly inferior degree, in some metals. It is a curious circumstance that the same quality which in ice allows gradual creeping and subsidence, and the consequent formation of glaciers, should in pitch help us to produce accurate optical surfaces.

Italian Butter.—The Italians do not excel in the manufacture of butter. It is produced considerably only in four districts, of which Lombardy furnishes the best, usually through the market of Milan. The butters of Reggio and the Tyrol are used for mixtures, and those of Æmilia and Sorrento are unimportant in quantity. In the rest of the country, oil, fat of American origin, or substitutes are used for daily wants. According to the French consul at Milan, the principal obstacle to the development of the trade in pure butter is the increasing use of these substitutes, and artificial butters, which are imported from America, France, Germany, England, and the Netherlands. "The demand for butters in Europe, South America, Australia, India, Japan, and even China, has become so important that, in presence of the insufficiency of the natural product, it became necessary to manufacture an analogous substance, so that in Holland and Denmark, the principal countries producing pure butter, the artificial butter industry was undertaken without fear of prejudicing the pure

article. It was not long before Italy followed the example of these two countries, but the first attempts were not fortunate." Italian margarine butter costs from forty to forty-five per cent less than pure butter, and is more easily handled.

NOTES.

THE "Hand-Book of Meteorological Tables," compiled by Prof. H. A. Hazen, contains in a convenient form the reductions needed for current work, omitting those not now generally used. Several of the tables are new, or recomputed in their present form after some years' experience by the author in their use. The table for reduction of barometrical observations to sea-level has been extended to eight thousand feet. Formulæ and tables are given for the determination of mean wind direction, and for the conversion of wind velocities from miles per hour to metres per second, and *vice versa*.

THE Society or Association of Sanitary Inspectors of Great Britain is composed of the professional inspectors who act under the direction of the medical boards of health. The "Lancet" claims that a great improvement has come over the character of these officers since the society was formed, five years ago, and that they have gained greatly in influence. The examinations by the Sanitary Institute have also contributed materially to raise the standing of these men. The diploma of the institute conveys no legal license or corporate privilege, but it is a testimonial of qualification, a badge of honor, and a stimulant to earnest work and improvement.

THE Watson gold medal and $100 in gold, founded by Dr. James C. Watson, to be given to the citizen of any country who has made the most important discoveries in astronomy, has been awarded to Dr. Edward Schönfeld, of the University of Bonn, Germany. The medal is given to Dr. Schönfeld for his researches concerning the variable stars and for his work in cataloguing the stars brighter than the tenth magnitude, from the equator to the southern tropic.

THE Congress on Tuberculosis that was held in Paris in the summer of 1888 recommended the inclusion of that affection in the list of contagious diseases of animals, and the seizure and destruction of every infected beast. It urged the spread of popular instruction respecting the precautionary methods for preventing tubercular contagion, the risks that are run by the infection of meat and milk coming from tuberculous cattle, and the measures to be taken for the disinfection of materials derived from phthisical patients. It insisted on the inspection of dairies and dairy farms.

A LOWLAND cure has been suggested by Dr. Lindsley, to be applied in places below the level of the sea, where the atmosphere is denser than at normal or higher levels. Such places are the valley of Conchilla, near Los Angeles, California, about two hundred and seventy-three feet; the Dead Sea district, twelve hundred and eighty-nine feet; Lake Asal in East Africa, six hundred and thirty-nine feet; the Arroyo del Muerto, California, two hundred and thirty feet; the oasis of Sirrah in Libya, one hundred and twenty-three feet, and the borders of the Caspian Sea, eighty-six feet below the sea-level.

COLORADO possesses large coal-fields which yielded 1,439,811 tons in 1886. The valuation of coal on the cars, at $2.35 per ton gross, was $3,375,095. About 3,500 men are employed. The average cost of producing the coal on the cars at the mines is $1.74 per ton. The fields yield anthracite, bituminous, and lignite coals; and it is thought by the officers of our Geological Survey that about 100,000 square miles of the territory of the State are underlaid by coal-bearing strata.

THE monument to be placed over General Prjevalsky's grave on the shores of Lake Issik-kul will represent a rock twenty-eight feet high, on the top of which a large eagle is perched. The eagle grasps in its talons a map of Central Asia, the arena of the scientific exploits of the deceased, and in its beak an olive-branch, symbolical of the peaceful scientific conquests which Russia owes to Prjevalsky. The inscription, recording the name, birth, and death of the deceased, on one side of the rock, is surmounted by a large bronze cross. In the interior of the monument is cut a spiral staircase crowned with an enlarged copy of the medal struck by the Academy of Sciences in 1887, and showing the inscription, "To the first explorer of Nature in Central Asia."

BISHOP'S Ring was seen in February, 1889, by Miss E. Brown, of Cirencester, England, at about noon one day when the sun was hidden behind a cloud. It appeared very similar in extent and color, but not in intensity, to its exhibition after the Krakatoa eruption.

IN a paper on "Destructors and Refuse Furnaces," read before a Yorkshire Sanitary Science Conference, Mr. W. Warner said that a chimney one hundred and sixty feet high was suitable for the cremation, and could be built, with a six-celled destructor, for about £3,000, or $15,000. If a town could utilize all the clinkers, fine ashes, and fine dust, it would pay the cost of burning and the return of capital expended on the plant, and produce a revenue to aid the necessary cost of erection. The author did not see why the point of perfection should not be reached.

In a paper in the British Association on "Tattooing," Miss A. W. Buckland said that in Africa, Australia, and the islands of the Indian Ocean, tattooing consists of a series of short cuts which heal, leaving cicatrices. In New Zealand, America, the Pacific islands, among the tribes of India, and in Burmah, Borneo, and New Guinea, patterns are first drawn upon the skin, and then punctured with thorns, needles, or splinters of human bones. Color is then rubbed in. The process is very painful and can only be carried on at intervals, several years being sometimes required for its completion. Among men tattooing is valued as a mark of bravery. In the case of women devices are worked upon the chin to signify marriage.

After his ethnological researches in Egypt, Prof. Virchow has concluded that the fellaheen do not exactly represent the ancient inhabitants in their physical aspect. The evidence afforded by the oldest sculpture and the earliest skulls shows that the primitive type was brachycephalic, whereas the types of the present time and of many centuries past are dolichocephalic and mesocephalic. It is uncertain whether the change was produced by the environment or by the influx of new races; but Prof. Virchow inclines to the latter view.

The principal and most useful wood in Borneo is *bilian*, or iron-wood. Its characteristics, as mentioned by Mr. R. T. Pritchet, are hardness, density, and being antproof. It is the best shingle wood, and, being large and plentiful, the most valuable timber. Other sinking woods are *russock*, *grealing*, *mirabou*, the last of which, a heavy, dark-yellow wood, is valuable for furniture and takes a fine polish; camphor-wood, and a red wood, and *sirayah*, which gives logs five feet in diameter and forty feet long.

Observations made by M. Janssen on Mont Blanc for the purpose of deciding whether certain lines in the solar spectrum are due to oxygen in our air or in the solar atmosphere, showing the lines weaker than at lower levels, seem to prove that they are due to our atmosphere.

The *nipa* is a palm-tree of Borneo which grows in the swamps above the mangrove, where the water begins to be brackish. It revels where the swamps are more fresh than salt, its leaves growing boldly and imposingly to a height of twenty feet and upward. House-thatching is principally made of these leaves stitched together, which form roofs well adapted to turn away the heat. The *kadjan* mats, which travelers find very useful, and will fold up into very small compass, are also made from them.

The pest of locusts has been fought vigorously and successfully in Cyprus by gathering the eggs and catching the developed insects in systems of screens. The number of eggs collected increased from 37½ tons in 1879 to 236 tons in 1880, and 1,330 tons in 1881. More than 6,000 screens were employed in 1882, and 195,000,000,000 insects were destroyed. The system was steadily made more effective, and in 1886 there were available for use more than 11,000 screens and 13,000 traps, the screens representing an aggregate length of about 315 miles, or nearly the whole coast-line of the island.

It sounds odd to read in a paper by Robert Wallace, on Indian agriculture, that the Manchester Chamber of Commerce is cooperating in an attempt to "reduce the amount of refraction" or impurities to be recognized as a "trade custom" in the sale of wheat from six or seven to two per cent. Regarding the present custom, it has been estimated, according to Mr. Wallace, that the direct loss to the community is equivalent to the sum of fifty thousand pounds a year, "spent upon the absolutely unremunerative work of shipping or carrying sand or clay which had been added to the cleaner samples of wheat with the deliberate object of netting an unjust gain."

OBITUARY NOTES.

Maria Mitchell, a distinguished astronomer and professor in Vassar College, died in Lynn, Mass., June 28th, of disease of the brain, from which she had been suffering for about eighteen months. She was born in Nantucket, in 1818, the daughter of an amateur astronomer, and studied under her father and Charles Pierce. At eleven years of age she recorded the time of the beginning and ending of an eclipse of the moon. In 1847 she discovered the first of her eight comets. She was the first woman to be elected to the American Academy of Arts and Sciences; was a member and fellow of the American Association for the Advancement of Science; an LL. D. of Hanover and Columbia Colleges; and was actively interested in measures to elevate woman's work. She resigned her professorship at Vassar College in January, 1888, but no action was taken on her resignation, so that she still remained the titular incumbent.

Reichenbach, the eminent botanist, has recently died in Hamburg, aged sixty-seven years. He was best known from his investigations of orchids and hybrids.

Dr. George Owen Rees, F. R. S., died in Mayfield, England, May 27th.

Dr. Paul Du Bois-Reymond, a brother of Dr. Emil Du Bois-Reymond, died in Freiburg, Baden, April 7th, in his fifty-ninth year. He was Professor of Mathematics at the Technical High School of Berlin; was formerly at the Universities of Freiburg and Tübingen; and was the author of two well-known mathematical works.

Joseph Lovering

THE

POPULAR SCIENCE MONTHLY.

SEPTEMBER, 1889.

A STUDY FROM LIFE.

By OLIVE THORNE MILLER.

MANY a strange little beast from far-off quarters of the globe may be picked up in New York, in places where sailors are wont to dispose of their pets. In this way I came into possession of a rare and interesting animal, a black-headed lemur, or *Lemur brunneus*, native of Madagascar. He was a member of my household for nearly a year, and during that time the family circle was never dull. The whole of Barnum's menagerie next door could not afford more entertainment than did this one droll little fellow.

He was about the size of a small cat, or, to be exact, from the tip of his pointed nose to the root of the tail he measured sixteen inches; of that length, three inches were face and thirteen body and neck. His girth back of the fore-legs was nine inches.

The manners of the little stranger were extremely odd. His home was a cage in the parlor, where he was generally alone all day, and spent the time, it is to be supposed, in sleeping, although I must admit I rarely found him so. At about four in the afternoon I went into the room and let him out. The moment I appeared he came to the front of the cage, pressed his weird little black face with its clear topaz eyes to the wires, and then began to call and "weave" impatiently. The latter was a singular movement. Planting his hind-legs far apart in a half-sitting position, he held up and outward his short arms, and swayed his whole body from side to side—at each end of his swing bringing his hands down almost to the floor. This he did very rapidly, uttering every moment a short, quick sort of double grunt, with an occasional explosion or "snort," in the exact tone of a pig.

Of course, I instantly opened his door, from that time till ten o'clock being his regular daily outing. Like a flash he bounced

through it, jumped to the nearest chair, from that to the sofa, the table, somebody's lap or shoulder, the mantel, the top of his cage, or the piano, and so made the circuit of the two parlors, without touching the carpet. After thus going the grand rounds, he generally jumped to the floor, and ran all about under the furniture. His sharp nose nearly touched the carpet, and his back (owing to the four inches difference in length between his fore and hind limbs) sloped up at an angle of forty-five degrees to the tail, which stood straight up like a banner over his back, the tip sometimes curling forward like a dog's, sometimes backward like a hook. During the whole performance he constantly uttered a contented single grunt like "woof!"

If any movement in the room startled him, he broke into a grotesque gallop, bringing his feet up closely beside his hands at every leap. This gallop, which was rapid and light, always ended in a sudden spring to somebody's lap, or a scramble to the top of a tall easel, where he looked around to see what had frightened him. But if not disturbed, when his tour of inspection was over he usually went to the open fire, placed himself, sometimes on the toe of a lady's slipper if it were conveniently near, sometimes on a little three-by-five-inch cushion on the arm of an easy-chair. Here he sat up like a cat with tail hanging out before him, or fell eagerly to dressing his peculiar woolly fur, which stood out all over his body, washing his face by licking the outside edge of his hand and rubbing it back and forth over his face, and wiping his mouth on a chair as a bird wipes its bill, first one side and then the other. Especially did he labor over his eighteen-inch-long tail, scraping up the fur till it stood out round and gave that member great apparent size. The tool with which he accomplished so much was his curious row of lower front teeth, which ended in points of almost needle sharpness, and projected at an angle that prevented their being used to bite, but made an effective scraper for the skin, or a comb for his own gray wool.

Warmed and dressed, the playful fellow began his evening's amusement. If the master's quiet game of cribbage was going on, he often began by marking his prey from his seat on the chair-arm, and without warning springing to the middle of the table, scattering cards like chaff, upsetting cribbage-board and sending the pegs flying, slapping cards out of the hands of the players, and biting needle-like holes in them.

To make a great commotion of any sort was his delight. Sitting peacefully on my lap, or lying flat upon his stomach, every limb stretched out, apparently the most innocent and harmless of pets, he would often quietly rise to his feet and, before I suspected him, snatch my book out of my hand or spring over it into my face. If I started at this rough salute, as I was tolerably sure to

do, he was struck with panic, gave one mighty bound to the mantel, the bracket of a lamp, the edge of an open door, or the floor, where he stood a few seconds motionless as he alighted. A panic, indeed, struck through him instantly, with curious effect. Whether he were lying quietly on one's knee, standing, sitting, or in whatever position, on being alarmed by an attempt to capture him, or by an unexpected sound, he instantly disappeared—sideways, backward, or forward mattered not—without in any way making ready, or getting upon his legs. It was as if his body were a spring, or as if he were flung by some force outside of himself—he simply went. It is impossible to give an idea of this most remarkable movement; I never saw anything like it. A curious fashion he had also of leaping against the bare side wall of the room, which he struck flatly with all fours, and then bounded off in another direction. I have seen the same thing done by a squirrel, and also—strange as it seems—by a bird.

The extreme nervousness of the little lemur seemed to be caused by too much company. When alone with one person, especially if that one were my daughter or myself—his prime favorites—he was as quiet as the family cat. He sat or lay in the lap, and allowed himself to be brushed; indeed, he enjoyed brushing, and thrust out arms and legs to be operated upon. He sat up with his tail laid over his shoulders in a comical way, and, if he wanted to turn his head, he "ducked" it under the tail and brought it up the other side rather than change its comfortable position. This member was really an important charge to the little beast; he spent hours in dressing it, and by it he expressed all his emotions. When in quiet mood it hung straight down, as stiffly as if made of wood; on mischief bent, it assumed a wicked-looking sidewise turn, though still hanging; during his pranks and in excitement it stood up like a flag-staff, safely out of harm's way; if his "angry passions rose," it was swished, after the manner of a cat; and when he jumped, it delivered a severe blow, like a smart rap with a stick.

Never was a living creature more alert than this small brute. So acute was his hearing that it was absolutely impossible to surprise him. No matter how quietly and apparently off his guard he sat on a chair, one could not jerk or tip that piece of furniture so quickly as to take him unawares; at the first sign of movement he appeared on the other side of the room, one could hardly tell how. I wanted much to see him when he did not see me, and to that end several times stole into the room from the front. The back of the cage was toward that side, and he could not possibly see me. I took off my shoes, and moved—to my senses—without the slightest sound over the carpet; but when I reached the point where I could see the open front of his cage, there he was, waiting,

looking for me, his bright yellow eye pressed eagerly against the wires, in the corner nearest the side I came to. The instant he saw me he uttered a mocking grunt, which plainly said, "Thought you'd surprise me, eh?" and began a violent weaving and coaxing to get out. Perhaps he was thus wide awake because he seemed really to fear being alone, and to dread the dark. The moment he was left in the room the spirit of mischief departed, and he retreated to the top of his cage, where he remained till some one came in. The dusk, with its shadows, always alarmed him, and, when taken into a strange room, he cowered and clung to his friend as if frightened out of his wits. Fond as was the lemur of society, he was exceedingly nervous about it. When he heard a person coming through the hall, he first ran to the end of a sofa nearest the door; as the steps approached, he grew more and more uneasy; and, when the hand touched the door-knob, he yielded to wild panic, bounded to the other end of the sofa and over the back, where he held by one hand, while his body dangled behind. His great sensitiveness showed also in another way—he never met a human eye with his own. He saw every expression of the face, but he always looked just beyond it. He violently objected to being stared at, turned his head away, and, if his head were held between two hands for the purpose of looking in his face, he got away, either by a sudden spring to the top of the head of his captor or by wriggling himself out backward. His wool-covered body was the most elusive in the world to hold.

But, although the little fellow would not look one squarely in the face, he saw everything that happened, and was as inquisitive as any monkey. He liked to sit before the window and look at passers-by, both beast and human; a cat aroused him to the point of expressing his mind, and he saluted her by a short, sharp bark. A bugle that was brought out with the hope of curing him of too great familiarity with the person of the owner, proved, on the contrary, to be a special lure. He rose on his hind-legs—which he did with perfect ease—and thrust his nose into the large end, evidently to find the sound. Once happening to get possession of the instrument when its guardian was absent, the lemur made a thorough examination of it. He pulled it on to the floor, threw his body across it, embracing it with his legs to keep it in place, and then proceeded to push his head almost out of sight into the big end, take the small end in his mouth, as if to blow, and to make minute and careful study of every part of it, until fully satisfied that whatever he sought was beyond his reach, when he abandoned it.

The intelligence of the creature was notable. He knew his own blankets instantly wherever he saw them, and was quite positive that no one had a right to touch them; he learned his name read-

ily, always answered when spoken to, and came at a call like a dog, a thing very rare among animals of his sort. He also knew his own box, his chosen seats, his place before the fire, and insisted that they should not be used by others. In pictures he recognized a bird, or, at least, he tried to snatch it out of the paper, and the same with figures that looked like insects. He disapproved of change, complained when I closed the shutters, and looked askance at me when I put on a different dress. He knew with perfect certainty who would let him out of the cage and who would not; one of the gentlemen of the house might sit in the parlor all day, and, except for keeping an eye on him, the little beast made no sign; but let either of his mistresses enter, and he was excited at once, weaving, grunting, and demanding that the door be opened. He understood at once, too, when forbidden to do anything.

On the occasion of a several days' visit of a child, he was at first very jealous; did not like her occupying a lap he had considered his own, and opposed with a squealing grunt her sitting on his special stool before the fire. But she was a gentle child, and a little later he became very fond of her, let her pat him, sit beside him on his seat, and at last insisted upon lying on some article of her dress if any were in the room.

What the small African set his mind on he always secured in the end, for his persistence was simply marvelous. He was as fond of apples as any school-boy, and the head of the family liked to tantalize him by coming in with one hidden in his pocket. The sharp little nose sniffed it at once, and the eager little fellow sprang upon the apple-bearer, tried to dive into his pocket head first, then to dig into it from below, and, despairing of this, went to work to tear away the garments that covered it. No doubt he would have succeeded, but before he went so far the owner gave in, and delivered the fruit to the impatient creature. He snatched it at once, and fairly "gobbled" at it, biting off pieces with his back teeth, throwing his head up to chew them, and carefully separating and dropping the skin. He never at any time made a full meal, as do many beasts. His desire seemed to be merely to stop the cravings of hunger; the moment these were satisfied he opened his hand, and whatever food was in it dropped, he being apparently as unconscious as if he had nothing to do with it. He ate bread, sweet potato, and banana, and drank milk and water; but his delight was—with the girls—in candy, and that he never dropped. If there was a bit in sight, and he not sharing it, he was simply wild. A piece being offered, he snatched it, chewed it down, and instantly begged for more. The favorite trick of a mischievous youth was to give him a licorice-drop, which became soft and tenacious in the mouth, held his jaws together, and in every way was troublesome; but, in spite of his strug-

gles with it, he was never discouraged, and always coaxed for another.

No beast that I ever saw was more fond of play than the little Malagasy, not even a lively kitten. From the moment his door was opened till he was shut in for the night he often gave his mind to a constant succession of pranks. He scraped the beads off our dress-trimmings with his comb-like teeth, and he slapped or pulled books or work out of our hands, and especially liked to frolic in one's lap, lying on his back kicking with all fours, pretending to bite, and even turning somersaults or indulging in the most peculiar little leaps. In the latter he flung out his arms, dropped his head on one side in a bewitching way, turned half around in the air, and came down in the spot he started from, the whole performance so sudden, apparently so involuntary, and his face so grave all the time, it seemed as if a spring had gone off inside, with which his will had nothing to do.

A favorite plaything with the lemur was a window-shade. He began by jumping up to the fringe, seizing it and swinging back and forth. One day he learned by accident that he could "set it off," and then his extreme pleasure was to snatch at it with so much force as to start the spring, when he instantly let go and made one bound to the other side of the room, or to the mantel, where he sat, looking the picture of innocence, while the released shade sprang to the top and went over and over the rod. We could never prevent his carrying out this little programme, and we drew down one shade only to have him slyly set off another the next instant.

Next to the shade, his chosen play-ground was a small brass rod holding a bracket-lamp. It was not more than half an inch wide, and so sharp-edged that it seemed impossible that an animal of his size and weight could stay on it one minute, especially as it was not more than eight or ten inches long, and held a burning lamp at the end. The lamp was no objection to the always chilly little beast; he enjoyed the heat of it, and not only did he sit there with perfect ease, and dress his fur or eat his bread, but he played what seemed impossible pranks on it. He turned somersaults over it; he hung by one hand and swung; he jumped and seized it with hand or foot; whisked over it, and came up the other side. He never made a slip nor touched the lamp, and his long, stiff tail served as a balancing-pole.

Perhaps the greatest fun in our little captive's residence in a parlor was with a newspaper. The thing that inspired his first interest in the article was being told to let it alone, when he longed to tear it up. That ungratified desire made us constant trouble, till at last I resolved to give him his wish. I took an old paper and put it on the floor for him. His first pass was to come

with a big leap into the middle of it, when the rustle instantly scared him off in a second bound as tremendous as the first. He soon returned, however, and began again. He turned somersaults on it, rolled over on it, took hold of one corner and rolled himself up in it. But during all these performances, every fresh rustle of the paper put him in a panic, and he leaped spasmodically away—a wild frolic impossible to describe, with attitudes so grotesque, movements so unexpected, and terror and joy so closely united, that it was the funniest exhibition one can imagine. The next evening I arranged a newspaper tentwise on the floor. The lemur looked at it, contemplated the tempting passage-way under it, then dashed frantically through and flew to the highest retreat in the room, as if he had taken his life in his hands. He returned—for it was impossible to keep away—and resumed the gambols, the hand-springs, the various fantastic exercises, and between each two antics flung himself about the room as if he had gone mad, ending every romp by sitting a few seconds motionless, with a grave and solemn air, as if it were out of the question that he could be guilty of anything frivolous.

Unlike most beasts, this little fellow had a great liking for strangers, and frequently took violent fancies, in which case it was quite impossible to keep him away from the object of his affections. Some people liked it, but others did not; and when one young lady was actually afraid of him, he appreciated her attitude, and not only resented it by angry barking grunts, but contrived again and again to surprise her, by stealing up behind her chair and suddenly pouncing upon her. Of course, she shrieked, and he squealed and grunted and ran out his tongue at her. With his friends he was troublesomely affectionate, insisting on being held, on lap, arm, or shoulder, and following them from room to room, in a long, droll gallop on the floor, or by jumping from chair to table, and sometimes to their backs as they passed.

Almost every sound the creature uttered reminded one of a pig. Going about the room contentedly, he constantly made a low sound represented by "oof!" or "woof!" with the tone and accent of the animal mentioned; when anxious to get out of his cage, the grunt was double, like the drawing in and expulsion of the breath in the same tone, varied—as has been said—by a little explosive sound. His bark even was of a piggish quality. When angry or hurt, he delivered a squeal and grunt together impossible to characterize; and if rubbed and caressed, he breathed out a loud, rough purr. His cry of loneliness was truly piteous; I heard it occasionally through the register. It was a sobbing, dismal sound, sometimes half a howl, sometimes with a retching sound. In uttering this he opened a small round hole of a quarter-inch diameter in the front of his very flexible lips. If this cry is a

common indulgence of his tribe in the wilds of Madagascar, I do not wonder that the people are superstitious about them, and call them "ghosts" or "specters." No lament can be imagined more weird and torturing to the nerves. At first, when I heard my pet cry thus, I ran hastily down-stairs, thinking something dreadful had happened; but the instant his eye fell upon me, the rogue changed his wails into the grunt of recognition, and a demand to be let out.

When, after five hours of revels that kept his audience in shrieks of laughter or in terror for his life, the time came for him to go to bed, and his wire-gauze door was—in spite of his remonstrance—closed upon him, it was curious to see him prepare for night. His bed was in a round wooden box, fastened upon the side of his cage, lined and covered with blankets. Sometimes he lay on his back, his head hanging out upside down, and two legs sticking out at awkward angles; occasionally his arms were thrown over his head, and his hands clung to the edge of the box. But usually, after a long preparation of fur-dressing, he placed his head on the bottom of the box, face down, and then disposed his body around it, wriggling and twisting and turning, till he was satisfied, when he was seen lying on his side, his head not under him as would be expected, and his tail curled neatly around. Sometimes, after long and elaborate arrangement of himself, when one would not expect him to move before morning, he suddenly started up and came out as bright and lively as if he never dreamed of going to sleep. But more often, when he had thus composed himself, the heavy blanket was dropped before his door, the lights were turned out, and he was left for the night.

RECENT ECONOMIC CHANGES.

By Hon. DAVID A. WELLS.

THE readers of "The Popular Science Monthly" will remember the interesting series of papers communicated to its pages during the years 1887 and 1888 by Mr. David A. Wells; in which were traced out, and exhibited in something like regular order, the causes and extent of the wonderful industrial and social changes and accompanying disturbances which have especially characterized the last fifteen or twenty years of the world's history. It is safe to say that no economic papers have been published in recent years, on either side of the Atlantic, that attracted more attention or were read by so many persons with such interest and profit.

It affords us pleasure now to state that, since their original

publication in this journal, these papers have been in great part rewritten by the author, and in all revised and brought up to the latest date; and are now nearly ready for publication in book form by Messrs. D. Appleton & Co., under the title of "Recent Economic Changes, and their Effect on the Production and Distribution of Wealth and the Well-being of Society."

From advanced sheets we are enabled to lay before our readers the following illustrations of the quality of the new material that Mr. Wells has incorporated in his forthcoming volume.—EDITOR.

ON THE ORIGIN AND SEQUENCE OF TRUSTS.

It was formerly a general assumption that, when price no longer equaled the cost of production and a fair profit on capital, production would be restricted or suspended; that the less favored producers would be crowded out, and by the relief thus afforded to the market normal prices would be again restored. But this doctrine is no longer applicable to the modern methods of production. Those engaged in great industrial enterprises, whether they form joint-stock companies or are simply wealthy individuals, are invested with such economic powers that none of them can be easily pushed to the wall, inasmuch as they can continue to work under conditions that would not permit a small producer to exist. Examples are familiar of joint-stock companies that have made no profit and paid no dividends for years, and yet continue active operations. The shareholders are content if the plant is kept up and the working capital preserved intact, and, even when this is not done, they prefer to submit to assessments, or issue preference shares and take them up themselves rather than go into liquidation, with the chance of losing their whole capital. Another feature of such a condition of things is, that the war of competition in which such industrial enterprises are usually engaged is mainly carried on by a greater and greater extension of the market supply of their products. An illustration of this is afforded in the recent history of the production of copper. When in 1885 the United States produced and put on to the market seventy-four thousand tons, as against forty thousand tons in 1882, the world's prices of copper greatly declined. A large number of the smaller producers were compelled to suspend operations, or were entirely crushed; but the great Spanish and other important mines endeavored "to offset the diminution of profit on the unit of quantity" by increasing their production; and thus the price of copper continued to decline until it reached a lower figure than ever before known in history.

Under such circumstances *industrial over-production*—manifesting itself in excessive competition to effect sales, and a reduction of prices below the cost of production—may become chronic;

and there appears to be no other means of avoiding such results than that the great producers should come to some understanding among themselves as to the prices they will ask; which in turn naturally implies agreements as to the extent to which they will produce. Up to this point of procedure no exception on the part of society can well be taken. But such an agreement, once perfected and carried out, admits of an almost entire control of prices and the establishment of monopolies, in the management of which the rights of the public may be wholly ignored. Society has practically abandoned—and from the very necessity of the case has got to abandon, unless it proposes to war against progress and civilization—the prohibition of industrial concentrations and combinations. The world demands abundance of commodities, and demands them cheaply; and experience shows that it can have them only by the employment of great capital upon the most extensive scale. The problem, therefore, which society under this condition of affairs has presented to it for solution is a difficult one, and twofold in its nature. To the producer the question of importance is, How can competition be restricted to an extent sufficient to prevent its injurious excesses? To the consumer, How can combination be restricted so as to secure its advantages and at the same time curb its abuses?

Another cause of the so-called over-production is undoubtedly due to an agency which has never before in the history of the world been operative to the extent that it is at present. With the great increase of wealth that has followed the increased control over the forces of nature and their utilization for production and distribution, there has come a desire to convert this wealth into the form of negotiable securities paying dividends or interest with regularity, and on the recipiency of which the owner can live without personal exertion or risk of the principal. Hence a stimulus for the undertaking of new enterprises which can create and market such securities; and these enterprises, whether in the nature of new railroad, manufacturing, or mining corporations, once developed, must go on producing and selling their products or services with or without a profit in order to meet their obligations and command a share of previously existing trade. Production elsewhere, as a consequence, is interfered with, displaced, and in not a few cases, by reason of better conditions, permanently undersold. And the general result is appropriately recognized by the term "over-production."

Furthermore, in anticipation of such consequences, the tendency and the interest of every successful manufacturing combination are to put the prices of its products down to a figure where it will not pay for speculators to form new competitive stock companies to be bought off or crushed by it. For, if it did

keep up high profit-assuring prices, one of two things would eventually happen: either new factories would be started; or the inventive spirit of the age would devise cheaper methods of production, or some substitute for the product they furnished, and so ruin the first combination beyond the possibility of redemption. And hence we have here another permanent agency, antagonistic to the maintenance of high and remunerative prices.

CURIOUS CHANGES IN PRICES.

The record of extreme changes in prices, by reason of circumstances that are acknowledged to have been purely exceptional, is also most instructive, and removes not a few commodities from the domain of any controverted economic theory respecting monetary influences.

The price of manufactured Mediterranean coral—the trade in which is extensive—has been greatly depressed in recent years by reason of the discovery of new banks of coral on the coast of Sicily, from which the raw material has been obtained most cheaply, and in large excess of demand. The consequent decline in prices has, however, opened new markets in Africa, where the natives now purchase coral ornaments in place of beads of Venetian and German manufacture.

Few commodities have fluctuated more violently in price in recent years, or more strikingly illustrate the degree to which supply and demand predominate over all other agencies in determining price, than the vegetable product *hops*. In 1881 there was an almost universal crop failure, and the highest grade of English hops (East Kent) commanded 700*s*. per cwt. In 1886 the German Hop-Growers' Association estimated the quantity grown throughout the world at 93,340 tons, and the annual consumption at only 83,200 tons, so that there was an excess of production over consumption for that year of nearly 10,000 tons. As might have been expected, there was a notable decline in the world's prices for hops, and the same quality of English hops which commanded 700*s*. per cwt. in 1882 sold for 74*s*. in 1887, and in June, 1888, for 68*s*. Later in the year, with unfavorable harvest reports, the price advanced to 147*s*.

DIAMONDS.

The recent price experience of diamonds is in the highest degree interesting. Diamonds were first discovered in South Africa about the year 1868, and a business of searching (mining) for them immediately sprang up. At the outset the mining was conducted by individuals, but, in consequence of the expense, the work gradually and necessarily passed into the control of joint-stock companies with command of large capital; and it was not until 1880 that operations on a great scale were undertaken. The result of

this improved system, conjoined with underground mining, was such an increase in the output of diamonds that an oversupply to the market and a serious reduction in price became imminent; and the period of 1883–'84 was, in fact, one of falling prices and intense competition among the various producing companies, during which the leading companies paid little or nothing to their shareholders, and some entirely suspended operations.* Continued disaster was, however, finally arrested through a practical consolidation of all the companies for the purpose of controlling product and prices; and a revival in demand having occurred about the same time, average prices were advanced between 1885 and 1887 from 20*s.* 5*d.* per carat to 23*s.* 7½*d.*

The value of the diamonds exported from South Africa since the first discovery of the mines, or from 1868 to 1887, is believed to have been between £40,000,000 and £45,000,000 ($200,000,000 to $225,000,000), of which about £15,500,000 ($77,500,000) represents the value of the output from 1883 to 1887. Very curiously, this large export of value—nearly all in the first instance to England—seems to find no distinctive place in the columns of British imports, although they have served in a large measure to enable South Africa to pay for her imports of British and other foreign products. If the export of diamonds from South Africa to Europe has aggregated £45,000,000 ($225,000,000) in the rough, the process of cutting may be regarded as having increased their market value full one hundred per cent, or to £90,000,000 (or $437,000,000)—a greater value than the yield of the world during the two preceding centuries. The aggregate weight of the entire diamond product of the South African mines up to 1887 is estimated at 38,000,000 carats, or over seven and a half tons.

Of this immense product there is good reason for believing that a very large proportion found a market in the United States. According to the customs returns, the value of the unset diamonds which were imported into the United States, and paid duty, from 1877 to 1887 inclusive, was in excess of $50,000,000; and it can hardly be doubted that an equal or larger import in the form of unset stones and jewelry escaped during the same period the cognizance of the revenue officials. The value of the present annual import of precious stones not set—mainly diamonds—is about $10,000,000. In 1868 the annual value of a corresponding import was about $1,000,000. These data, imperfect as they are,

* The "Kimberly Central Company"—the leading organization—which from 1880 to 1883 increased its dividend from ten to thirty per cent, paid nothing to its shareholders during 1884 and 1885, and at the close of 1886 was only able to declare a dividend of five per cent. The other great diamond-mining company, the "De Beers," was more fortunate, and paid for 1884 to 1886 an average of about eight and a half per cent; but most of the companies paid nothing during the same period, and some entirely suspended mining.

afford some indication of the rapid increase in wealth in recent years among the people of the United States.

We have, therefore, in this experience, the phenomenon of the strangely persistent value of a comparatively useless gem, during a period when the prices of most other commodities were diminishing by leaps and bounds, as well as the extraordinary concurrent absorbent power of the world for a greatly increased product. But the demand for diamonds latterly is thought not to have kept pace with their increasing production; and it is said that the stock of diamonds in the hands of dealers in 1888 was fully twenty-five per cent in excess of their requirements. To meet and neutralize the influence of this condition of affairs, the South African diamond-mining companies have limited production, which for the time has advanced prices. But the tendency obviously is for diamonds to decline in value; and the wonder, indeed, is that this has not happened at an earlier date. "One thing, furthermore, seems certain, and that is, that when the breakdown of speculation and prices does occur, the consequences will be singular and far-reaching. For it is to be remembered that for the most part the use of diamonds is a mere whim of fashion, that may change at any time. There is no way of stimulating the demand for them, except by lowering prices, and, of course, if prices were materially reduced, the wealthy votaries of fashion would inevitably cease to wear diamonds, and would take up some other form of personal adornment."* The price experience of diamonds in the near future promises, therefore, to be even more interesting than it has been in the recent past.

In the United States during recent years there has been a remarkable decline in the price of hides and in certain descriptions of leather; "Buenos Ayres" hides having sold in May, 1889, at the lowest figures for thirty years, while the leather trade generally has been depressed and unsatisfactory. The agency occasioning the first result is ascribed to the great increase in the supply of domestic hides consequent upon a notable extension of the American (Western) cattle industry; and, in the case of the second, to an over-production and decline in demand for upper-leather, in consequence of a change in fashion, whereby lighter grades of foot-wear have supplemented the use of "leg-boots."

CHANGES OF INDUSTRIAL CONDITIONS IN TROPICAL COUNTRIES.

The improvements in recent years in the production of sugar from the beet, and the artificial encouragement of this industry in the continental states of Europe through the payment of large bounties, have in turn compelled the *large* producers of cane-sugars in the tropics to entirely abandon their old methods of working,

* London "Economist."

and reorganize this industry on a most gigantic scale as a condition of continued existence. Thus, for example, although the business of cane-sugar production was commenced more than three hundred years ago on the island of Cuba, the grinding of the cane by animal or "wind" power, and the boiling and granulating by ancient, slow, and wasteful methods, were everywhere kept up until within a very recent period, as they still are by small planters in every tropical country. But at the present time, upon the great plantations of Cuba and some other countries, the cane is conveyed from the fields by a system of railroads to manufacturing centers, which are really huge factories, with all the characteristics of factory life about them, and with the former home or rural idea connected with this industry completely eliminated. In these factories, where the first cost of the machinery plant often represents as large a sum as $200,000 to $250,000, with an equally large annual outlay for labor and other expenses, all grades of sugar from the "crude" to the "partially refined" are manufactured at a cost that once would not have been deemed possible. In Dakota and Manitoba the employment on single wheat estates of a hundred reapers and an aggregate of three hundred laborers for a season has been regarded as something unprecedented in agricultural industry; but on one sugar estate in Cuba—"El Balboa"—from fifteen hundred to two thousand hands, invariably negroes, are employed, who work under severe discipline, in watches or relays, during the grinding season, by day and night, the same as in the large iron-mills and furnaces of the United States and Europe. At the same time there are few village communities where a like number of people experience the same care and surveillance. The male workers occupy quarters walled and barricaded from the women, and the women from the men. There are in every village an infirmary, a lying-in hospital, a physician, an apothecary, a chapel, and priest. At night and morning mass is said in chapel, and the crowds are always large. There is of a Sunday less restraint, though ceaseless espionage is never remitted. On these days and in parts of holidays there are rude mirth, ruder music, and much dancing. This picture is given somewhat in detail, because it illustrates how all-pervading and tremendous are the forces that are modifying society everywhere, in civilized, partially civilized, and even barbarous countries, conjointly with the new conditions of production and consumption.

THE English Society for Promoting the Growth of Industrial Villages has been formed to counteract the tendency of workingmen to huddle themselves in the slums of cities, and to encourage suburban settlements. Its report cites, in illustration of the practical working of this thought, the example of a manufacturing firm in London, which has placed many of its hands in the country, and sends out material to them to be returned manufactured, paying them full wages.

THE SURFACE TENSION OF LIQUIDS.

By W. H. LARRABEE.

WHAT is it that keeps a drop of water in shape; that enables it to resist a considerable pressure or blow before it will collapse into a spatter; that holds it in its integrity to a leaf or the eaves till it is mature to fall, while it still maintains its round, independent individuality? Whatever the power is, it appears yet more distinctly in a globule of mercury, which will not be hammered out of shape or compelled to spread. Dr. Thomas Young conceived, for the explanation of this and some other phenomena exhibited by small, isolated liquid masses, the idea of their being surrounded by a thin, elastic membrane, less dense than the deeper parts of the drop, and capable of adhering perfectly to them, and more or less strongly to solid bodies. It seemed capable of opposing a certain resistance to being rent, and this was called its superficial tension. Some curious movements take place when certain solid substances are cast upon water, to account for which Dutrochet supposed a new force, which he called epipolic force. These phenomena of the drops, the "epipolic force," the calming effects of oil on storm-disturbed water, and a variety of other curious actions hitherto unaccounted for, have lately been referred to this property of superficial tension. Taking a drop of water as typically embodying the property, M. E. Gossart * asserts that all the energies of nature may be found in its tenuous envelope. Besides M. Gossart, studies of the curious and protean properties of this superficial tension, or the envelope of the water-drop, have been published by M. H. Devaux † and M. Van der Mensbrugghe.‡ The present article is a summary of some of the results of their studies. Regarding water in a vessel, M. Van der Mensbrugghe finds that whatever may once have been thought on the subject, it is not equally constituted throughout. Its particles are solicited by attractive forces which are exhibited when, upon drawing out a pencil which has been dipped into the mass, a drop is found adhering to the point. If this drop be conceived to be cut by a horizontal plane, all the parts below the plane may be supposed to be sustained by those which are above it. It is also acted upon by repulsive forces tending to scatter the particles, the effects of which are seen in evaporation. When the

* "A Voyage on the Surface of a Drop of Water." Lecture before the Scientific and Literary Society of Caen, published in the "Revue Scientifique," 1887.

† "Spontaneous Movements of certain Bodies on the Surface of some Liquids," "La Nature," 1888.

‡ "Superficial Tension." Lecture before the Belgian Society of Microscopy, March 3, 1888, published in "La Nature," 1888.

attractive and repulsive forces are at equilibrium within the liquid, there is supposed to be in the immediate vicinity of the free surface a tendency to the dispersion of the particles which is constantly opposed by the attractive forces. The condition of the superficial layer may be compared with that of a thin, elastic membrane under stretch, the cohesion of which constantly opposes itself to a more considerable elongation. The superficial layer of a liquid is thus subject to a contractile force or tension, by virtue of which it tends to become as small as possible. M. Gossart, comparing the relative situation of two molecules, *A* within the drop, and *B* at its surface, against the air or another liquid or a solid body, shows that each molecule is attracted by the others only from a certain distance (less than ten thousandth of a millimetre), which is as formidably great to it as it seems little to us. Those molecules which are at a greater distance from *A* and *B* will have no more action upon them than the stars have upon our sun, earth, and planets. Regarding these spheres alone, *A*, equally solicited in all directions by an equal number of molecules, will be free in its movements, and obedient to Pascal's principle; while *B* has not the same surrounding in every direction. Hence a kind of rarefaction which extends to only a slight depth in the drop; and hence also, on the surface, the elastic membranous or resistant quality.

This property is illustrated in some experiments described by M. Van der Mensbrugghe. Take two pencils, one of which should be of light wood and thinner than the other (Fig. 1); place them alongside and in contact; drop a little clear water in the angle between them, so as to moisten the line of contact. There will be formed a slight liquid mass, adherent to both pencils, of concave outline, the section of which is represented by *a b* in the corner diagram of Fig. 1. The lighter pencil will hang from the other by virtue of the tension of the concave surfaces *a b*, that bound either side of the line of contact. With the pencils twelve centimetres long, a weight of eighteen hundred milligrammes may be sustained in this way. In a second experiment, a ring of copper wire a millimetre thick and three and one quarter inches in diameter, is laid carefully upon the surface of pure water, when —if everything be entirely clean—it will float, as in Fig. 2, section *a*, and this, notwithstanding copper is 8·8 times heavier than water. This takes place because all the tensions of the liquid that touches upon the ring produce an upward resultant. A ring weighing seventeen hundred and thirty milligrammes may be thus upheld, while the maximum effect of the tensions is three thousand seven hundred and seventy milligrammes, or more than double the weight of the ring. Needles, globules of mercury, a thin ring of platinum, etc., may be similarly made to float on water.

In a third experiment a strip of thin, unglazed paper, say six inches and three quarters long by an inch and a half wide, is folded so as to form a box or trough, as represented in the lower part of Fig. 3. Set the box on a table, moisten the inner faces with a wet brush, and pour in water from an inch or two above. The tension of the liquid surface will at once bring the long sides of the box together, and the vessel will thus shut upon itself.

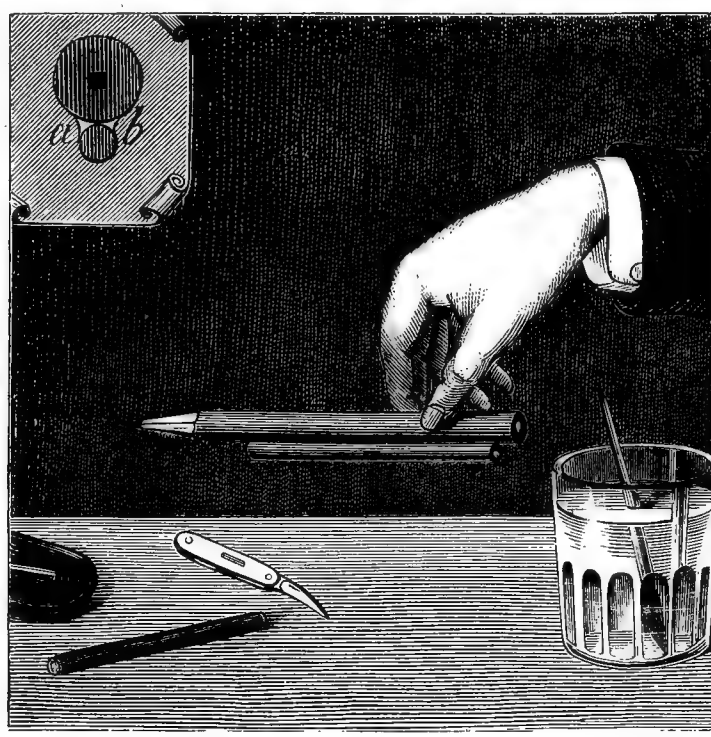

FIG. 1.—ADHERENCE OF ONE PENCIL TO ANOTHER BY THE TENSION OF CONCAVE SURFACES OF WATER.

Again, take a cylindrical cork of about wine-bottle size; fix in the center of one end a fine iron wire terminating in a hook or pan to hold ballast. In the other end fix a ring about four inches in diameter, lifted on branching supports as in Fig. 4. Plunge the apparatus into a vessel containing a suitable depth of water. With a proper weight of ballast, the cork will assume a vertical position, and will rise only to a certain distance above the level of the water. But if the whole is pushed down into the liquid and left there, the ring will not again clear itself from the water; it will only rise a little above its level, producing a double concave meniscus. In this case the effect of superficial tension is to give rise to a downward resultant sufficient to counterbalance the increase of the upward thrust. If the ballast is managed so that the excess of this resultant is but slight, on the application of ether by a wad or sponge, the effect of which will be to diminish the superficial tension of the water, the ring will rise from the liquid and the apparatus assume its original position.

In a fifth experiment a square frame of wire is dipped into a

mixture of soap and sugar with water. On withdrawing the frame its inner space will be occupied with a flat film of so little weight that it does not visibly sag, but becomes more tense as it is attenuated. A closed contour of cotton or silk thread laid upon the film will lie in any form so long as the film is whole and its tension equal in every direction. But the instant it is broken

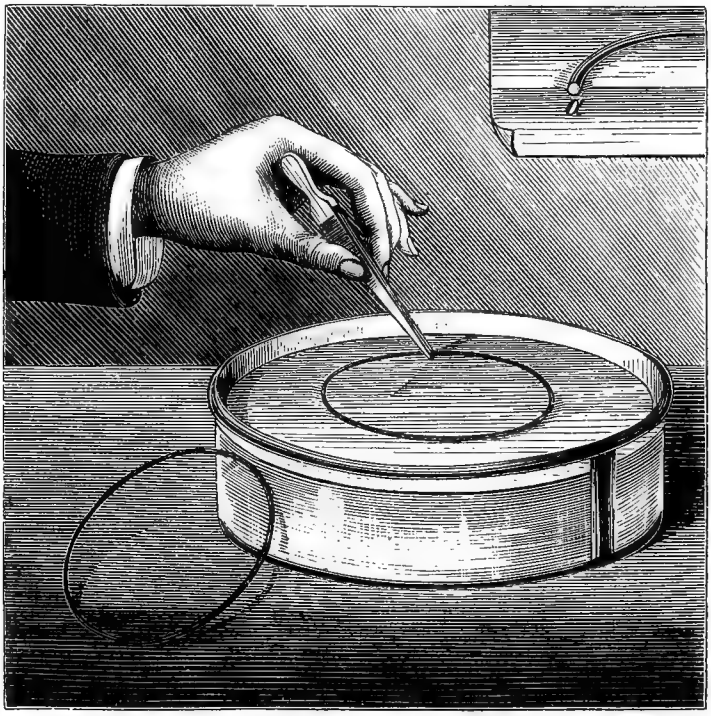

FIG. 2.—COPPER RING FLOATING ON THE SURFACE OF WATER.

within the contour the thread will stretch and assume a circular form as in Fig. 5, under the influence of the outward tensions of the rest of the film. It takes the shape in which it bounds as great a surface as its length permits, which is that of a circle. Prof. Schoentjes has varied upon this experiment by using, instead of a simple thread, a system composed of portions of rectilinear solids and portions of arbitrary form, made by passing threads loosely through pieces of fine straws (as in the object lying on the table in Fig. 5). This being placed upon the film and the film pierced, as in the previous experiment, invariably assumed a shape in which all the loose thread portions became arcs of a single circumference, of which the rectilinear solid portions (the straws) constituted chords—or the figure, according to Steiner, of the maximum surface that can be limited by a contour so composed. M. Terquem and M. Gossart, by breaking the film at one or more points outside of the contour, make the thread double into loops.

M. Gossart has studied the pressure of this supposed membrane surrounding the drop of water, and its variation under different degrees of curvature. Investigating its behavior in a

homogeneous medium, he takes the envelope itself—a drop void of water, or rather full of air—represented for convenience of manipulation by a soap-bubble, and consisting of two films separated by an extremely thin mass of water. The pressure is the same in every part, and the curvature uniform, and that which gives the least possible surface—a sphere. The pressure is strong enough to drive tobacco-smoke back through a pipe-stem or to blow out a candle. The curved film may be deformed by passing it through rigid frames, but it will always preserve a geometrical shape, for it can not continue to exist except upon the condition of exercising an equal pressure throughout upon the air imprisoned within it; but some of the shapes it will assume within this rule are very curious.

If a drop of water is poured upon another liquid, it is still imprisoned in its contractile sac, but in one having two walls of unequal elasticity; the upper wall resting against the air, and the lower one against the liquid. The line of suture of these two

FIG. 3.—A PAPER BOX CLOSING UPON ITSELF WHEN WATER IS POURED INTO IT.

walls floats in three different media—air, water, and the subjacent liquid; or, to use M. Gossart's figure, it is like a cord drawn by three different forces, which are represented in this case by the upper and lower walls of the sac and the uncovered membrane of the inferior liquid, pulling against one another, as when three ropes are pulled by three men of unequal strength. Suppose, as the extreme case, that the attraction of the membrane exterior to the drop so prevails over the tension of the two walls of the sac that they can not rest in equilibrium. Then the sac will be drawn

out, and all the superior liquid will spread in an infinitely thin layer over the other. This is what happens to a drop of oil when it is thrown upon water. When a liquid is brought in contact with a solid, as when a first drop of water is let fall upon a horizontal plate of glass, the inclosing sac is flattened where it is in touch with the glass, and bulges where it is in contact with the air. The form of the sac and the angle of its junction with the glass are determined by the fact that the two tensions of the envelope,

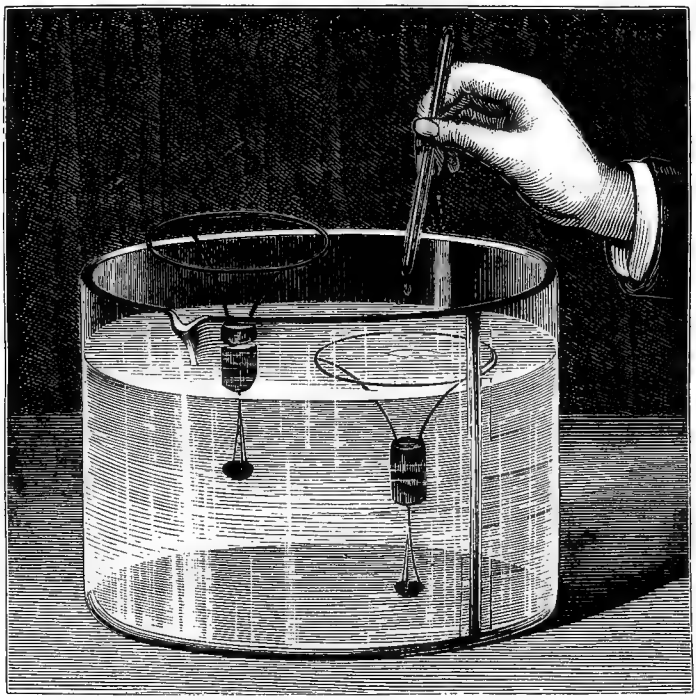

FIG. 4.—AN IRON RING HAVING BEEN PLUNGED UNDER WATER, HOLDING DOWN THE CORK TO WHICH IT IS ATTACHED.

the upper and lower, should balance the traction of the exterior glass upon the cordon separating them. In the case of a drop of alcohol, the tensions being much weaker, can not resist the traction of the glass, and the liquid spreads out at once, as also happens with water when the plate has already been moistened. Mercury opposes a very strong tension, and is hardly flattened at all on striking the glass. A drop of water cast upon a hot plate also exhibits a superior tension, and assumes the spheroidal state, which was first analyzed in 1850 by M. Boutigny, of Evreux. He said, "Bodies in a spheroidal state are bounded by a film of matter, the molecules of which are so connected that we can compare them to a solid, transparent, very thin, very elastic envelope, probably less dense than the rest, that protects the liquid within it against any too considerable heating."

This force of superficial tension exists and is manifest in all liquids, but in different degrees. It is stronger in water than in any other of the common liquids except mercury. Its value has been measured, and is usually expressed, in milligrammes per milli-

metre of superficial length, at 60° Fahr., as 7·5 for distilled water; 49 for mercury; 4 for glycerin; 3·6 for olive-oil; 2·8 for soap-suds; 2·7 for spirits of turpentine; 2·6 for petroleum; 2·5 for absolute alcohol; and 1·88 for ether. It is diminished when the liquid is warmed, and is weakened and even destroyed by impurity. M. Terquem has determined, from observations on the interference of luminous rays, that the envelope is less than $\frac{1}{20,000}$ of a millimetre thick.

Curious effects appear when liquids having different superficial tensions are brought together, and when solids containing volatile properties are thrown upon a liquid. With two liquids that will mix, as water and alcohol or ether, the tension at the point of contact becomes null, and the lighter fluid spreads out over the other. This is followed, according to M. Van der Mens-

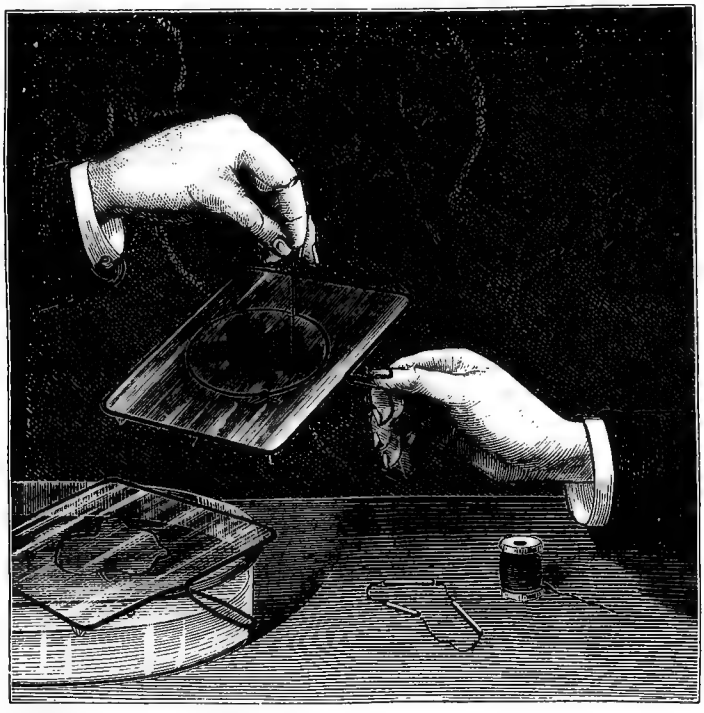

FIG. 5.—A CONTOUR OF SILKEN THREAD EXPANDING INTO A CIRCLE WHEN THE FILM ON WHICH IT HAS BEEN LAID IS BROKEN.

brugghe, by a retreat of this fluid toward the point where it was dropped, in consequence of an increased tension given to that point by the cooling that follows the evaporation of the dropped liquid. If the liquids will not mingle, as when oil or turpentine is dropped on water, the drop spreads over the surface, forming a thin layer upon it which is marked by beautiful plays of colors.

M. Devaux exemplifies one of these effects by an experiment (Fig. 6) in which a tin boat, having a notch cut in the stern, is launched upon the water. On letting a drop of alcohol fall at the notch, the boat moves away as if driven by some repulsion. There is, however, no repulsion; but the tension astern has been

destroyed or diminished, while that forward continues in full force to draw the boat onward. If a bit of camphor be substituted for the alcohol, its vapor has the same effect upon the ten-

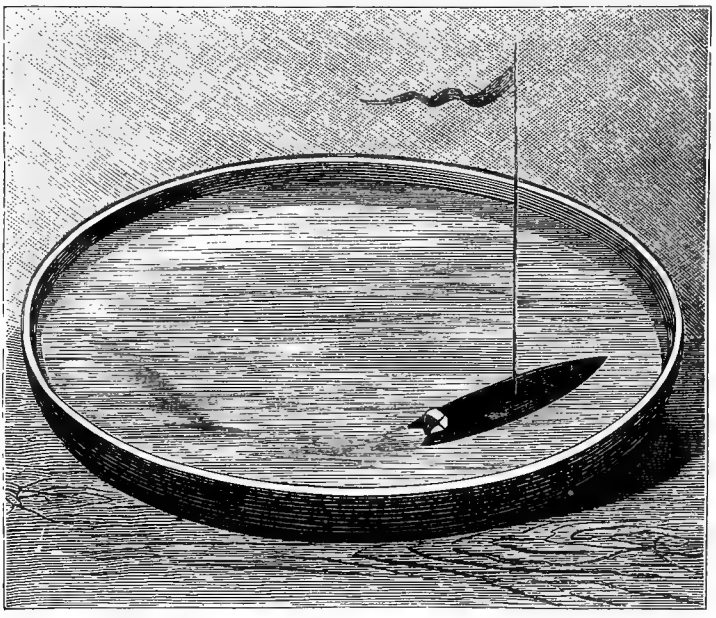

FIG. 6.—TIN BOAT SAILING AROUND ON WATER BY THE AID OF A BIT OF CAMPHOR.

sion, and the boat may be made to sail regularly, with considerable speed, for hours. The experiment is made more spectacular by furnishing the boat with a mast carrying a flag.

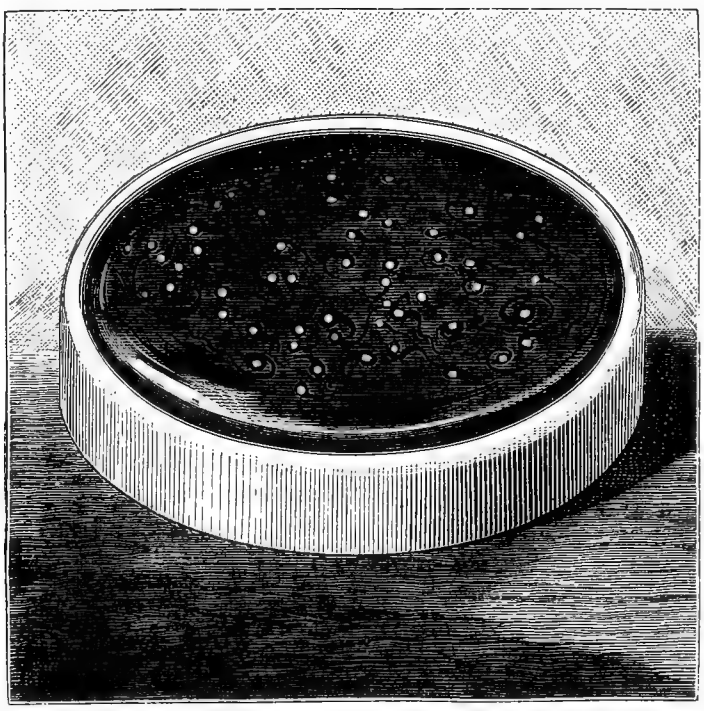

FIG. 7.—MOVEMENTS OF FINE GRAINS OF CAMPHOR ON THE SURFACE OF MERCURY.

In another experiment described by M. Devaux, a few granules of camphor are sprinkled upon mercury, and breathed upon till a kind of lye is formed, when a multitude of long-tailed "tadpoles"

appear swimming over the surface of the mercury (Fig. 7). If, now, we breathe continuously from one side upon the mercury, the "tadpoles" will become more lively, and direct themselves against the breath, coming up to the very edge of the mercury. The breath, driving the vapors back, clears a space in front of the "tadpole," leaving the tension of the mercury free to act upon it and draw it forward, while it clouds the rear, weakening the tension.

M. Devaux has exemplified the strength and persistence of the tensional force by connecting his camphor-boat with a float in the shape of a watch-glass. The movement of the boat continues, car-

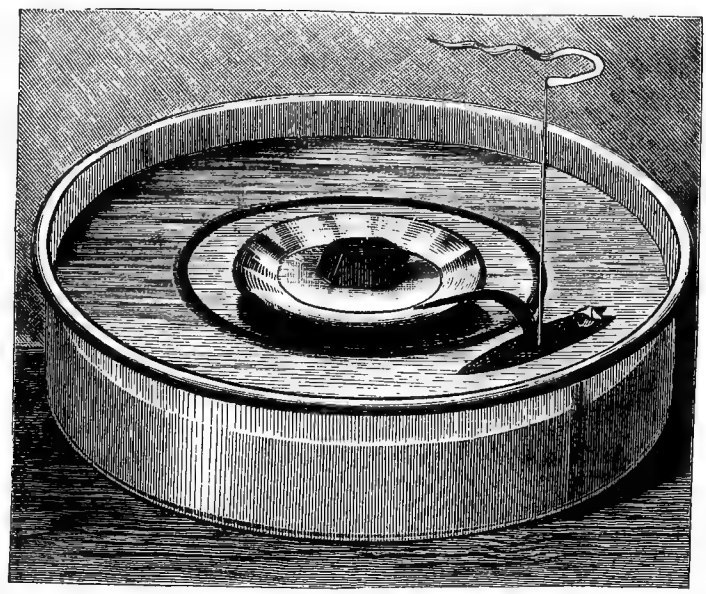

FIG. 8.—TIN BOAT CAUSING A LOADED FLOAT TO GO ROUND WITH IT.

rying the float around while it is loaded with weights rising to fifty or a hundred grammes, and even to a kilogramme (Fig. 8); and if forcibly stopped, it will begin again when the obstacle is removed.

The phenomena of capillary attraction are explained under the theory of superficial tension. The liquid rises in the tubes by virtue of the adhesion of its superficial membrane to their walls, and to a less height in the larger than in the smaller tubes because the mass of the liquid to be raised increases more rapidly than the power of the membrane to sustain it. Just as the tension of a liquid is diminished by adding a foreign substance, the capillary force of a tube is diminished by the presence of a foreign vapor. This is illustrated by M. Devaux as in Fig. 9, where water rises to the greatest height in the tube A, which was filled simply with air, to a less height in E, which has been charged with the vapor of ether, and to a still less height in C, which was occupied with the vapor of camphor.

Other energies than this mechanical energy have been shown

by different investigators to reside in the thin envelope of the water-drop; acoustic energy by M. Savart, as noticed in a cascade of water-drops, the envelopes of which underwent rhythmical deformations; calorific energy, due to the displacement of molecules that pass from the surface to the ranks, or which ascend to the superficial layer; luminous energy, as studied by Newton, Boyle, Hooke, Young, and Fresnel; and electrical energy, as manifested in effects that have been observed by M. Lipmann—all of which, according to M. Gossart, are transformable one into another in accordance with the law of conservation of force.

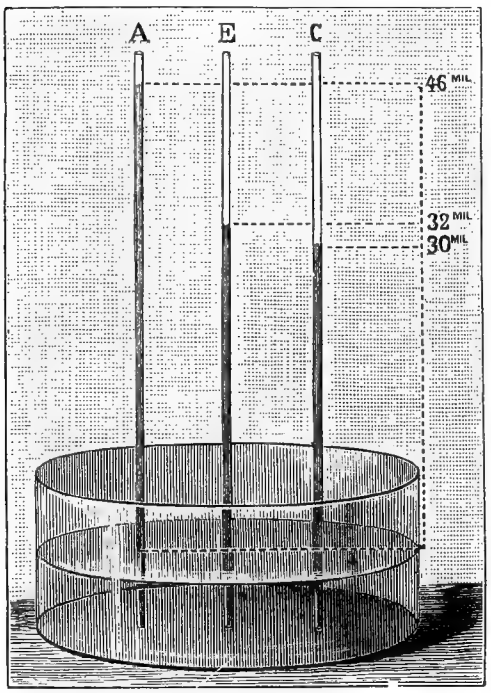

FIG. 9.—LEVELS TO WHICH WATER WILL RISE IN CAPILLARY TUBES CHARGED, RESPECTIVELY, WITH AIR (A), VAPOR OF ETHER (E), AND CAMPHOR-VAPOR (C).

A drop of water hangs from a leaf or the eaves of a house, held up as in a bag by its superficial envelope. It continues to increase in size and weight many times faster than the tension of its cordon of attachment is re-enforced, till it overcomes that tension, and then it falls; and, according to M. Gossart, all the drops of water that fall—of themselves—are of the same size. The drops of melted metals, whose superficial tensions are enormous, reach correspondingly enormous magnitude. The purity of liquids can be determined by observing the size of the drops they give; in the case of wines, by counting the number of drops per cubic centimetre; for the superficial tension of all liquids is modified by adulteration.

M. Van der Mensbrugghe has calculated what he calls the potential energy of water, on the basis of the estimation of its superficial tension at 7·5 milligramme-millimetres per square millimetre of free surface. This is resident in a film not more than $\frac{1}{20,000}$ of a millimetre thick. Distributed over the whole ocean, it gives an amount of mechanical force which we have no means of accurately calculating. If we suppose that of two equal and adjacent superficial layers of sea-water, one washes over the other by the effect of the wind, for example, the layer that is covered loses its free surface, and with it its proper potential energy, which appears again in an increase of speed. Thus on the ocean the action goes on, the energies of the successive waves being extinguished as to them and transferred to others; so that

every wave in course of formation is composed of portions the speeds of which are greatest toward the top. In a violent wind the acceleration produces on each wave a crest that becomes more and more protuberant, and at length is disintegrated, or breaks. It follows that any agent capable of preventing the washing of the superficial slices over one another will constitute an obstacle to the progressive increase of the living force of the liquid masses.

Such an agent is found in oil when it covers a sufficient extent of the surface of the sea. By virtue of its specific levity it keeps on the surface and prevents the washing of one layer of water over another. Thus is explained the soothing action, which appears so mysterious at first sight, of oils upon rough seas. Susceptible of being spread out into laminæ of the incredible thinness of $\frac{1}{100,000}$ or $\frac{1}{200,000}$ of a millimetre, a small quantity of oil is efficacious to cover and prevent overwashing of waves upon a large surface. When this is done, the formation of the crests or breaking waves, so dangerous to ships, can not take place, and the terrible breaker is converted into a harmless swell.

THE VALUE OF WITNESS TO THE MIRACULOUS.

By Prof. T. H. HUXLEY, F. R. S.

CHARLES, or, more properly, Karl, King of the Franks, consecrated Roman emperor in St. Peter's, on Christmas day, A. D. 800, and known to posterity as the Great (chiefly by his agglutinative Gallicized denomination of Charlemagne), was a man great in all ways, physically and mentally. Within a couple of centuries after his death Charlemagne became the center of innumerable legends; and the myth-making process does not seem to have been sensibly interfered with by the existence of sober and truthful histories of the emperor and of the times which immediately preceded and followed his reign, by a contemporary writer who occupied a high and confidential position in his court, and in that of his successor. This was one Eginhard, or Einhard, who appears to have been born about A. D. 770, and spent his youth at the court, being educated along with Charles's sons. There is excellent contemporary testimony not only to Eginhard's existence, but to his abilities, and to the place which he occupied in the circle of the intimate friends of the great ruler whose life he subsequently wrote. In fact, there is as good evidence of Eginhard's existence, of his official position, and of his being the author of the chief works attributed to him, as can reasonably be expected in the case of a man who lived more than

a thousand years ago, and was neither a great king nor a great warrior. These works are—1. "The Life of the Emperor Karl." 2. "The Annals of the Franks." 3. "Letters." 4. "The History of the Translation of the Blessed Martyrs of Christ, SS. Marcellinus and Petrus."

It is to the last, as one of the most singular and interesting records of the period during which the Roman world passed into that of the middle ages, that I wish to direct attention.* It was written in the ninth century, somewhere, apparently, about the year 830, when Eginhard, ailing in health and weary of political life, had withdrawn to the monastery of Seligenstadt, of which he was the founder. A manuscript copy of the work, made in the tenth century, and once the property of the monastery of St. Bavon on the Scheldt, of which Eginhard was abbot, is still extant, and there is no reason to believe that, in this copy, the original has been in any way interpolated or otherwise tampered with. The main features of the strange story contained in the "Historia Translationis" are set forth in the following pages, in which, in regard to all matters of importance, I shall adhere as closely as possible to Eginhard's own words:

While I was still at court, busied with secular affairs, I often thought of the leisure which I hoped one day to enjoy in a solitary place, far away from the crowd, with which the liberality of Prince Louis, whom I then served, had provided me. This place is situated in that part of Germany which lies between the Neckar and the Main,† and is nowadays called the Odenwald by those who live in and about it. And here having built, according to my capacity and resources, not only houses and permanent dwellings, but also a basilica fitted for the performance of divine service and of no mean style of coustruction, I began to think to what saint or martyr I could best dedicate it. A good deal of time had passed while my thoughts fluctuated about this matter, when it happened that a certain deacon of the Roman Church, named Deusdona, arrived at the court for the purpose of seeking the favor of the king in some affairs in which he was interested. He remained some time; and then, having transacted his business, he was about to return to Rome, when one day, moved by courtesy to a stranger, we invited him to a modest refection; and while talking of many things at table, mention was made of the translation of the body of the blessed Sebastian,‡ and of the neglected tombs of the martyrs, of which there is such a prodigious number at Rome; and the conversation having turned toward the dedication of our new basilica, I began to inquire how it might be possible for me to obtain some of the true relics of the saints which rest at Rome. He at first hesitated, and declared that he did not know how that could be done. But observing that I was both anxious and curious about the subject, he promised to give me an answer some other day.

* My citations are made from Teulet's "Einhardi omnia quæ extant opera," Paris, 1840–1843, which contains a biography of the author, a history of the text, with translations into French, and many valuable annotations.

† At present included in the duchies of Hesse-Darmstadt and Baden.

‡ This took place in the year 826 A. D. The relics were brought from Rome and deposited in the Church of St. Medardus at Soissons.

When I returned to the question, some time afterward, he immediately drew from his bosom a paper, which he begged me to read when I was alone, and to tell him what I was disposed to think of that which was therein stated. I took the paper, and, as he desired, read it alone and in secret. (Cap. i, 2, 3.)

I shall have occasion to return to Deacon Deusdona's conditions, and to what happened after Eginhard's acceptance of them. Suffice it, for the present, to say that Eginhard's notary, Ratleicus (Ratleig), was dispatched to Rome and succeeded in securing two bodies, supposed to be those of the holy martyrs Marcellinus and Petrus; and when he had got as far on his homeward journey as the Burgundian town of Solothurn or Soleure,* notary Ratleig dispatched to his master, at St. Bavon, a letter announcing the success of his mission.

As soon as by reading it I was assured of the arrival of the saints, I dispatched a confidential messenger to Maestricht, to gather together priests, other clerics, and also laymen, to go out to meet the coming saints as speedily as possible. And he and his companions, having lost no time, after a few days met those who had charge of the saints at Solothurn. Joined with them, and with a vast crowd of people who gathered from all parts, singing hymns, and amid great and universal rejoicings, they traveled quickly to the city of Argentoratum, which is now called Strasburg. Thence embarking on the Rhine they came to the place called Portus,† and landing on the east bank of the river, at the fifth station, thence they arrived at Michilinstadt,‡ accompanied by an immense multitude, praising God. This place is in that forest of Germany which in modern times is called the Odenwald, and about six leagues from the Main. And here, having found a basilica recently built by me, but not yet consecrated, they carried the sacred remains into it and deposited them therein, as if it were to be their final resting-place. As soon as all this was reported to me, I traveled thither as quickly as I could. (Cap. ii, 14.)

Three days after Eginhard's arrival began the series of wonderful events which he narrates, and for which we have his personal guarantee. The first thing that he notices is the dream of a servant of Ratleig the notary, who, being set to watch the holy relics in the church after vespers, went to sleep, and during his slumbers had a vision of two pigeons, one white and one gray and white, which came and sat upon the bier over the relics; while, at the same time, a voice ordered the man to tell his master that the holy martyrs had chosen another resting-place and desired to be transported thither without delay.

Unfortunately, the saints seem to have forgotten to mention where they wished to go, and, with the most anxious desire to gratify their smallest wishes, Eginhard was naturally greatly perplexed what to do. While in this state of mind, he was one day

* Now included in western Switzerland.

† Probably, according to Teulet, the present Sandhofer-fahrt, a little below the embouchure of the Neckar.

‡ The present Michilstadt, thirty miles northeast of Heidelberg.

contemplating his "great and wonderful treasure, more precious than all the gold in the world," when it struck him that the chest in which the relics were contained was quite unworthy of its contents; and after vespers he gave orders to one of the sacristans to take the measure of the chest in order that a more fitting shrine might be constructed. The man, having lighted a wax candle and raised the pall which covered the relics, in order to carry out his master's orders, was astonished and terrified to observe that the chest was covered with a blood-like exudation (*loculum mirum in modum humore sanguineo undique distillantem*), and at once sent a message to Eginhard.

Then I and those priests who accompanied me beheld this stupendous miracle, worthy of all admiration. For just as when it is going to rain, pillars and slabs and marble images exude moisture, and, as it were, sweat, so the chest which contained the most sacred relics was found moist with the blood exuding on all sides. (Cap. ii, 16.)

Three days' fast was ordained in order that the meaning of the portent might be ascertained. All that happened, however, was that at the end of that time the "blood," which had been exuding in drops all the while, dried up. Eginhard is careful to say that the liquid "had a saline taste, something like that of tears, and was thin as water, though of the color of true blood," and he clearly thinks this satisfactory evidence that it was blood.

The same night another servant had a vision, in which still more imperative orders for the removal of the relics were given; and, from that time forth, "not a single night passed without one, two, or even three of our companions receiving revelations in dreams that the bodies of the saints were to be transferred from that place to another." At last a priest, Hildfrid, saw, in a dream, a venerable white-haired man in a priest's vestments, who bitterly reproached Eginhard for not obeying the repeated orders of the saints, and upon this the journey was commenced. Why Eginhard delayed obedience to these repeated visions so long does not appear. He does not say so in so many words, but the general tenor of the narrative leads one to suppose that Mulinheim (afterward Seligenstadt) is the "solitary place" in which he had built the church which awaited dedication. In that case all the people about him would know that he desired that the saints should go there. If a glimmering of secular sense led him to be a little suspicious about the real cause of the unanimity of the visionary beings who manifested themselves to his *entourage* in favor of moving on, he does not say so.

At the end of the first day's journey the precious relics were deposited in the church of St. Martin, in the village of Ostheim. Hither a paralytic nun (*sanctimonialis quædam paralytica*) of the

name of Ruodlang was brought in a car by her friends and relatives from a monastery a league off. She spent the night watching and praying by the bier of the saints; "and health returning to all her members, on the morrow she went back to her place whence she came, on her feet, nobody supporting her, or in any way giving her assistance." (Cap. ii, 19.)

On the second day the relics were carried to Upper Mulinheim, and finally, in accordance with the orders of the martyrs, deposited in the church of that place, which was therefore renamed Seligenstadt. Here, Daniel, a beggar boy of fifteen, and so bent that "he could not look at the sky without lying on his back," collapsed and fell down during the celebration of the mass. "Thus he lay a long time, as if asleep, and all his limbs straightening and his flesh strengthening (*recepta firmitate nervorum*), he arose before our eyes, quite well." (Cap. ii, 20.)

Some time afterward an old man entered the church on his hands and knees, being unable to use his limbs properly:

> He, in the presence of all of us, by the power of God and the merits of the blessed martyrs, in the same hour in which he entered was so perfectly cured that he walked without so much as a stick. And he said that, though he had been deaf for five years, his deafness had ceased along with the palsy. (Cap. iii, 33.)

Eginhard was now obliged to return to the court at Aix-la-Chapelle, where his duties kept him through the winter; and he is careful to point out that the later miracles which he proceeds to speak of are known to him only at second hand. But, as he naturally observes, having seen such wonderful events with his own eyes, why should he doubt similar narrations when they are received from trustworthy sources?

Wonderful stories these are indeed, but as they are, for the most part, of the same general character as those already recounted, they may be passed over. There is, however, an account of a possessed maiden which is worth attention.

This is set forth in a memoir, the principal contents of which are the speeches of a demon who declared that he possessed the singular appellation of "Wiggo," and revealed himself in the presence of many witnesses, before the altar, close to the relics of the blessed martyrs. It is noteworthy that the revelations appear to have been made in the shape of replies to the questions of the exorcising priest, and there is no means of judging how far the answers are really only the questions to which the patient replied yes or no.

The possessed girl, about sixteen years of age, was brought by her parents to the basilica of the martyrs.

> When she approached the tomb containing the sacred bodies, the priest, according to custom, read the formula of exorcism over her head. When he began

to ask how and when the demon had entered her, she answered, not in the tongue of the barbarians, which alone the girl knew, but in the Roman tongue. And when the priest was astonished and asked how she came to know Latin, when her parents, who stood by, were wholly ignorant of it, "Thou hast never seen my parents," was the reply. To this the priest, "Whence art thou, then, if these are not thy parents?" And the demon, by the mouth of the girl, "I am a follower and disciple of Satan, and for a long time I was gatekeeper (janitor) in hell; but, for some years, along with eleven companions, I have ravaged the kingdom of the Franks." (Cap. v, 49.)

He then goes on to tell how they blasted the crops and scattered pestilence among beasts and men, because of the prevalent wickedness of the people.*

The enumeration of all these iniquities, in oratorical style, takes up a whole octavo page; and at the end it is stated, "All these things the demon spoke in Latin by the mouth of the girl."

And when the priest imperatively ordered him to come out, "I shall go," said he, "not in obedience to you, but on account of the power of the saints, who do not allow me to remain any longer." And, having said this, he threw the girl down on the floor and there compelled her to lie prostrate for a time, as though she slumbered. After a little while, however, he going away, the girl, by the power of Christ and the merits of the blessed martyrs, as it were awakening from sleep, rose up quite well, to the astonishment of all present; nor after the demon had gone out was she able to speak Latin: so that it was plain enough that it was not she who had spoken in that tongue, but the demon by her mouth. (Cap. v, 51.)

If the "Historia Translationis" contained nothing more than has been, at present, laid before the reader, disbelief in the miracles of which it gives so precise and full a record might well be regarded as hyper-skepticism. It might fairly be said: "Here you have a man, whose high character, acute intelligence, and large instruction are certified by eminent contemporaries; a man who stood high in the confidence of one of the greatest rulers of any age, and whose other works prove him to be an accurate and judicious narrator of ordinary events. This man tells you, in language which bears the stamp of sincerity, of things which happened within his own knowledge, or within that of persons in whose veracity he has entire confidence, while he appeals to his sovereign and the court as witnesses of others; what possible ground can there be for disbelieving him?"

Well, it is hard upon Eginhard to say so, but it is exactly the honesty and sincerity of the man which are his undoing as a witness to the miraculous. He himself makes it quite obvious that when his profound piety comes on the stage, his good sense and even his perception of right and wrong make their exit. Let us

* In the middle ages one of the most favorite accusations against witches was that they committed just these enormities.

go back to the point at which we left him, secretly perusing the letter of Deacon Deusdona. As he tells us, its contents were—

> that he (the deacon) had many relics of saints at home, and that he would give them to me if I would furnish him with the means of returning to Rome; he had observed that I had two mules, and, if I would let him have one of them and would dispatch with him a confidential servant to take charge of the relics, he would at once send them to me. This plausibly expressed proposition pleased me, and I made up my mind to test the value of the somewhat ambiguous promise at once; * so giving him the mule and money for his journey I ordered my notary Ratleig (who already desired to go to Rome to offer his devotions there) to go with him. Therefore, having left Aix-la-Chapelle (where the emperor and his court resided at the time) they came to Soissons. Here they spoke with Hildoin, abbot of the monastery of St. Medardus, because the said deacon had assured him that he had the means of placing in his possession the body of the blessed Tiburtius the martyr. Attracted by which promises he (Hildoin) sent with them a certain priest, Hunus by name, a sharp man (*hominem callidum*), whom he ordered to receive and bring back the body of the martyr in question. And so, resuming their journey, they proceeded to Rome as fast as they could. (Cap. i, 3.)

Unfortunately, a servant of the notary, one Reginbald, fell ill of a tertian fever, and impeded the progress of the party. However, this piece of adversity had its sweet uses; for, three days before they reached Rome, Reginbald had a vision. Somebody habited as a deacon appeared to him and asked why his master was in such a hurry to get to Rome; and when Reginbald explained their business, this visionary deacon, who seems to have taken the measure of his brother in the flesh with some accuracy, told him not by any means to expect that Deusdona would fulfill his promises. Moreover, taking the servant by the hand, he led him to the top of a high mountain and, showing him Rome (where the man had never been), pointed out a church, adding: "Tell Ratleig the thing he wants is hidden there; let him get it as quickly as he can and go back to his master"; and, by way of a sign that the order was authoritative, the servant was promised that from that time forth his fever should disappear. And as the fever did vanish to return no more, the faith of Eginhard's people in Deacon Deusdona naturally vanished with it (*et fidem diaconi promissis non haberent*). Nevertheless, they put up at the deacon's house near St. Peter da Vincula. But time went on and no relics made their appearance, while the notary and the priest were put off with all sorts of excuses—the brother to whom the relics had been confided was gone to Beneventum and not expected back for some time, and so on—until Ratleig and Hunus began to despair, and were minded to return, *infecto negotio.*

* It is pretty clear that Eginhard had his doubts about the deacon, whose pledge he qualifies as *sponsiones incertæ.* But, to be sure, he wrote after events which fully justified skepticism.

But my notary, calling to mind his servant's dream, proposed to his companion that they should go to the cemetery which their host had talked about without him. So, having found and hired a guide, they went in the first place to the basilica of the blessed Tiburtius in the Via Labicana, about three thousand paces from the town, and cautiously and carefully inspected the tomb of that martyr, in order to discover whether it could be opened without any one being the wiser. Then they descended into the adjoining crypt, in which the bodies of the blessed martyrs of Christ, Marcellinus and Petrus, were buried; and, having made out the nature of their tomb, they went away thinking their host would not know what they had been about. But things fell out differently from what they had imagined. (Cap. i, 7.)

In fact, Deacon Deusdona, who doubtless kept an eye on his guests, knew all about their manœuvres and made haste to offer his services, in order that, "with the help of God" (*si Deus votis eorum favere dignaretur*), they should all work together. The deacon was evidently alarmed lest they should succeed without *his* help.

So, by way of preparation for the contemplated *vol avec effraction*, they fasted three days; and then, at night, without being seen, they betook themselves to the basilica of St. Tiburtius, and tried to break open the altar erected over his remains. But the marble proving too solid, they descended to the crypt, and "having invoked our Lord Jesus Christ and adored the holy martyrs," they proceeded to prise off the stone which covered the tomb, and thereby exposed the body of the most sacred martyr Marcellinus, "whose head rested on a marble tablet on which his name was inscribed." The body was taken up with the greatest veneration, wrapped in a rich covering, and given over to the keeping of the deacon and his brother Lunison, while the stone was replaced with such care that no sign of the theft remained.

As sacrilegious proceedings of this kind were punishable with death by the Roman law, it seems not unnatural that Deacon Deusdona should have become uneasy, and have urged Ratleig to be satisfied with what he had got and be off with his spoils. But the notary having thus cleverly captured the blessed Marcellinus, thought it a pity he should be parted from the blessed Petrus, side by side with whom he had rested for five hundred years and more in the same sepulchre (as Eginhard pathetically observes); and the pious man could neither eat, drink, nor sleep, until he had compassed his desire to reunite the saintly colleagues. This time, apparently in consequence of Deusdona's opposition to any further resurrectionist doings, he took counsel with a Greek monk, one Basil, and, accompanied by Hunus, but saying nothing to Deusdona, they committed another sacrilegious burglary, securing this time, not only the body of the blessed Petrus, but a quantity of dust, which they agreed the priest should take, and tell his employer that it was the remains of the blessed Tiburtius.

How Deusdona was "squared," and what he got for his not very valuable complicity in these transactions, does not appear. But at last the relics were sent off in charge of Lunison, the brother of Deusdona, and the priest Hunus, as far as Pavia, while Ratleig stopped behind for a week to see if the robbery was discovered, and, presumably, to act as a blind if any hue and cry were raised. But, as everything remained quiet, the notary betook himself to Pavia, where he found Lunison and Hunus awaiting his arrival. The notary's opinion of the character of his worthy colleagues, however, may be gathered from the fact that, having persuaded them to set out in advance along a road which he told them he was about to take, he immediately adopted another route, and, traveling by way of St. Maurice and the Lake of Geneva, eventually reached Soleure.

Eginhard tells all this story with the most *naïve* air of unconsciousness that there is anything remarkable about an abbot, and a high officer of state to boot, being an accessory both before and after the fact to a most gross and scandalous act of sacrilegious and burglarious robbery. And an amusing sequel to the story proves that, where relics were concerned, his friend Hildoin, another high ecclesiastical dignitary, was even less scrupulous than himself.

On going to the palace early one morning, after the saints were safely bestowed at Seligenstadt, he found Hildoin waiting for an audience in the emperor's antechamber, and began to talk to him about the miracle of the bloody exudation. In the course of conversation, Eginhard happened to allude to the remarkable fineness of the garment of the blessed Marcellinus. Whereupon Abbot Hildoin replied (to Eginhard's stupefaction) that his observation was quite correct. Much astonished at this remark from a person who was supposed not to have seen the relics, Eginhard asked him how he knew that. Upon this, Hildoin saw that he had better make a clean breast of it, and he told the following story, which he had received from his priestly agent, Hunus: While Hunus and Lunison were at Pavia, waiting for Eginhard's notary, Hunus (according to his own account) had robbed the robbers. The relics were placed in a church, and a number of laymen and clerics, of whom Hunus was one, undertook to keep watch over them. One night, however, all the watchers, save the wide-awake Hunus, went to sleep; and then, according to the story which this "sharp" ecclesiastic foisted upon his patron—

it was borne in upon his mind that there must be some great reason why all the people, except himself, had suddenly become somnolent; and, determining to avail himself of the opportunity thus offered (*oblata occasione utendum*), he rose and, having lighted a candle, silently approached the chests. Then, having burned through the threads of the seals with the flame of the candle, he quickly opened

the chests, which had no locks;* and, taking out portions of each of the bodies which were thus exposed, he closed the chests and connected the burned ends of the threads with the seals again, so that they appeared not to have been touched; and, no one having seen him, he returned to his place. (Cap. iii, 23.)

Hildoin went on to tell Eginhard that Hunus at first declared to him that these purloined relics belonged to St. Tiburtius; but afterward confessed, as a great secret, how he had come by them, and he wound up his discourse thus:

They have a place of honor beside St. Medardus, where they are worshiped with great veneration by all the people; but whether we may keep them or not is for your judgment. (Cap. iii, 23.)

Poor Eginhard was thrown into a state of great perturbation of mind by this revelation. An acquaintance of his had recently told him of a rumor that was spread about, that Hunus had contrived to abstract *all* the remains of SS. Marcellinus and Petrus while Eginhard's agents were in a drunken sleep; and that, while the real relics were in Abbot Hildoin's hands at St. Medardus, the shrine at Seligenstadt contained nothing but a little dust. Though greatly annoyed by this "execrable rumor, spread everywhere by the subtlety of the devil," Eginhard had doubtless comforted himself by his supposed knowledge of its falsity, and he only now discovered how considerable a foundation there was for the scandal. There was nothing for it but to insist upon the return of the stolen treasures. One would have thought that the holy man, who had admitted himself to be knowingly a receiver of stolen goods, would have made instant restitution and begged only for absolution. But Eginhard intimates that he had very great difficulty in getting his brother abbot to see that even restitution was necessary.

Hildoin's proceedings were not of such nature as to lead any one to place implicit trust in anything he might say; still less had his agent, priest Hunus, established much claim to confidence; and it is not surprising that Eginhard should have lost no time in summoning his notary and Lunison to his presence, in order that he might hear what they had to say about the business. They, however, at once protested that priest Hunus's story was a parcel of lies, and that after the relics left Rome no one had any opportunity of meddling with them. Moreover, Lunison, throwing himself at Eginhard's feet, confessed with many tears what actually took place. It will be remembered that, after the body of St. Marcellinus was abstracted from its tomb, Ratleig deposited it in the house of Deusdona, in charge of the latter's brother, Lunison. But Hunus, being very much disappointed that he could not get

* The words are *scrinia sine clave*, which seem to mean "having no key." But the circumstances forbid the idea of breaking open.

hold of the body of St. Tiburtius, and afraid to go back to his abbot empty-handed, bribed Lunison with four pieces of gold and five of silver to give him access to the chest. This Lunison did, and Hunus helped himself to as much as would fill a gallon measure (*vas sextarii mensuram*) of the sacred remains. Eginhard's indignation at the "rapine" of this "nequissimus nebulo" is exquisitely droll. It would appear that the adage about the receiver being as bad as the thief was not current in the ninth century.

Let us now briefly sum up the history of the acquisition of the relics. Eginhard makes a contract with Deusdona for the delivery of certain relics which the latter says he possesses. Eginhard makes no inquiry how he came by them; otherwise, the transaction is innocent enough.

Deusdona turns out to be a swindler, and has no relics. Thereupon Eginhard's agent, after due fasting and prayer, breaks open the tombs and helps himself.

Eginhard discovers by the self-betrayal of his brother abbot, Hildoin, that portions of his relics have been stolen and conveyed to the latter. With much ado he succeeds in getting them back.

Hildoin's agent, Hunus, in delivering these stolen goods to him, at first declared they were the relics of St. Tiburtius, which Hildoin desired him to obtain; but afterward invented a story of their being the product of a theft, which the providential drowsiness of his companions enabled him to perpetrate from the relics which Hildoin well knew were the property of his friend.

Lunison, on the contrary, swears that all this story is false, and that he himself was bribed by Hunus to allow him to steal what he pleased from the property confided to his own and his brother's care by their guest Ratleig. And the honest notary himself seems to have no hesitation about lying and stealing to any extent, where the acquisition of relics is the object in view.

For a parallel to these transactions one must read a police report of the doings of a "long firm" or of a set of horse-coupers; yet Eginhard seems to be aware of nothing, but that he has been rather badly used by his friend Hildoin and the "nequissimus nebulo" Hunus.

It is not easy for a modern Protestant, still less for any one who has the least tincture of scientific culture, whether physical or historical, to picture to himself the state of mind of a man of the ninth century, however cultivated, enlightened, and sincere he may have been. His deepest convictions, his most cherished hopes, were bound up in the belief of the miraculous. Life was a constant battle between saints and demons for the possession of the souls of men. The most superstitious among our modern countrymen turn to supernatural agencies only when natural

causes seem insufficient; to Eginhard and his friends the supernatural was the rule, and the sufficiency of natural causes was allowed only when there was nothing to suggest others.

Moreover, it must be recollected that the possession of miracle-working relics was greatly coveted, not only on high but on very low grounds. To a man like Eginhard, the mere satisfaction of the religious sentiment was obviously a powerful attraction. But, more than this, the possession of such a treasure was an immense practical advantage. If the saints were duly flattered and worshiped, there was no telling what benefits might result from their interposition on your behalf. For physical evils, access to the shrine was like the grant of the use of a universal pill and ointment manufactory; and pilgrimages thereto might suffice to cleanse the performers from any amount of sin. A letter to Lupus, subsequently abbot of Ferrara, written while Eginhard was smarting under the grief caused by the loss of his much-loved wife Imma, affords a striking insight into the current view of the relation between the glorified saints and their worshipers. The writer shows that he is anything but satisfied with the way in which he has been treated by the blessed martyrs whose remains he has taken such pains to "convey" to Seligenstadt, and to honor there as they would never have been honored in their Roman obscurity:

> It is an aggravation of my grief and a reopening of my wound, that our vows have been of no avail, and that the faith which we placed in the merits and intervention of the martyrs has been utterly disappointed.

We may admit, then, without impeachment of Eginhard's sincerity, or of his honor under all ordinary circumstances, that when piety, self-interest, the glory of the Church in general, and that of the church at Seligenstadt in particular, all pulled one way, even the work-a-day principles of morality were disregarded; and, *a fortiori*, anything like proper investigation of the reality of the alleged miracles was thrown to the winds.

And if this was the condition of mind of such a man as Eginhard, what is it not legitimate to suppose may have been that of Deacon Deusdona, Lunison, Hunus, and company, thieves and cheats by their own confession; or of the probably hysterical nun; or of the professional beggars, for whose incapacity to walk and straighten themselves there is no guarantee but their own? Who is to make sure that the exorcist of the demon Wiggo was not just such another priest as Hunus; and is it not at least possible, when Eginhard's servants dreamed night after night in such a curiously coincident fashion, that a careful inquirer might have found they were very anxious to please their master?

Quite apart from deliberate and conscious fraud (which is a

rarer thing than is often supposed), people whose mythopœic faculty is once stirred are capable of saying the thing that is not, and of acting as they should not, to an extent which is hardly imaginable by persons who are not so easily affected by the contagion of blind faith. There is no falsity so gross that honest men, and, still more, virtuous women, anxious to promote a good cause, will not lend themselves to it without any clear consciousness of the moral bearings of what they are doing.

The cases of miraculously effected cures of which Eginhard is ocular witness appear to belong to classes of disease in which malingering is possible or hysteria presumable. Without modern means of diagnosis, the names given to them are quite worthless. One "miracle," however, in which the patient was cured by the mere sight of the church in which the relics of the blessed martyrs lay, is an unmistakable case of dislocation of the lower jaw in a woman; and it is obvious that, as not unfrequently happens in such accidents to weakly subjects, the jaw slipped suddenly back into place, perhaps in consequence of a jolt, as the woman rode toward the church. (Cap. v, 53.)*

There is also a good deal said about a very questionable blind man—one Albricus (Alberich ?)—who, having been cured, not of his blindness, but of another disease under which he labored, took up his quarters at Seligenstadt, and came out as a prophet, inspired by the archangel Gabriel. Eginhard intimates that his prophecies were fulfilled; but, as he does not state exactly what they were or how they were accomplished, the statement must be accepted with much caution. It is obvious that he was not the man to hesitate to "ease" a prophecy until it fitted, if the credit of the shrine of his favorite saints could be increased by such a procedure. There is no impeachment of his honor in the supposition. The logic of the matter is quite simple, if somewhat sophistical. The holiness of the church of the martyrs guarantees the reality of the appearance of the archangel Gabriel there, and what the archangel says must be true. Therefore, if anything seem to be wrong, that must be the mistake of the transmitter; and, in justice to the archangel, it must be suppressed or set right. This sort of "reconciliation" is not unknown in quite modern times, and among people who would be very much shocked to be compared with a "benighted papist" of the ninth century.

The readers of this review are, I imagine, very largely composed of people who would be shocked to be regarded as anything but enlightened Protestants. It is not unlikely that those of them

* Eginhard speaks with lofty contempt of the "*vana ac superstitiosa præsumptio*" of the poor woman's companions in trying to alleviate her sufferings with "herbs and frivolous incantations." Vain enough, no doubt, but the "mulierculæ" might have returned the epithet "superstitious" with interest.

who have accompanied me thus far may be disposed to say: "Well, this is all very amusing as a story; but what is the practical interest of it? We are not likely to believe in the miracles worked by the spolia of SS. Marcellinus and Petrus, or by those of any other saints in the Roman calendar."

The practical interest is this: If you do not believe in these miracles, recounted by a witness whose character and competency are firmly established, whose sincerity can not be doubted, and who appeals to his sovereign and other contemporaries as witnesses of the truth of what he says, in a document of which a MS. copy exists, probably dating within a century of the author's death, why do you profess to believe in stories of a like character which are found in documents, of the dates and of the authorship of which nothing is certainly determined, and no known copies of which come within two or three centuries of the events they record? If it be true that the four Gospels and the Acts were written by Matthew, Mark, Luke, and John, all that we know of these persons comes to nothing in comparison with our knowledge of Eginhard; and not only is there no proof that the traditional authors of these works wrote them, but very strong reasons to the contrary may be alleged. If, therefore, you refuse to believe that "Wiggo" was cast out of the possessed girl on Eginhard's authority, with what justice can you profess to believe that the legion of devils were cast out of the man among the tombs of the Gadarenes? And if, on the other hand, you accept Eginhard's evidence, why do you laugh at the supposed efficacy of relics and the saint-worship of the modern Romanists? It can not be pretended, in the face of all evidence, that the Jews of the year 30, or thereabout, were less imbued with the belief in the supernatural than were the Franks of the year A. D. 800. The same influences were at work in each case, and it is only reasonable to suppose that the results were the same. If the evidence of Eginhard is insufficient to lead reasonable men to believe in the miracles he relates, *a fortiori* the evidence afforded by the Gospels and the Acts must be so.*

But it may be said that no serious critic denies the genuineness of the four great Pauline Epistles—Galatians, First and Second Corinthians, and Romans—and that, in three out of these four, Paul lays claim to the power of working miracles.† Must we suppose, therefore, that the Apostle to the Gentiles has stated that which is false? But to how much does this so-called claim amount?

* Of course there is nothing new in this argument; but it does not grow weaker by age. And the case of Eginhard is far more instructive than that of Augustine, because the former has so very frankly, though incidentally, revealed to us, not only his own mental and moral habits, but those of the people about him.

† See 1 Cor. xii, 10–28; 2 Cor. vi, 12; Rom. xv, 19.

It may mean much or little. Paul nowhere tells us what he did in this direction, and, in his sore need to justify his assumption of apostleship against the sneers of his enemies, it is hardly likely that, if he had any very striking cases to bring forward, he would have neglected evidence so well calculated to put them to shame.

And, without the slightest impeachment of Paul's veracity, we must further remember that his strongly marked mental characteristics, displayed in unmistakable fashion in these Epistles, are anything but those which would justify us in regarding him as a critical witness respecting matters of fact, or as a trustworthy interpreter of their significance. When a man testifies to a miracle, he not only states a fact, but he adds an interpretation of the fact. We may admit his evidence as to the former, and yet think his opinion as to the latter worthless. If Eginhard's calm and objective narrative of the historical events of his time is no guarantee for the soundness of his judgment where the supernatural is concerned, the fervid rhetoric of the Apostle of the Gentiles, his absolute confidence in the "inner light," and the extraordinary conceptions of the nature and requirements of logical proof which he betrays in page after page of his Epistles, afford still less security.

There is a comparatively modern man who shared to the full Paul's trust in the "inner light," and who, though widely different from the fiery evangelist of Tarsus in various obvious particulars, yet, if I am not mistaken, shares his deepest characteristics. I speak of George Fox, who separated himself from the current Protestantism of England in the seventeenth century as Paul separated himself from the Judaism of the first century, at the bidding of the "inner light"—who went through persecutions as serious as those which Paul enumerates, who was beaten, stoned, cast out for dead, imprisoned nine times, sometimes for long periods, in perils on land and perils at sea. George Fox was an even more widely traveled missionary, and his success in founding congregations, and his energy in visiting them, not merely in Great Britain and Ireland and the West India Islands, but on the continent of Europe and that of North America, was no less remarkable. A few years after Fox began to preach there were reckoned to be a thousand Friends in prison in the various jails of England; at his death, less than fifty years after the foundation of the sect, there were seventy thousand of them in the United Kingdom. The cheerfulness with which these people —women as well as men—underwent martyrdom in this country and in the New England States is one of the most remarkable facts in the history of religion.

No one who reads the voluminous autobiography of "Honest George" can doubt the man's utter truthfulness; and though, in

his multitudinous letters, he but rarely rises far above the incoherent commonplaces of a street preacher, there can be no question of his power as a speaker, nor any doubt as to the dignity and attractiveness of his personality, or of his possession of a large amount of practical good sense and governing faculty.

But that George Fox had full faith in his own powers as a miracle-worker, the following passage of his autobiography (to which others might be added) demonstrates:

Now after I was set at liberty from Nottingham gaol (where I had been kept prisoner a pretty long time) I traveled as before, in the work of the Lord. And coming to Mansfield Woodhouse, there was a distracted woman under a doctor's hand, with her hair let loose all about her ears; and he was about to let her blood, she being first bound, and many people being about her, holding her by violence; but he could get no blood from her. And I desired them to unbind her and let her alone; for they could not touch the spirit in her by which she was tormented. So they did unbind her, and I was moved to speak to her, and in the name of the Lord to bid her be quiet and still. And she was so. And the Lord's power settled her mind and she mended; and afterwards received the truth and continued in it to her death. And the Lord's name was honoured; to whom the glory of all his works belongs. Many great and wonderful things were wrought by the heavenly power in those days. For the Lord made bare his omnipotent arm and manifested his power to the astonishment of many; by the healing virtue whereof many have been delivered from great infirmities, and the devils were made subject through his name: of which particular instances might be given beyond what this unbelieving age is able to receive or bear.*

It needs no long study of Fox's writings, however, to arrive at the conviction that the distinction between subjective and objective verities had not the same place in his mind as it has in that of ordinary mortals. When an ordinary person would say "I thought so and so," or "I made up my mind to do so and so," George Fox says "it was opened to me," or "at the command of God I did so and so." "Then at the command of God on the ninth day of the seventh month 1643 [Fox being just nineteen] I left my relations and brake off all familiarity or friendship with young or old." "About the beginning of the year 1647 I was moved of the Lord to go into Darbyshire." Fox hears voices and he sees visions, some of which he brings before the reader with apocalyptic power in simple and strong English, alike untutored and undefiled, of which, like John Bunyan, his contemporary, he was a master.

"And one morning, as I was sitting by the fire, a great cloud came over me and a temptation beset me; and I sate still. And it was said, *All things come by Nature.* And the elements and stars came over me; so that I was in a manner quite clouded

* "A Journal or Historical Account of the Life, Travels, Sufferings, and Christian Experiences, etc., of George Fox," ed. i, 1694, pp. 27, 28.

with it. . . . And, as I sate still under it, and let it alone, a living hope arose in me, and a true voice arose in me which said, *There is a living God who made all things.* And immediately the cloud and the temptation vanished away, and life rose over it all, and my heart was glad and I praised the Living God" (p. 13).

If George Fox could speak as he proves in this and some other passages he could write, his astounding influence on the contemporaries of Milton and of Cromwell is no mystery. But this modern reproduction of the ancient prophet, with his "Thus saith the Lord," "This is the work of the Lord," steeped in supernaturalism and glorying in blind faith, is the mental antipodes of the philosopher, founded in naturalism and a fanatic for evidence, to whom these affirmations inevitably suggest the previous question: "How do you know that the Lord saith it?" "How do you know that the Lord doeth it?" and who is compelled to demand that rational ground for belief without which, to the man of science, assent is merely an immoral pretense.

And it is this rational ground of belief which the writers of the Gospels, no less than Paul, and Eginhard, and Fox, so little dream of offering that they would regard the demand for it as a kind of blasphemy.—*Nineteenth Century.*

MUSEUMS OF HOUSEHOLD PRODUCTS.

By RUDOLF VIRCHOW.

THE publication of a plan for establishing, in the capital of the German Empire, a "Museum of Popular Costumes and Products of Home Industry," has aroused so earnest and general an interest that the realization of the thought may be regarded as assured. It may, it is true, be possible to carry it out at first only to a very limited extent, for neither sufficient means nor space can be secured at once for setting up a comprehensive institution. But the initial purpose of the authors of the enterprise will have been accomplished when they have exhibited a series of objects illustrative of their plan. They confidently hope that these examples will satisfy their fellow-citizens of the usefulness and even the need of such a museum; and that the Government will assist it as it has assisted the technical museum, and will eventually take it under official care.

Herr von Gossler, the Prussian Minister of Worship, has already given the costume museum free temporary quarters in the old Industrial Academy, the present Hygienic Institute, in the Kloster-Strasse. The first acquisitions, which were made in the peninsula of Monkgut, in Rügen, satified him that profitable re-

sults could be secured. It is obvious that the acquisitions can be more easily made through private persons who are in more immediate intercourse with the inhabitants of the special districts, than through state officers, who will be hampered by numerous reserves. It seems clear, therefore, that the best course for the immediate present will be to excite interest in the enterprise among the people themselves; and to secure the participation of friends of the scheme in the practical support of its promoters. The development of the older museums has been predominantly to the advantage of the representative arts. Even architecture has been crowded into the background after sculpture and painting. Industrial art has been very slowly and tardily recovered from oblivion. Those highest efforts of human skill, while they arouse the admiration of the observer, vitalize and elevate the understanding, excite it to imitation, and give direction to the activity of whole generations. They have thus become pre-eminently the criterion of civilization.

But civilization has never anywhere come up at once. Many generations have to apply their best force, through slow labor, to gain artistic skill and make it at home. A kind of hereditary transmission assures the continuance of progress in this field, and in case of long interruption the recovery of aims and methods once possessed. Not only, therefore, does the investigator, the real art-expert, give his attention to the study of the history of art, but the question also occurs to the simple man of the people —who may have made such a great discovery, and how, in the course of time, ever higher degrees of skill and understanding in art are mastered.

Two circumstances have hitherto given deep significance to these questions, and extended them far over the domain of pure art: First, the increasing knowledge of the efforts of savages. This began with the great discoveries of the fifteenth and sixteenth centuries, but only obtained that fruitful significance in the general view which is now apparent to all with the scientific expeditions of the last century, especially with Cook's voyages and Alexander von Humboldt's researches. Who does not know that the course of civilization from its rudest beginnings to an often surprising height, lies visible as in an open book in the savages of to-day, and that the development of society, law, and religions, as well as the ordering of the household and the whole theory of property in household goods and ornaments, domestic animals and useful plants, may be observed, now here, now there, in their gradual building up? Unhappily, the savages are disappearing with fearful rapidity under contact with civilized races; and it may be considered fortunate that the increased care in the observation and collection of the things peculiar to these perishing sur-

vivals of primitive times is exerted in preserving the objects themselves as well as the recollection of them, for future study. Thus are explained the origin and growth of ethnological museums, of which the one in Berlin is one of the best specimens.

The second circumstance that has determined with hardly less force the direction of late research is the shaping of archæology into a real science of prehistory. The growing interest in the European states in collecting the antiquities of the country, with the activity of Danish and Swedish students and the co-operation of several German investigators, have been the means of introducing general order and chronological consistency into this previously chaotic domain. The discovery of the Swiss pile-dwellings kindled zeal in the study through all Europe; and prehistoric museums are now among the institutions in the completeness of which each nation has a peculiar pride.

In this study, out of the graves and dwellings of our ancestors, is unfolding before us a new picture of the growth of human civilization; and we observe with surprise and wonder how it serves as a complement to the conception supplied by the view of the development of savages, so that one supplements the other. We look at our ancestors themselves as they stood in their day where savages are now.

Art-history proper is preceded by the history of labor; a long story, that began in the farthest primeval time, is still continuing, and is destined to continue ever. There is no boundary-line between the two, for no man can say where art begins, or toil for daily living ends. Art proceeds out of the labor of the day, as a flower from a bud. History and prehistory are only outwardly separate, while inwardly they are undistinguishable. As prehistory survives in the present savages, so likewise prehistoric traditions pass over into the lives of civilized peoples. The recovery and preservation of these traditions is a not less important aid to the understanding of civilization than prehistory itself; for they furnish the threads by which we can trace the connection of the past and the present in immediate sequence.

The connections of the oldest traditions are afforded first by language and legends, for the study of which no museums are required. Next to these in value are material objects, particularly useful ones, with which are associated antique designs and mythic—sometimes superstitious—meanings, and which also in their forms, decorations, and applications give very definite views of their age. It is the purpose of the projected museum of costumes and household goods to collect these objects—not the only purpose, for there are many stages in the historical development of peoples which have left their traces in dress and furnishings, but the principal one. A museum of costumes and household

goods will, therefore, close the gaps between ethnological and prehistoric museums on the one side and between ethnological and historical museums on the other side. It will do for our own people what ethnological museums have done in relation to foreign peoples, particularly to savages; it will seek out objects of the present as historical museums have recovered them from the tombs and dwelling-places of primitive times; and will give for the common life and conduct of the peoples what historical museums have furnished as to their ecclesiastical and courtly life.

We have a right, therefore, to expect much from the museum of costumes and household goods. Experience has contradicted the objection that it is too late to carry out such a purpose. Our beginnings have already taught us that even in Germany one has only to inquire and exert himself earnestly to obtain a great number of objects of antique tradition. In other countries brilliant success has been achieved, especially in Sweden, which, through the indefatigable industry of Herr Hazelius, has had a model museum of this kind in Stockholm for many years. There are also notable collections of similar character in Moscow and Amsterdam; but the expectations should not be raised too high. Thus it is evident that what we perhaps too ambitiously call national costumes do not reach back into prehistoric times. There was then nothing like them. Such characteristic styles can exist only among those peoples of whom some of the tribes have continued in a kind of natural condition, and these are found in Europe only among those of the Finnish stock. With all the Aryan peoples of Europe the national costume is a relatively late, almost a modern, product. In Germany such costumes can be found only in limited districts, sometimes only in particular villages, and are seldom of earlier origin than the fifteenth century. Not a few of them were first fixed by the Reformation. The actual collection of the material may open the way to comparative studies that will furnish earlier dates, but this is likely to be the case only as applies to single parts of the dress.

Men are more permanent in their house construction, methods of tillage and of domesticating animals, in their furnishings and tools, than in their dress. Articles of stone, bone, horn, and clay, in particular, incline to be fixed in character. The groundwork of house arrangement persists through all the additions which the extension of the scale and the larger estate may entail; and it is, in respect to the family, as permanent as are the topography and flora to whole districts.

Whole houses can hardly be brought into museums except as they may be represented by models or drawings. Consideration will be given to these. Rooms and chambers may be introduced in complete arrangement, and we hope at the opening of the

museum to make such exhibitions of apartments from various stations, by means of which we shall be able to convey ideas of the more important parts of the house.

The new enterprise invites the active co-operation of our countrymen. As a rule, the people know best where such treasures as we desire to bring to light are to be found. We therefore ask them to help us gather up such national relics as still exist in the way of dress and house furnishings to be preserved for the observation of posterity.—*Translated for the Popular Science Monthly from Die Gartenlaube.*

THE WASTES OF MODERN CIVILIZATION.

By FELIX L. OSWALD, M.D.

II.

THE use of certain remedial drugs is apt to become a confirmed habit, which often continues to afflict the patient for years after his apparent recovery from the effects of the original disease. The medication of desperate moral disorders has now and then entailed a similar penalty. During the millennium of mediæval superstition, when the enforcement of antinatural dogmas had made common sense a capital crime and secular science an article of contraband, the study of classic literature became for thousands a refuge from the peril of madness. From the tyranny of the monkish Inquisition thousands of persecuted thinkers could still escape to the haunts of Plato and Virgil, as, in spite of chains and guards, a Siberian exile may in dreams return to the lost paradise of freedom. Knowledge, too, could still be delved from the treasure-mine of pagan philosophy, and for nearly a thousand years the study of dead languages became thus a chief condition of intellectual survival.

Intellectual progress had been almost completely arrested. Like a monstrous dam, the barrier of an unnatural dogma obstructed the currents of civilization; all through priest-ridden Europe the rivers of national life had been collected into a vast theological mill-pond, and only from the heights of a classical education, from turrets accessible only by steep and tortuous stairs, philosophers could, in retrospect, study the phenomena of life under less abnormal conditions, and naturally made the attic of that edifice the repository of their own choicest thought.

Then came the great dam-burst of the Protestant revolt. The rills of the first breach soon became uncontrollable torrents, and the flood of the accumulated waters rushed onward with an impetus which, in the rapid progress of science and reform, promised

to compensate the stagnation of a thousand years. Thus far, however, the speed of that progress has been sadly retarded by the very means which once constituted its only hope of revival. Instead of navigating the river of the new era in manageable boats, scholars persisted in clinging to the wreck of their classic observatory, to a cumbersome raft of old beams and planks which got stranded at every turn of the stream, and often became a serious obstacle in the channels of reform. The experience of the last three hundred years has as yet failed to disassociate the ideas of Latin and Greek from the scholastic notions of culture, and the time may come when practical educators will almost fail to realize the possibility of the fact that, in our own rapid age of discovery and invention, millions of our most gifted students had to waste from one-third to three-fifths of their time on the study of dead languages. Witness the following curriculum of the German *Gymnasia*, or high schools—the preparatory colleges of the best European universities, and the gates to every highway of liberal education:

Latin, ten hours per week; Greek, eight hours; Hebrew, three hours; German, four hours; mathematics, four hours; geography, two; history, two; drawing, two; French, two; physiology, two; religion, optional; English, optional (occasionally taught instead of French); gymnastics, four hours. In other words, twenty-one hours of graveyard studies to eighteen hours of all living sciences taken together, since gymnastics has ceased under certain circumstances to be a compulsory branch of education.

Those twenty-one hours devoted to the dead leave not a minute's time for the study of such problems of life as biology and rational hygiene; not a minute for anatomy, political economy, philosophy, rhetoric, or non-sectarian ethics. Such things, of course, are taught by the regular or special professors of the university; but a large percentage of students pass directly from the primer-class of the gymnasium to the duties of practical life, and in ninety-nine of a hundred cases may charge the long period given to the study of the ancient languages to the budget of total loss. Not one of a hundred non-philological students (graduates devoting themselves to the special study and the teaching of ancient languages) would ever dream of continuing his antiquarian pursuits or be able to look upon a Greek or Latin textbook without a shudder of disgust. It has been conclusively proved that all the etymological benefit derived from linguistic graveyards could be reaped in a single year by the study of root-words (most of them familiarized by their French and English derivatives). It has been demonstrated to the satisfaction of every impartial thinker that grammar-drill is *not* the superlative

intellectual exercise vaunted in the arguments of its advocates, but, on the contrary, almost the worst of all possible systems of mental training—a dead-lift of memory, exercising the lower at the expense of the higher mental faculties. Nor is there a shadow of a doubt that in natural history, astronomy, geography, physiology, and mathematics, the achievements of Greece and Rome have been distanced as far as their own writers eclipsed the wiseacres of Scythia and Abyssinia. Yet the New World continues to emulate the Old in wooing the specters of the past, and thousands of American parents encumber the memory of their children with a mass of antiquarian rubbish that leaves no room for the culture of progressive science, too often not even for the adequate study of their own mother-tongue.

A cardinal tenet of mediæval ethics was the belief in the merit of *mental prostitution*—the duty of submitting to dogmas which their professors did not and could not believe, and which the exigencies of daily life obliged them practically to repudiate.

A logical consequence of that doctrine was the antagonism of theory and practice, which continues to involve an enormous waste in our method of moral education. A million pulpits still preach a gospel that inculcates the vanity of industrial pursuits. "Take no thought of the morrow, for the morrow shall take thought for the things of itself." "Take no thought, saying, What shall we eat, or what shall we drink, or wherewithal shall we be clothed? For after all these do the Gentiles seek." As a practical comment on the wisdom of those precepts, nations, cities, and corporations vie in the restless pursuit of wealth, and a thousand lessons of daily life admonish the young citizen of our industrial world to take earnest and constant thought of the morrow; nay, the mere attempt to disregard those lessons would be followed by the punishment of the shiftless vagrant.

Loss of health and wealth, loss of working capacity—in fact, every form of temporal affliction—the disciples of our moral exemplar are instructed to consider as proofs of divine favor. Yet the prevention of such favors is the legally encouraged purpose of dozens of fire and life insurance companies and mutual aid associations with their omnipresent agencies.

Our ethical text-books in the plainest terms teach the possibility of curing diseases by prayer and mystic ceremonies. "If any man is sick among you, let him call for the elders of the church and let them pray over him, anointing him with oil in the name of the Lord." "And the prayer of faith shall save the sick, and the Lord shall raise him up." "And when he had called unto him his twelve disciples, he gave them power against unclean spirits, to cast them out and to heal all manner of disease." Yet in at least forty-five of the fifty most civilized countries of Chris-

tendom the attempt to cure any serious disease on that plan would be followed by a prompt indictment for quackery.

The possibility of diabolical apparitions is implied in a countless number of passages which our traditional creed requires us to accept as infallible truth. Devils by scores and legions range the land of faith, tempting the virtuous, afflicting men and animals with strange diseases, or even taking permanent possession of a human body still tenanted by a conscious soul. The report of a five minutes' interview with the smallest of those imps would now expose the narrator to the risk of a lunacy inquest.

The worthlessness of earthly life is inculcated with a distinctness which seems intended as an encouragement to the indirect suicide of monastic asceticism; yet the same moralists who bewail this earth as a vale of tears take the liveliest interest in the prolongation of human life, and court popularity by indorsing every measure tending to promote the progress of sanitary reform.

The inevitable result of such inconsistencies is a moral confusion resembling the bewilderment of the guests invited to the banquet of Rueckert's Hakim Baba, who urged his visitors to indulge in wine, but thrashed them fearfully if they showed any signs of intoxication.

From the chaos of conflicting theoretical and practical lessons our children, by the aid of experience, somehow manage to evolve a moral compromise code of their own; but what a waste of time could be saved, how many hours of doubt, perplexity, and repentance could be obviated by a system of ethics inculcating precepts in harmony with the laws of nature and the facts of actual life!

Yet the injury caused by the theoretical survival of obsolete dogmas is far surpassed by the baneful results of the attempt to reestablish their authority by the aid of legal enforcements. Moral confusion in that case takes the more serious form of a moral revolt which strikes at the very root of social order by making injustice a synonym of law and order. The statesmen who constantly warn us against the danger of attempting social reforms by an appeal to "paternal legislation" have as yet failed to explain by what right they continue to employ that method for the perpetuation of social abuses. They decline to meddle with the affairs of their poor brother, for fear of sheltering him against "the natural penalties of his shiftlessness"; but they risk that interference by enforcing laws to deprive him of the natural rewards of his labor, especially if their own position enables them to evade the inconveniences of such laws. In other words, they denounce meddlesome help but connive at meddlesome injury. Their tender conscience shrinks from the injustice of confessing an arbitrary, unearned blessing, but consents to the injustice of inflicting an arbitrary, undeserved curse.

For what else is the tyranny of the laws by which nine tenths of our fellow-citizens are robbed of their scant chance of recreation and obliged at the expense of their mental and physical health to toil like criminals, whose only alternative of labor is the dreary inactivity of their prison-cells—all in order to retain a conventional mark of deference to the joy-hating insanity of the middle ages—or, perhaps, to enhance by the charm of contrast the prerogatives of the privileged few, whose abundance of leisure days enables them to dispense with the blessing of a free Sunday?

It is true that the rigor of mediæval ethics has been modified in several important respects. The duty of abstaining from work and relying on prayer has been abrogated in favor of our tax-paying national industries. The duty of despising the danger of defilement by things that enter the mouth has been generally remitted in favor of candidates for the temperance vote. The obligation of despising the vanities of secular science does not prevent the Rev. Tollemach-Tollemach from collecting his tithes by telephone; but the duty of renunciation, of submissive abstinence from worldly and physical enjoyments, is still enforced at the expense of every laborer whose financial circumstances preclude the luxury of extra-Sabbatarian leisure days.

In the course of the last twenty years several hundred appeals for the abrogation of our anachronistic blue laws have been calmly ignored as below the notice of legislators engaged in such important reforms as the dredging of Catfish Bayou, though it might be questioned if the total amount of misery entailed on our workingmen by the systematic suppression of public recreation has ever been surpassed by the results of the most inhuman alliance of mediæval bigotry and despotism. The Spanish Inquisition enforced its mandates regardless alike of fear and pity; but its victims were selected from a class forming, after all, only a small fraction of the total population—one scapegoat, perhaps, in a herd of ten thousand—while at least a hundred-fold proportion of our countrymen feel the galling yoke of the Sabbath despots. The Scotch ascetics of David Hume's time filled their churches by a system of penal statutes which made financial and social ruin almost the only alternative of conformity; but the Caledonian peasant who had passed a week among the flocks of his Highland home might easily endure a day of confinement in the man-pen of his kirk, while the bigots of our manufacturing communities enforce their asceticism upon men who need recreation and outdoor sports as they need food and sunlight, and whose numbers include thousands for whom the promise of a *post-mortem* Utopia has lost its compensating value.

A few Sundays ago I accompanied a friend on a stroll across a

hill-pasture where a young goat-herd lay stretched out at full length under a tree still dripping from the showers of a recent thunder-storm.

"Hallo, Billy!" called out my companion. "What are you doing in that puddle of rain? Don't you know there is a law against bathing on Sunday?"

"That's a fact," laughed Billy. "If a stretch in the wet grass could do a fellow any good, I have no doubt there would be a law against it."

That reply exactly defines the popular verdict on a code of laws founded upon a system whose corner-stone is indeed the dogma that "whatever is natural is wrong." Sabbatarian despotism has succeeded in connecting the popular notion of a moralist with the idea of a kill-joy, and made religion a synonym of a system for the infliction of the greatest possible misery on the greatest possible number.

"Why, but is there not an offset in the leisure gained for the perusal of moral and instructive pamphlets?" asks the agent of the Free Tract Society.

Our pious friends can, indeed, not be accused of underrating the value of those tracts if they expect them to compensate the waste of opportunities for life-brightening recreations, the loss of good humor, the loss of patriotism, the loss of faith in the benefits of laws and creeds, the loss of content, and the often irretrievable loss of health and vital energy.

THE ETHICAL VIEW OF PROTECTION:

A WORD TO THE WAYFARING MAN.

By HUNTINGTON SMITH.

WHENEVER any great question comes up for settlement, there are always people ready with arguments on both sides. These arguments are all supported by what we call facts. Facts in great numbers are accumulated to prove diametrically opposite things; for there is no question, it matters not how absurd it may be, that facts in abundance can not be found in its favor. Now the simple truth is, that facts mean nothing till we know the relation which they bear to other facts. A mass of facts is like a heap of bricks; and just as you can construct any sort of a building out of a given heap of bricks, so out of a sufficient number of facts you can, by picking your material and fitting it together in accordance with some plan you have already determined upon, build up any sort of an argument. There is a common saying that figures will not lie. It is true that figures do not

of themselves lie, any more than a heap of bricks will lie; but they can be made to lie, just as a heap of bricks may be used for the construction of a sham building. We may compare the discussion over a great question to the terminal moraine of a glacier. The word *moraine* means a heap of rubbish. When a glacier is formed and begins to push its way down a valley, a vast mass of rubbish gathers and conceals its approach from view. If you did not look carefully at one of these terminal moraines, you never would know that there was any glacier; and after you discovered the glacier you never would know, except by careful observation, that it moved. Yet it does move, slowly but surely, in spite of the rubbish that seems to block its way. The rubbish is pushed on little by little, and in due time the glacier gets to the sea. Every one realizes then that the important thing was not the moraine but the glacier. The moraine has been ground out of sight or is scattered along the path; but the glacier remains.

So it is with every great truth that is making its way in the world. It stirs up a vast amount of talk. Some people approve of the truth, and bring their little store of facts to show what a fine thing it will be; others disapprove of it, and bring the same little facts, arranged in a different way, to show that if this principle is adopted it will inflict immense damage upon the welfare of society. Many remember how it was when the great question of the abolition of slavery came up in this country. Some men argued against it, ingeniously devising plausible arguments, full of statistics and Bible texts, and assertions that slavery was indorsed by Christianity; and others argued in its favor, with more statistics, and other Bible texts, and the assertion that Christianity and slavery were totally incompatible; and meanwhile the principle of human freedom went on working, and in time the slaves were set free.

How did the man of upright mind and noble heart decide the question of slavery or abolition in the days when that question was before the country? Did he weigh argument against argument, statistics against statistics, this Bible text against that Bible text? No. He simply sat down in the quietude of his own chamber and said to himself: "The slaves are men like me. Would I be willing to be a slave? Will it, in the long run, be profitable to humanity if a portion of the human race remains in bondage?" And it did not take him long to answer the question. His own reason told him what the answer was. He declared then and there that slavery was wrong, and henceforth he was on the side of freedom.

Now, a man who takes such a course as that, it matters not how learned or how ignorant he may be in the science of facts, is a philosopher. A philosopher is a lover of wisdom, and it is pos-

sible to be wise and yet to know very few facts. Wisdom does not consist in the ability to heap up facts, although our school instructors seem to think it does. Wisdom is concerned with something far higher than facts; it is concerned with the true, the eternal, the unchanging relations of things. The man who has grasped a few of the elementary truths of existence and governs his life in accordance with them is wise, even if he can not read a line of Latin, or solve a problem in algebra, or work out a sum in the rule of three. A few of the elementary truths of existence are that you must treat others as you would be treated yourself; that, if you would derive the utmost possible advantage from your relations with your fellows, you must be frank and open in what you do; that you must not build up barriers of restrictions between yourself and others and expect to thrive, either materially or morally, as you would if the barriers did not exist—in a word, the elemental truths of existence upon which we must depend are justice, fraternity, and love. The man who governs his life by these principles may not be a learned man; he may not be able to construct ingenious arguments from census reports; but he will be a good father, a kind neighbor, a man you can trust in business, and he is pretty sure to be prosperous, because he is on the side of truth and righteousness, and somehow or other truth and righteousness, sooner or later, always win.

The great questions, as we have said, are all the time arising, and they have to be met in some way. Each generation has its own particular question to settle. In this country, a generation ago, it was the abolition of slavery. That question was effectually settled, as we all know. Now a new generation has come upon the stage, and a new question arises. The new question is broader than the other, although it does not go so deep. If it does not affect so closely the very principle of manhood or call for such heroic treatment, its settlement concerns the welfare of a far greater number, and upon it depend the prosperity and happiness of the whole nation. It is not, then, a question to be decided lightly. Every man should think long and carefully before rendering his decision. The question with which we are now concerned is that of protection and free trade.

Here, as in all other great questions, we find men taking sides and trying to win converts to their own special views by arguments in which statistics—that is, facts—in one form or another, are brought together to prove diametrically opposite things. If we listen to them, we are perplexed, we are not enlightened. If one man tells us that wages are higher in this country because of protection, and that consequently everybody is better off with protection than without it; and another man tells us that, while wages will be lower under free trade, the expenses of living will

be far less, and, being relieved from the burden of heavy taxation, we shall all be much more prosperous than we are now; and if each of these men supports his assertions with a vast array of incontrovertible statistics, what are we to do—we who are not learned in figures, or who see that the same facts differently arranged can be made to prove different things?

Evidently there is only one course open to us if we wish to decide the question on its merits and not in accordance with personal prejudice, or party affiliation, or the superior eloquence and ingenuity of the orator we hear last. We must brush aside all these confusing statistics, ignore the arguments based upon them, and put the matter before our minds in the simplest form. We must deal, not with a misleading array of facts, but with the elemental truths of existence. We must do this, even though we run the risk of being called mere theorists and impractical. The trouble with the practical man is, that his vision is closely limited; he sees only what is directly under his nose. The practical man always wants to get change for his dollar as quickly as possible. He is never willing to run what he calls risks—that is, he is never desirous of making a beginning till he has the end within his grasp. It was not a practical man who built the first steamship to cross the Atlantic, or invented the electric telegraph, or planned the first ocean cable, or conceived the idea of the Pacific Railway. The relation of the practical man to humanity in general is the same as that of the hands to the body. It is not for the hands to make plans or say how things shall be done; that must be left to the brain. It is the business of the hands, when the plan is made, to take hold and do the work. And just as the hands can not judge of a thing simply by the sense of touch—can not tell a five-dollar gold-piece from a copper cent—so the practical man, because governed by immediate appearances, is of all men the most easily deceived.

But you, if you are a theorist, a philosopher, a man who deals with general principles, will settle the matter for yourself in accordance with general principles. If the question before you is that of free trade and protection, and practical men are being confused and misled by the artful devices of statistical orators, you will simply refuse to listen to the conflicting statements of either side, which do not prove anything, and never can prove anything. You will decide the matter for yourself on general principles; and you will first wish to determine clearly and definitely what is meant by the terms protection and free trade.

The word protection means a defense, a guard, literally a cover or shield against something or somebody, and it can be used, of course, only against an enemy. No one would think of protecting himself against a friendly influence. The word protection, or its

equivalents in different languages, was devised by man when he was still in a barbarous condition, when his hand was against every other man, and every other man's hand was against him. It was necessary that he should have some sort of a defense or cover to enable him to attack his enemies without being immediately killed, and this defense or cover, whether it was a shield to hold before his person or a strong wall built about his dwelling-place, he called a protection. Holding the shield before him, he could throw his spear or shoot his arrows at his enemy and not be harmed by the spear or the arrows his enemy returned; behind the strong wall he could be safe from assault and carry on the various activities of life without fear of molestation. He could, if he chose, scour the surrounding region, and rob and kill right and left, and get back to his strong wall before those he attacked could rally and take him prisoner. The outside barbarians would not endure this sort of thing forever. They also longed for protection. They got shields for themselves and built strong walls about their places of refuge, and in this way groups of what we now call society were first organized. Each of these groups was a very barbarous sort of society, but it was society nevertheless. A society means an association of persons for mutual profit or advantage. The barbarous group was a society based on protection, and protection was therefore an invention of barbarism; it was armed and organized selfishness; it was the means by which theft and rapine and murder were made possible on a large scale.

Time went on, and man gradually acquired better ideas of living. The little protected groups who were continually making war on each other and trying to prosper, each at the advantage of the other's happiness and prosperity, were led to see that they would be happier and more prosperous if they would stop making war on each other, tear down their strong walls, and unite in one harmonious community. It is not known who the first man was that conceived this idea, but whoever he may have been he was unquestionably a great benefactor to the human race. The groups that united into communities, however, did not embrace the whole of mankind. In fact, in these first days of primitive intelligence, a single community in which all mankind could unite was out of the question. A good many groups were still so barbarous that they preferred a hazardous existence maintained by war, rather than the prosperity that was sure to follow a friendly cultivation of the arts of peace. The groups that did join into communities were closely related to one another by blood; they spoke the same or nearly the same language, they had the same or similar customs, and their ideas of what life was for were nearly identical. These groups united and formed larger

groups or communities, and then the same relation existed between the large communities that had hitherto existed between the smaller groups. They all felt the need of protection, and this desire for protection led them to build larger and stronger walls, and to devise new methods of defense.

The only advantage was—and it was a great one—that, instead of a lot of little groups all fighting with one another, there were now large communities, and the chances for fighting were correspondingly decreased. But the process of assimilation once begun could not stop, because man, if he was to be anything more than a fighting animal, must agree to live on friendly terms with his fellows and cultivate the arts of peace. The process went on: communities that had gradually grown to have similar ideas united into still larger communities; tribes became states, and then, at last, states became nations.

Now the idea of the necessity for protection has so long been dominant with the various associations of men that these associations, even in our days of general enlightenment, do not readily believe that it can be given up. A man who has been living for years in a wild country where he has been liable to attacks from savages at any moment, does not readily adapt himself to the new conditions of mutual trust when he comes to live again among civilized and peaceful folks. You will find him still sleeping with his revolver at his side, and when he walks abroad he has his eye out for a possible ambush. So it is with the associations of mankind that have developed from the far-back barbarous groups. They know that the conditions of existence have changed, they know that if they are peaceable and industrious they will not be molested; but the idea of protection still lurks in their minds, and they feel that they must have it in some form, or be at the mercy of the rest of mankind, whom they wrongfully regard as enemies, but who are by nature as peacefully inclined as themselves.

And so we find man, as intelligent and enlightened as he is today, still clinging to this relic of barbarism, this system of organized selfishness known as protection. The trade of man is no longer fighting, the trade of man is now to devise inventions for his own comfort, and although we find some great associations maintaining vast standing armies in conformity with the spirit of protection, the chief occupation of man is with the arts of peace. The arts of peace and warfare are incompatible; one builds up and the other tears down; one creates, the other destroys; hence it is generally acknowledged that warfare is an evil which must soon be abolished. Men can not fight and at the same time till the fields, work in factories, construct railways, write novels, preach sermons, and paint pictures. Men are beginning to see now that

fighting is a foolish waste of blood and time and money, especially money, and before long fighting will be abandoned, because when men once are thoroughly convinced that a thing is foolish, or that it costs more than it comes to, they stop doing it. The few men who are now in favor of war are practical men who believe that war conduces in some way to national prosperity or helps trade. They would like to see things torn down, if they could have the opportunity of building them up. The theorists, the philosophers, are all opposed to war; they know it does a great deal more harm than good.

War, then, which has so long been the chief form of protection adopted by nations, is doomed. Men began some time ago, when peaceful communities were fully established, to see that it was doomed; but the old idea of protection, growing out of the distrust of humanity for humanity, had its hold upon them, and they set themselves at work to devise some new method of protection which would meet the new conditions and not destroy what we may call the industrial type of society. The practical men of the day put their heads together and said that the chief thing now was trade, and that they must not permit any rivalry in trade. The enemies of their special community were no longer the men who were better armed or better fortified; the enemies of their community were the men who could make things they could not make, or supply things they could make at a lower price.

"Let us," they said, "keep trade to ourselves. Let us make everything we want, be sufficient to ourselves, and be independent of the rest of mankind. In that way we shall grow rich and prosperous, and the rest of mankind may supply its wants the best it can."

How were they to do this? The days of war were going by. They could not establish guards and shoot every one of their fellow-citizens who bought anything of a foreigner, or shoot every foreigner who brought goods to sell within their borders. They could not do this, because it would be ruinous and expensive, but they could fine every person who engaged in trade with any person outside their own nation, and this they proceeded to do. They established a new form of protection, and called it very properly a protective tariff. The word *tariff* comes, so some philologists tell us, from Tarifa, a town in Spain at the entrance of the Strait of Gibraltar, where passing vessels were detained by force and obliged to pay tribute to the inhabitants. The citizens of Tarifa were the first of the modern protectionists. When we speak of protection nowadays, we mean a system of tribute imposed upon a whole nation by a certain small but powerful class of its practical men. The system is so devised that it takes money out of the pockets of the people and puts it into the pockets of the practical

men, who are manufacturers and traders. At least, it does so at first. After a while it does something else, and the manufacturers and traders lose by it, just as the practical men of barbarous times lost in the end more than they gained by war.

We have now traced the idea of protection from the beginnings of human society down to the present time, and we know what it means. What, on the other hand, is free trade? The term free trade explains itself. It is the opposite of protection. It does not believe in barriers or covers or defenses. It does not believe in organized selfishness at the expense of the many for the good of the few. It believes in the most open and free intercourse between all mankind. It believes that all men are brethren, and that it is no more right to fine an Englishman, a German, or a Frenchman because he can do a thing well than it is to fine an American for employing an Englishman, a German, or a Frenchman to do a thing well. It believes that the world is large enough, the resources of nature sufficient, to enable every man to support himself without joining a protected community and forswearing the help of others. Protection, as we have seen, is organized selfishness. Free trade is based on the elemental principles of existence—on justice, fraternity, and love.

But now come the orators and tell us, on one side, that protection means higher wages and greater prosperity for everybody, and, on the other side, that free trade means reduced expenses for the necessities of life and diminished taxation; and the orators on both sides have countless statistics to prove the absolute truth of what they say. What are we, who are not practical men, and who know that statistics will prove anything—what are we to do? Evidently we must fall back on elemental principles, and extend our reasoning a little further. We must examine the assertions of the orators in the light of general principles, and ask whether they are true.

Let us suppose a primitive group modeled after the groups of barbarous times to be formed in our day in accordance with the existing industrial conditions. Let us suppose a family group—for such the early groups were—a family group consisting of a father, a mother, three daughters, and four sons. In the barbarous days families were sometimes of this size. The father, we will imagine, is a shoemaker; the mother a milliner; the first daughter, Sarah, a dressmaker; the second daughter, Jane, a cook; the third daughter, Mary, a seamstress; the first son, James, a tailor; the second son, Thomas, a hat-maker; the third son, John, a butcher; the fourth son, Henry, a grocer. Each has grown to be expert at his or her particular trade, and is doing well. But the third son, John, is a very practical man, and he has studied what is called political economy. Political economy

is the science of selecting suitable facts to prove certain predetermined propositions with regard to the laws of trade; it can always be made to favor protection, but it will also favor free trade if you choose to have it do so and select your facts with proper discretion; political economy is the favorite science of practical men. John, then, has studied political economy, and he comes to the conclusion that the various members of the family are squandering their forces by working for outsiders. He calls the family together and says:

"I think I see a way in which we could be more prosperous. We must give up working for the rest of the world. Father must make shoes only for us; Jane must not cook for anybody except ourselves; James must not make clothes for any one except his father and his three brothers; Henry must not undertake to sell groceries to people who do not belong to the family; and I shall not supply any one but you with meat. Moreover, no one must buy of other people. We must have our shoes made by father, our clothes by James, and we must buy our groceries of Henry. If any member of the family buys anything of an outsider, he is to be fined twenty-five per cent of the cost of the article; and if any one of us sells anything to an outsider, and takes that outsider's goods in exchange, those goods shall be taxed one fourth of their value. The money so collected shall be put into a common fund, and used for defraying the joint family expenses."

What, think you, would be the reply of the philosophic father to a proposition like that? He would not be likely to waste many words over the matter. He would tell John flatly that he was a fool, and advise him to let political economy alone, and he would send the whole family about their business.

But now let us suppose that, instead of a family, we have a town made up of a hundred families, and the people get together and are asked to adopt a proposition similar to that made by John, the political economist. Some prominent citizen arises and declares that the town would be vastly more prosperous and independent if all its trading were done within its own limits; that the poor and struggling traders would have enough to do if people would patronize them instead of sending to other towns for goods; and that to discourage trade with outsiders it was expedient to tax all such commercial transactions, and place the money so obtained in the town treasury. Would not this proposition be as absurd as the other? Would not some citizen with a philosophical turn of mind, who reasoned from general principles, reply in words like these:

"The gentleman who has made this proposition is talking nonsense. The prosperity of this town and the comfort of its

inhabitants depend on its relations with other towns and the country at large. Our prosperity and comfort depend on the number and quality of things we can make that the rest of the world wants, and the facility with which we can exchange those things for things that we want. The gentleman who has just spoken proposes to tax the very relations upon which our material welfare is founded! We want corn and wheat and tea and coal and sugar; can we produce any of those things here? Certainly not. In order to get them we must make things wanted by the people who can and do produce corn, wheat, tea, coal, and sugar, and exchange our products for theirs. If we tax corn, wheat, tea, coal, and sugar, the people who want our goods will take them and pay for them in money, and we shall simply be paying out of our own pockets the extra valuation put upon goods that we want. We all of us who want and must have corn, wheat, tea, coal, and sugar, will be paying extra for them, and the only people who will be benefited will be the few among us who produce the articles that outsiders want. They can put larger prices on their goods on the strength of the extra valuation of corn, wheat, tea, coal, and sugar, and so the greater portion of the taxes will fall indirectly into their pockets. It will be cheaper for us in the end to pay the money directly over to them in the form of subsidies, which is a polite term for legalized charity."

Somewhat in this way, no doubt, the philosophical citizen would speak, and it would be strange if a majority of his fellow-citizens did not agree with him. If we enlarge our community, and instead of a city have a state, would the conditions be any different? Not at all. Certain people in this state would be able to do certain things well, and their prosperity would depend upon the facility with which they could exchange their labor or the products of their labor with the labor or the products of labor of the citizens of other states. What would have been the condition of this country, of the United States of America, if every State had put up a barrier against its neighbors in the shape of a protective tariff? Suppose that an inhabitant of Massachusetts could not get anything from Pennsylvania or New York without paying a duty, and suppose that an inhabitant of New York or Pennsylvania could not buy of an inhabitant of Illinois without being taxed by his own State from twenty-five to forty per cent on his purchase, what would become of our national prosperity? To ask the question is to answer it. The prosperity of each depends upon the utmost freedom of intercourse with all the others.

Let us now take a still wider outlook, and extend our reasoning a little further. Why, if a protective tariff is not conducive to prosperity when established between families or towns or

states of the same country, should it be regarded as beneficent to the welfare of a country when every country is only a state in the great federation of humanity we call the world? Do not the elemental principles of existence apply to countries as well as to states? They certainly do. Then whence the argument that a protective tariff between states of the same country is wrong, while between countries even of the same blood and race it is right and proper, and conducive to national prosperity? Is it not plain that the device of a protective tariff between countries is a relic of the old barbarous idea of protection, the idea that people belonging to other communities are enemies, and that we must have as little to do with them as possible, except to fight them if they trespass on our rights or threaten to take trade away from us? It must be so, or men who profess to believe in justice and fraternity and love between all mankind never would be found advocating the detestable and misleading system of organized selfishness built up of burdensome taxes upon the relations that alone can civilize, enlighten, and elevate the whole of humanity and so conduce immeasurably to the welfare of the whole world.

One of the chief arguments of the orators who favor protection is, that under the tariff system the prosperity of this country has been very great, and as usual they cite an endless array of statistics to prove the truth of what they say. But is the assertion reasonable? Can we who govern our ideas by common sense and not by the dictates of short-sighted expediency agree with the orators when they say that our national prosperity is due to protection? Do we not find, when we come to consider the matter, that through our boundless resources and unlimited energy in industrial affairs we have prospered in spite of the protective tariff, not because of it? If the State of Pennsylvania adopted a protective tariff and continued to prosper and heap up wealth within her borders, should we say that it was because of the tariff? No. We should see at once that her prosperity was due to causes superior to the disadvantages of a tariff system—that is, to the extraordinary capacity of her citizens for industrial affairs and the vast stores of material at their command, enabling them to conquer obstacles under which less powerful communities would languish or utterly perish. If a man sets up a bazaar for the sale of any sort of goods, and charges an admission fee to customers, and yet can sell his goods low enough to induce customers to pay the admission fee and enter and make purchases, and if this man amasses a great deal of money from his business, we shall not be likely to say that his riches are due to his system of admission fees. We simply conclude that he must have an extraordinary capacity for getting his goods at a low price; he

prospers, not on account of his system of admission fees, but in spite of it.

We have gone far enough now in our course of reasoning to see that in the light of the elemental principles of existence the evils of protection are very great. Its greatest evil is that it interferes with the free exchange of human activities; it puts a check upon justice, fraternity, and love. But a great evil can not exist without engendering other evils. Another evil engendered by the protective system is that it encourages poor and defective work. If a man is sure of plenty of trade, no matter how he makes his goods, he will not be so particular with regard to the quality. Ask an American oculist where he gets the delicate instruments with which he tests the eyes of his patients. He will tell you, if he is an expert at his profession, that he gets his instruments abroad. Why? Because the men in this country who produce such articles are not careful to do good work. They can make inferior instruments and sell them to the generality of oculists who are not expert, and make more money than they could by producing really excellent articles, and selling them at the same price as the foreign goods. If you buy a suit of cheap clothing in this country, the chances are that it will be of little service compared with a suit of clothes you could buy for a third less if you were living in London. Why? Because the tariff on woolens enables the American manufacturers of clothing to use cheaper and poorer goods, and to charge more for a suit of clothes than the foreign suit of first-class material would cost if you could send to London and buy it without being fined for patronizing an English tailor. As a matter of fact, a great many rich Americans who go abroad do patronize foreign tailors and do not get fined, but of course the poor Americans who have to stay at home and support the tariff system can not do this. They must buy poor clothing of their fellow-citizens and pay nearly as much for it as they would for a foreign article of excellent quality. American clothing manufacturers will tell you that they can make as good clothing as a foreigner can and at as low a price. Of course they can, but they don't. If they did, they would not be in favor of protection; they would be willing to meet the foreigner on terms of friendly competition, and not take advantage of him by skulking behind the tariff wall maintained at the expense of the people who do not make, but who buy, clothing.

Imagine a community isolated from the rest of the world, and that this community suffers from a water famine. All the wells have dried up, and water has to be brought from a distant river. Each person goes after what water he needs, or employs some one else to bring water for him, and every one is supplied. But a few

practical men get together and say: "How much better it would be if everybody went after water and poured what was brought into a common tank from which supplies could be drawn as needed! We will build the tank." They build the tank, and the people bring water and fill it. Then the practical men take possession of the spigots and charge the people so much a gallon for all the water drawn from the tank. The practical men are protected by the labor of the rest of the community; unfortunately, all can not be practical men.

Of course, the effect of protection upon the morals of the protected must in the end be very bad. It has a tendency to make them cowardly, treacherous, and grasping. The fear of meeting outsiders in friendly competition; the temptation to make poor goods when poor goods can be sold for an unjustly high price; the business of seizing as legitimate prey the labor of others and turning that labor to one's own uses—must, sooner or later, have a bad effect on the individual and the community at large. A man can not thrive at the expense of other men, whether those men are his near neighbors or are living at the antipodes, without being hardened in his sensibilities and becoming to a certain extent inhuman. The effect of protection upon the moral welfare of the protected is bad; its effect on their material welfare is eventually ruinous. In barbarous times, when men collected in protected groups behind strong walls, the outside barbarians had as little to do with them as possible. They removed their goods if they could beyond the reach of plunder. On the other hand, a great many practical men crowded into the fortified groups when the advantages of protection were recognized, there was soon not enough plunder to go round, and the practical men who believed in protection quarreled among themselves as to who should have the spoils, till they learned by experience how foolish fighting was, and joined a larger community where they could live on friendly terms with a larger number of their fellows. So it is with the protected in our day. As long as the wants of a protected community are simple and the industries with reference to the population few, the community gets on very well. If its resources are ample, it will be able to produce things at a low price and compete in the open markets of the world with the producers of older, unprotected communities which have no such natural resources to draw upon. But the time comes when the natural resources of the favored community are exhausted and it can no longer produce certain things at a lower price than anybody else. Then the members of other communities will not pay for the privilege of trading with a protected community on equal terms. They will go elsewhere with their products, where they can exchange them freely. An Englishman, who is a practical man

taught by the theorists and by hard experience that free trade pays in the long run better than protection, will buy of an American only as long as he can exchange his own goods, plus the duty exacted by the tariff, for the American's goods, and still get them lower than he can of anybody else. When the American can no longer sell the goods the Englishman wants at a lower price than that demanded by other people, the Englishman will go elsewhere; and if the American puts a tax on the Englishman's goods, it is the same as charging more for his own goods, and he is simply handicapping himself in what ought to be a free race.

When this happens—and it is sure to happen sooner or later, because if a man, however strong, willfully handicaps himself in a race, there is sure to be found in time a man who will beat him —when this happens the producers of a protected community have no longer any foreign demand to depend upon and the home demand is not enough to take up the supply, because so many practical men have been attracted into the protected community and gone to producing, that more things are made than the community really desires. The community desires things that its own members can not make, and to get them it must exchange money, which represents labor in some form, at a ruinous disadvantage. The result of all this is, that the practical men who have been producing things their own country does not want are deprived of patronage and are worse off than if they had never been protected. If the family of which we were speaking a little way back had been contented to live out in the country by themselves in a simple way, they would have got on very well without the rest of the world. They would have cut down trees and built a cabin, made a clearing and planted corn and potatoes, hunted game, clad themselves in the skins of animals, and existed entirely independent of their fellow-men. But their wants were numerous, they were forced to depend on others to supply them, and they were obliged to exchange the products of their own labor with the products of the labor of the rest of the world.

We could go on multiplying examples, but we might end by being statistical, and we must not forget the general principles which were to govern our decision. It is clear enough now that protection is a relic of barbarism; that it interferes with and often interrupts the interchange of human activities; that it is ruinous to justice, fraternity, and love; that just as protection in barbarous times, by means of strong walls and armor, put a premium on brute force and treachery, so protection in these days, by means of a commercial tariff, puts a premium on ignorance and fraud. For these reasons we know that the world would be better off without protection in any form, and we are bound

to do all we can to rid humanity of a burden so heavy to bear and so injurious, materially and morally, to every member of a civilized community.

"Gold and iron are good
To buy iron and gold;
All earth's fleece and food
For their like are sold.

. . . . . .

"Nor kind nor coinage buys
Aught above its rate.
Fear, craft, and avarice
Can not rear a state."

SOME MODERN ASPECTS OF GEOLOGY.*

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GEOLOGY has, from the earliest times, claimed the serious attention of mankind, by appealing to two entirely different sides of human character. In the first place, the reverence for the mysterious in nature, which in untutored men amounts to worship, has always been excited by the secrets of the earth; while, in the second place, the cupidity of man has always led him to explore the rocks in quest of the mineral treasures which they contain.

Thus we have at the very outset a *theoretical* and a *practical* interest in geology, both of which have played a most important part in the development of the science. From the earliest times and under various guises we can trace their influence side by side, and they are throughout typical of the two objects with which Nature is always studied—as an end in herself or as a means to an end—as science pure or applied.

The ultimate object of geology is to decipher the complete life-history of our planet. The biologist at his microscope succeeds by patient watching in tracing the entire existence of some minute organism. Often the most surprising metamorphoses of form and function are observed, and more than one generation may be necessary to complete the cycle of changes. Through phases far more varied and through conditions infinitely more complex, we may follow the story of "world-life." The globe, like the organism, is developing according to some inherent law of its own; while among its countless fellow-occupants of space it is hardly more than the single insect amid the myriads which compose its swarm.

* Portion of an address delivered at the commencement exercises of the Worcester Polytechnic Institute, June, 1888.

But the history written in the rocks is long and difficult to read. Here, the record is scanty; there, lost, or, worse still, misleading. Only by the most minute and careful tracing out of every clew can we hope to read aright the glorious tale. A thousand earnest students are collecting observations and comparing their results. Astronomy, physics, chemistry, mineralogy, and biology are all contributing to the sum of what old Mother Earth herself can tell us of her history.

If such a task as this is worthy to arrest the attention and excite the interest of all intelligent men and women, then I may feel justified in speaking of some of the *modern aspects of geology.*

If we would understand the true significance of the present outlook in geological science, we must take at least a glance at its past history.

Ages before it became a science, geology itself existed. The germs of an interest in the history of the earth are as old as man's own questionings about the origin of himself and his surroundings. In the religions of all ancient peoples are cosmogonies and theories of the world innumerable; and fanciful as these are, they still bear witness to an appreciation of the mysterious in nature amounting even to a worship.

With the advent of Christianity and the acceptance of the Bible, geology became a burning question which has hardly ceased to smolder, even in our day. The Mosaic account of the creation and the true meaning of fossil remains were eagerly discussed by the early Church fathers and by the keenest minds of the Renaissance. Tertullian, Leonardo da Vinci, and Voltaire alike exhausted upon them their sharpest wit and their profoundest wisdom. No assertion could be too absurd to secure a following, provided it accorded with the six creative days. One supposed that the shells imbedded in the rocks on mountain-summits owed their existence to a certain "plastic force" inherent in matter; another imagined them produced by the influence of the sun or stars. Still others were so blasphemous in their mad defense of Scripture as to assert that fossils were only the waste *débris* formed in earlier and unsuccessful attempts of the Deity to create a world. And, lastly, Voltaire, in bitter irony, maintained that in his opinion the fossils of the mountains were merely shells dropped from the pilgrims' hats as they journeyed homeward from the Holy Land! The decrees of religious dogma as to what interpretation was to be placed upon facts which the rocks disclosed, were as stern and implacable as those placed by the Church on Galileo; but still more stern and implacable were the facts themselves. For centuries the fierce war raged on one battle-field after another, and from each, Dogma sullenly retired, leaving the victory to Truth. This fascinating phase of the history of geology

has been made the subject of a series of recent papers by President Andrew White. It does not, however, concern us further than to show that, although such violent opposition certainly retarded the early and free development of geology, it was nevertheless not unfavorable to its ultimate success. The wide-spread partisanship excited by theological discussions only disseminated a broader knowledge of the subject, and hence a greater interest in it, so soon as the hindrances to its cultivation were finally removed.

But it is to neither religious persecution nor to religious zeal that we owe our modern science of geology. Dogma and discussion might have been extended indefinitely without approaching one whit nearer to the truth. Observation, not theory, was the one thing needful. While the doctors were deciding whether or not shells could have been strewn over mountain-tops by the waves of Noah's deluge, the "practical men" of the earth were busy in exploring its crust for hidden wealth. Some accurate means of comparing and classifying the strata was to them a matter of necessity, and it need not surprise us to find that the first real geologists were not professors, but "practical" miners; that the earliest germination of a truly scientific study of the earth was not in the university, but in the technical school.

At that remarkable period, about one hundred years ago, when not merely the sciences, but Science herself in the modern sense, sprang into life, geology was doubly prepared to receive the benefit of the great awakening. As she gradually developed from a creed into a science, there was twofold interest in her welfare: the first, theoretical, or, as we may more properly say, theological, since it amounted to a religious fanaticism; the second, practical, and brought about by the growth of mining industries and the search for wealth.

During the past century of geological activity the objective points of these two ideas have been in succession more or less cultivated. Among the theologians the question at issue related to the fossils; among the miners, on the other hand, to the rocks.

Originating, as the systematic study of the earth's crust did, in the mining schools, it is not strange that the latter first received the serious attention of scientific men. The rocks were the earliest objects of investigation, and *petrography*, or the science of rocks, was, naturally enough, the starting-point in geology. But as a science, petrography was, at the outset, a failure, though not on account of any lack of appreciation or patience on the part of its cultivators. Mineralogy throve, but no means could be discovered of applying her methods to the finer-grained rocks, and so the interest in petrography necessarily declined. After repeated

trials, resulting only in disappointment, the students of rocks followed the example of the theologians; and, in lieu of observations and facts, produced only the useless and often virulent polemics of the Neptunist and Vulcanist.

Again, there was a reaction against such waste of energy. Geologists, wearied by more barren controversy, turned eagerly to some new field where observation should be less difficult. They had opened the great book of Nature and had first tried to read the text; but the hieroglyphics were obscure, and the clew could not be found. Is it strange, therefore, that they should have gladly left this hard and unintelligible writing for the picture-book which Nature spread before them in the fossils? Here at least was something tangible. None now doubted that these fossils had once been living organisms which could be understood by careful comparison with living forms.

It was through the study of fossil organisms—or paleontology—that geology first accomplished its true aim, viz., the deciphering of a portion of the earth's history by observed facts. We can hardly wonder that a field so fruitful should, since the beginning of our century, have been cultivated to the exclusion of almost every other. But paleontology is essentially a biological, not a geological science. Its service to the sum of human knowledge can scarcely be overestimated, for it has done much in establishing the greatest generalization of this or perhaps of any century—the doctrine of evolution. Nevertheless, its contributions must ever be to the history of life on the globe, rather than to the history of the life of the globe.

So strong has been the growth of the organic side of our science that a popular idea still prevails that there is no geology aside from stratigraphy and the fossil-bearing rocks. The paleontological school is still in the ascendant, but it is no longer without a vigorous rival.

Within recent years there seems to have been infused into almost every domain of physical science a fresh life. Through gradually acquired generalizations higher points of view have been reached; old notions have been discarded for newer and broader ones. Prof. Langley tells us of the "new astronomy"; the doctrine of the conservation of energy has given us a new physics; evolution, a new biology; and the study of carbon compounds, a new chemistry. So, too, the application of the microscope to the study of rocks has given us a new geology.

The recent development in the science of the earth consists of the return to the work begun by its earliest pioneers. The old Petrographers were right. If we would know the life-history of our planet, we must learn the origin, structural relations, and composition of our rocks. We must discover the forces—chemi-

cal and physical—which work in and upon them, and we must see *how* they work.

As I have already said, the early geologists had full faith in the importance of their labors, but they were forced to abandon them by a lack of methods and appliances suitable to cope with the difficulties presented. To-day this importance is not diminished, but rather increased, by what has been accomplished along other lines. If we can renew the attack upon the old questions with improved weapons, the rewards of victory are as promising as ever. It is believed that such weapons are now in our hands, and the hope of success is almost daily attracting fresh and earnest workers to the ranks from every land.

The first and strongest impetus to a renewed study of the rocks themselves was given by the successful application of the microscope to this end; but this most valuable acquisition has by no means remained alone in the rapid growth of modern petrography. Other appliances, scarcely less useful in rock-study, followed quickly in its wake. Microchemical analysis, the separating funnel, and, most of all, the furnace, in which has been accomplished the perfect synthesis of many rocks, have all contributed, along with the microscope, to make the methods of petrography not inferior in delicacy and accuracy to those of any other science.

The greatest difficulty with which the older geologists had to contend, in their studies of the rocks, was their inability to identify the constituent minerals which composed them. Their disappointment and vexation are still curiously recorded in some of our oldest rock-names, like "*dolerite*," deceptive; and "*aphanite*," not apparent or distinguishable. With the successful application of the microscope to rock-study, this difficulty at once disappeared, and at the same time new and unexpected problems of the greatest interest unfolded themselves in quick succession.

In the light of all that had been done with the aid of the microscope in the organic sciences, it may at first seem strange that its application to geology was so long delayed. This was due to the imaginary difficulties in preparing transparent rock-sections, and to the fact that rock powders had been examined microscopically at an early date with absolutely no result.

In spite of certain sporadic efforts in this direction, it was not until the year 1858 that the clew to the solution of the difficulty was hit upon by Henry Clifton Serby, a wealthy manufacturer of Sheffield, England, who as a pastime succeeded in making transparent rock-sections. These he examined with the microscope with good results, but the matter would hardly have received serious attention by scientific men had he not, almost by accident, transplanted his idea to Germany. In this congenial

soil it readily took root and flourished like a vigorous tree, bearing rich fruit and sending its seeds into every land upon the earth where knowledge is sought for.

At first progress was necessarily slow, mistakes were frequent, and a general interest in the subject was almost lacking. But as one point after another was gained, and as a deeper insight into the problems presented was secured, the number of workers steadily increased. The patient labors of such pioneers as Zirkel, Vogelsang, and Rosenbusch can never be forgotten by those who can now avail themselves of their years of toil in a few months.

Interesting and surprising results were secured at the outset by the new science, but they were mineralogical rather than geological in their bearing. It is only now, after thirty years of preparation, that the time is fully ripe for the application of the new petrography to some of the deepest questions of theoretical geology. This it is which affords almost the only hopeful means of dealing with the records of the crystalline strata of the earth, which undoubtedly contain the longest, as they do by far the darkest, chapter of its history. What paleontology has already done and is still doing for the more superficial strata in which organic remains are preserved, the microscope must do for the crystalline rocks, whether volcanic, plutonic, or metamorphic. These contain their own life-histories, written in characters which need only to be carefully studied in order to be properly interpreted.

The purely mineralogical services of the microscope need not here concern us, but it may be pertinent to inquire, What specific classes of facts has this instrument disclosed and what new ideas has it suggested that entitle it to so high a consideration by those who are interested with the broader problems of the earth's history? To this inquiry we may answer:

1. The microscope has shed light into darkness; and, by its promise of results, has stimulated an enthusiastic cultivation of a most important but hitherto neglected field.

2. It has shown us that the internal structure of the commonest pebble is not less admirable, delicate, and exquisitely beautiful than that of a living organism.

3. It has already thrown much light upon the origin of many of the crystalline rocks—both massive and schists—by allowing us to judge of the conditions under which they must have been formed.

4. Most wonderful of all, it has taught us that the components of the "everlasting hills" are not mere masses of dull, unchangeable, inert matter, but that, in so far as constant change of form and composition to accord with altered conditions is a sign of life, they live.

Any single one of the four points which I have here enumer-

ated is enough to assure a lively interest in modern petrography, not merely on the part of geologists, but on the part of all intelligent persons who love to study the "wonderful wisdom and power of God as shown in his works." Together they promise far more for the future than has been fulfilled in the past.

We can not pause long enough to consider each of these four points in succession, but it will be worth our while to glance for a few moments at the last.

It is a question how far the popularly received distinction between dead and living matter can be made amenable to strict definition as long as we know so little of what the so-called "life-force" is. As far as we can judge of the phenomena presented by the organic and mineral worlds, they differ rather in degree than in kind. This seems like a bold statement, and I am fully aware that it would be totally unwarranted except for the recent disclosures of the microscope in geology.

The chemistry of life is the chemistry of carbon; the chemistry of the rocks is the chemistry of silicon. Both are closely allied elements, with the property of forming extremely complex compounds, which become more or less unstable with a variation of external conditions. We are accustomed to regard unceasing change as a sign of life, and to look upon the rocks as unchanging, and therefore dead. But the microscope shows that this is a false conception. Not only do the component minerals assume a form as directly inherent in their nature as that of a plant; but, if the surrounding conditions become unfavorable, they change to other forms, and leave written in the rocks the records of their often complicated histories. The only difference seems to be in the relative slowness of the action. I say "seems to be," because I am by no means convinced of the absolute identity of the two processes.

In his recent annual address, the well-known President of the Geological Society of London, Prof. John W. Judd, has attempted to throw aside entirely the distinction between crystallized and living matter, and to bring the phenomena of change observed by the microscopist in rocks within the limits of such definitions of life as those of Lewes and Spencer. While we may be unwilling to follow him to this extent, we can but confess that the analogy to vital terms and processes recently used with so much power by Prof. Drummond in quite a different sphere is also capable of a valuable application in illustrating some of the modern aspects of geology. We may speak of the embryology of a mineral, of its histology, morphology, physiology, vitality, and suitability to its environment, designating by these terms phenomena which are at least analogous to those which they represent in biology.

We encounter, in thin sections of both volcanic and metamorphic rocks, microscopic crystals arrested in every stage of their growth, and it is *not* true that these earlier forms are mere epitomes of the perfected individual. We have the fundamental globulite and the complicated and fantastic "growth-forms," which are as different from the finished crystal as is the larva from the butterfly. Thus, to one familiar with such facts as these, there can be no confusion in speaking of the "embryology of a crystal." We think with wonder of the marvelous vitality of seeds which sprouted after three thousand years spent in Egyptian pyramids, and yet the "vitality" of a crystal is such that it will continue its growth under favorable conditions after any number of thousands of years of interruption.

There is, however, nothing among the recent disclosures of the microscope in regard to rocks so surprising as their delicate adjustment to their environment. We are accustomed to look upon the masses of our mountains as the very type of what is stationary and eternal; but in reality they are vast chemical laboratories full of activity and constant change. With every alteration of external conditions or environment, what was a state of stable equilibrium for atoms or molecules ceases to be so. Old unions are ever being broken down and new ones formed. Life in our planet, like life in ourselves, rests fundamentally on chemical action. The vital fluid circulates unceasingly through the arteries of the oceans and the currents of the air; it penetrates the rocks through the finest fissures and invisible cracks, as the human blood penetrates the tissues between artery and vein, producing, with the help of heat and pressure, like changes in the histology of the globe. The recurrence, after a long interval, of the same set of conditions in the same rock-mass, may bring about the unending cycle—analogous to succeeding generations—which Hutton, the earliest of the Scotch geologists, recognized a hundred years ago.

Such processes as these, which properly represent the physiology of our earth's crust, have long been suspected, but their exact nature and details are only now being gradually disclosed by microscopical studies of the rocks.

Suppose, for instance, that a lava-stream bursts from the side of some volcano. As it flows onward, quickly solidifying and crystallizing under circumstances of intense heat, chemical compounds are produced which accord with such conditions, but perhaps not with those ordinarily obtaining at the earth's surface. If this is the case, the hardened lava will be in a chemically unstable state, and will tend in turn to adapt itself to its new surroundings by chemical change.

Countless examples of this adaptability of rocks to their envi-

ronment are familiar to every geologist who has availed himself of the newest and most potent aid in his profession. There is nothing hypothetical about them, for the minerals have written their own "life-histories" in characters which can not be misread. They throw a flood of light upon many types of rocks whose origin and nature have heretofore remained an unsolved riddle; and they open up a vista of possibilities to the future explorer whose length and whose attractiveness can hardly be exaggerated.

Let me quote, in closing this brief survey of a new field in geology, a single passage from Prof. Judd:

"In the profound laboratories of our earth's crust," he says, "slow physical and chemical operations, resulting from the interaction between the crystal, with its wonderful molecular structure, and the external agencies which environ it, have given rise to new structures, too minute, it may be, to be traced by our microscopes, but capable of so playing with the light-waves as to startle us with new beauties, and to add another to

> 'The fairy tales of science,
> And the long results of time.'

"Yes! minerals have a *life-history*, one which is in part determined by their original constitution, and in part by the long series of slowly varying conditions to which they have since been subjected. . . . In spite of the limitations placed upon us by our brief existence on the globe, it is ours to follow, in all its complicated sequence this procession of events; to discover the delicate organization in which they originate; to determine the varied conditions by which they have been controlled; and to assign to each of them the part which it has played in the wonderful history of our globe during the countless ages of the past.

"Mineralogy has been justly styled the alphabet of petrology; but if the orthography and etymology of the language of rocks lie in the province of the mineralogist, its syntax and prosody belong to the realm of the geologist. In that language, of which the letters are minerals and the words are rock-types, I am persuaded that there is written for us the whole story of terrestrial evolution."

Concluding its review of the report of the Krakatoa Committee of the Royal Society, "Nature" calls attention to the fact that the study of the sequelæ of the great explosion "has not merely enlarged our conceptions of volcanic powers and the continuity of atmospheric circulation, as well as yielded positive information of great value to different branches of science, but has opened up fresh problems in optical and meteorological physics, the attack and solution of which will stimulate research as well as materially advance the boundaries of our present knowledge of these subjects."

ANIMAL LIFE IN THE GULF STREAM.

By RALPH S. TARR.

IN the Gulf Stream, near the surface, animal life is extremely abundant, both young and adult finding the warm waters of the current peculiarly adapted for life and rapid growth. Cuttle-fish swim about, chased by sword-fish, dolphins, and sharks. Attracted by the glare of the electric lights in the evening, large schools sport around the United States Fish Commission steamer Albatross, swimming backward and forward with equal facility, leaping out of water and ejecting their black, inky fluid whenever surprised. Many devices were tried for the capture of one of these quick-motioned creatures, but we failed to secure any until an ingenious sailor rigged a peculiar spear, which, when properly used, would bring the cuttle-fish on board. This curious animal, classed by naturalists among the mollusks, or shell-fish, has so little resemblance to its relatives, oysters and clams, that an average observer would be far more likely to place it among the true fishes. It has large, prominent eyes, and its mouth is armed with a horny beak, very much like a parrot's bill. With this it undoubtedly proves itself a dangerous enemy to many marine animals. Forward motion is obtained by a fin-like tail, while it moves backward by suddenly forcing water out of a bag having its opening near the creature's mouth. Ten arms or feelers, with their inner surfaces lined with suckers, are arranged about the mouth. Although it seldom grows over a foot long, an embrace from its arms is painful. How much more so must it be in the case of the large octopus, or devil-fish, of the North, which is often forty feet in length, measured from the tips of the two long arms! In this latter animal the suckers are sometimes two inches in diameter, and, when worked by the powerful muscles, painful wounds can be produced. From earliest times fabulous accounts of a creature like this have been circulated,

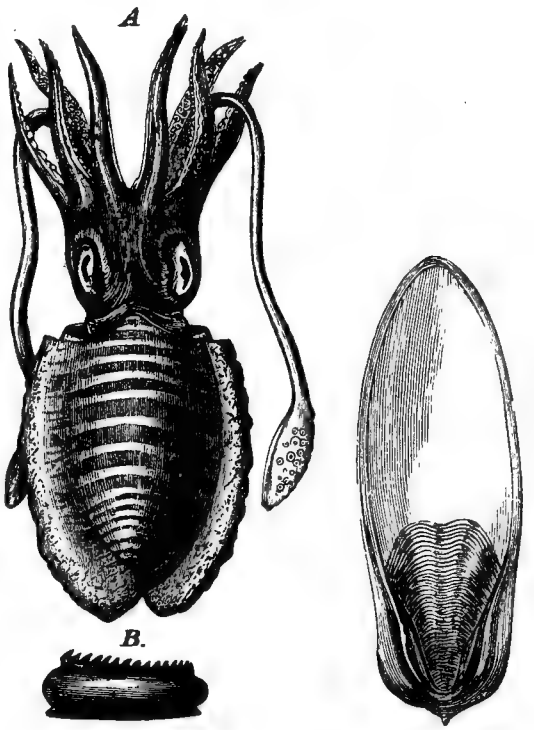

FIG. 1.—CUTTLE-FISH (*Sepia officinalis*) AND SHELL.

but it was not until 1870 that this animal was accurately studied and described by responsible persons. Previous to that time it was regarded with the same skepticism that the sea-serpent now

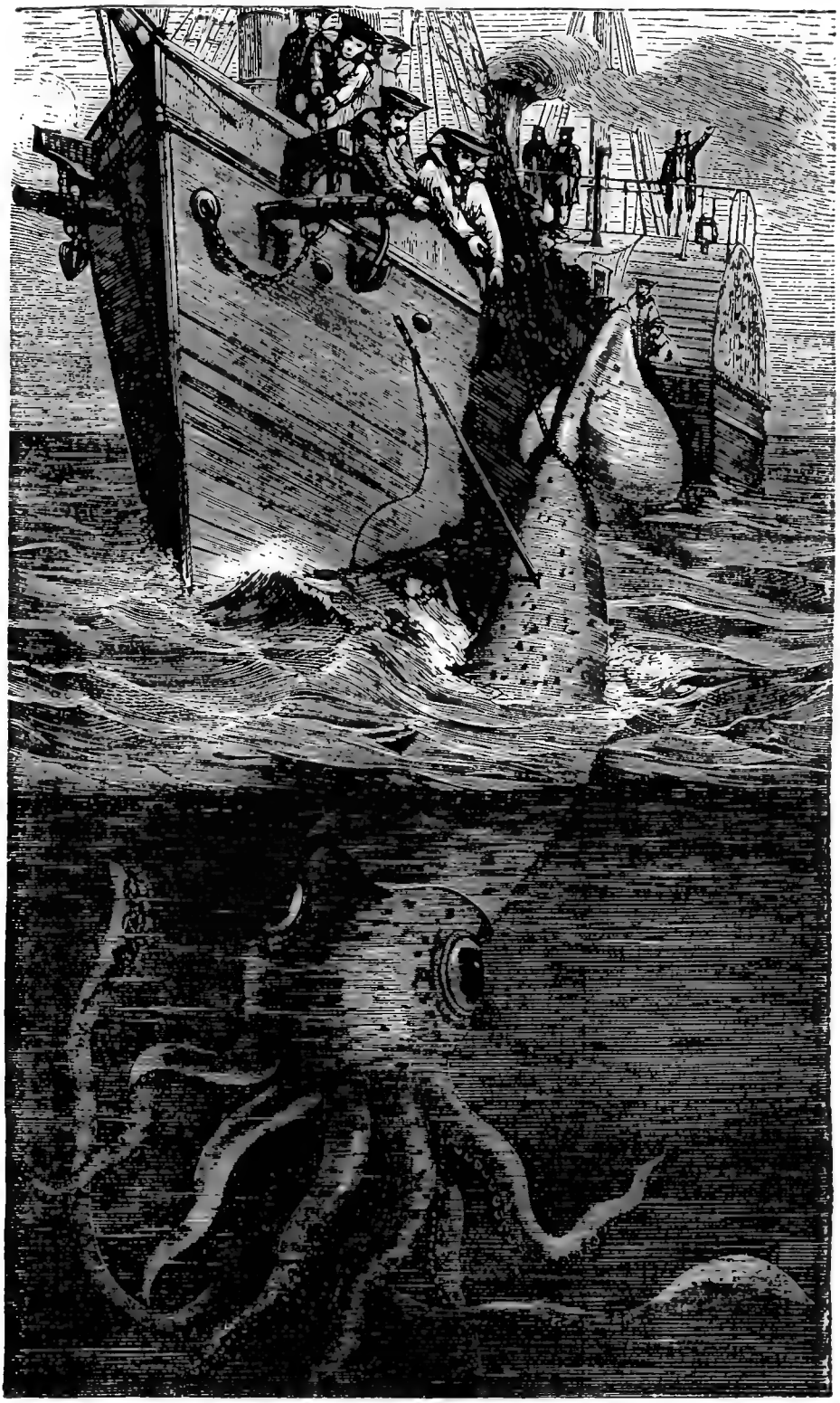

FIG. 2.—CAPTURE OF A GIANT SQUID.

is by many. However, naturalists are beginning to look upon the sea-serpent theory with more favor, while a few are active

supporters of the belief that the sea is still possessed of some descendants of the enormous fish-like reptiles which inhabited it in early geological periods. A fair picture but poor description of an octopus is given by Victor Hugo in his "Toilers of the Sea." He, in the course of his description, becomes very much confused, mixing devil-fish with polyp, and describing an animal possessed of habits belonging to each of these two widely separated groups. The confusion apparently arises from the fact that a common name for the octopus is *poulp*, but this etymological resemblance to the polyp, or sea-anemone, is the only one. He also confounds the name *Cephalopoda* with *Cephaloptera*, a gigantic ray or skate, also called devil-fish, and this causes new confusion in the description. There are gigantic octopi in the Southern waters, and these furnish food for the toothed sperm whale. Our Northern devil-fish is not a true octopus, but a squid, for it has ten arms instead of eight.

A sword-fish captured during the voyage was found to have in its stomach over thirty eyes and twenty beaks of the small cuttle-fish, together with a few partly digested individuals. Sword-fishes and sharks are natural enemies, always fighting when they meet, and there are accounts of fierce and deadly encounters between them. An ugly sword-fish is a bad enemy to encounter, using its weapon, as it does, with such ease and force. One will often drive its sword through the bottom of a boat, and, if it succeeds in withdrawing it without breaking it off, the boat rapidly fills with water, and the occupants, driven into the sea, are savagely attacked and badly wounded by the furious fish. At times they are abundant on all sides, lying near the surface, with their dorsal fin projecting above.

A sailor speared a dolphin one day, much to our surprise, for they seldom came near enough to reach. For several days there had been a school around, probably attracted by the refuse thrown overboard, by the brilliant light at night, and by the cuttle-fish which kept near the vessel. They usually remained many feet below the surface, and, viewed through the deep azure-blue water of the Gulf Stream, the different colors of their bodies reflected in the sunlight, and again in the electric light, were beautiful in an extreme degree. At last one, coming too near the surface, received a fatal wound, and was successfully brought on deck. I had often heard of the changing colors of a dying dolphin, and now I was to witness them for the first time. No one can exaggerate the weird beauty of the sight as the fish in its last struggles changes through all its various hues. One can see the colors disappear, to be followed by others. Beginning with the head, they seem to sweep as a wave over the body. Blue gives place to white, then a light yellow, which in turn changes to a

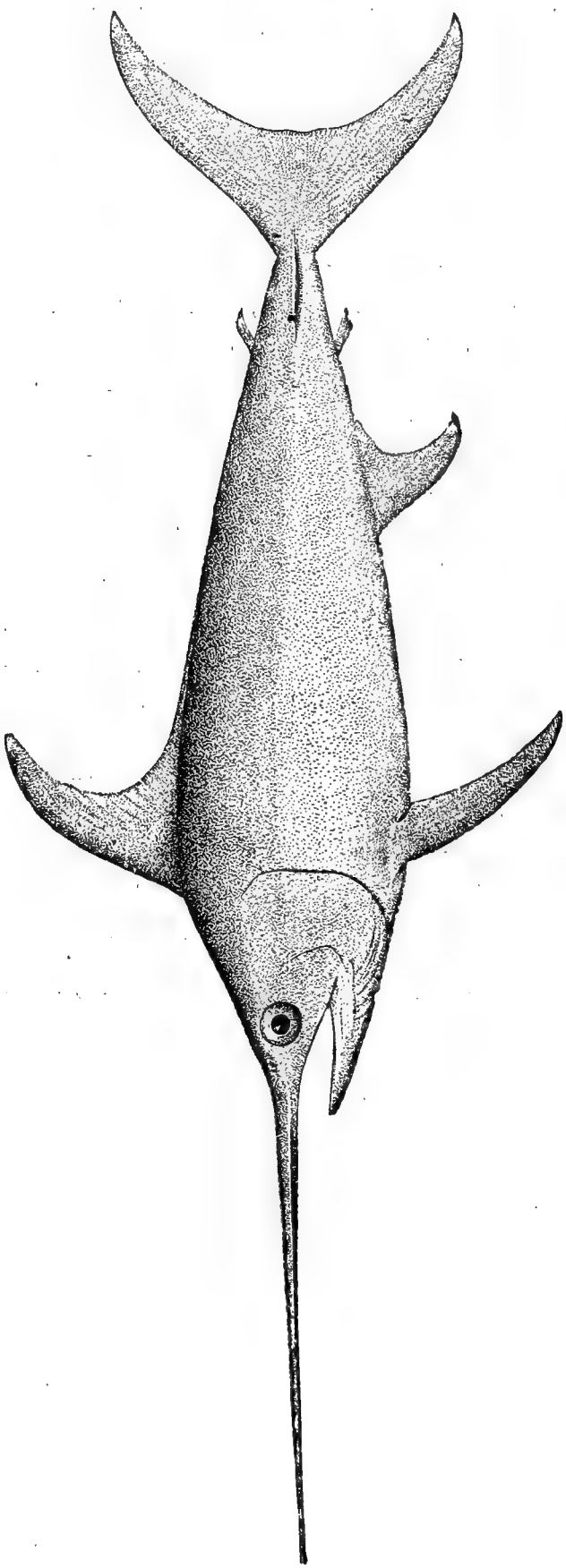

FIG. 3.—THE SWORD-FISH (*Xiphias gladius*).

golden, and following this a copper-colored tint; and so on through all conceivable hues, until finally, the end having come, change is interrupted in its course, and two tints are left in possession of the body — one in the act of disappearing, the other about to spread itself over the surface. That portion exposed to sunlight changes more rapidly, while the under side is less gorgeous. Here we see a peculiar property possessed by many animals widely separated in the scale of life—that of changing color at will, either to suit the surrounding shade, as illustrated in the chameleon and dolphin, or to attract certain kinds of prey, as seen in many of the lower marine animals — which becomes so much a habit in the case under consideration that, even when death is at hand, the changes are all passed through involuntarily.

Stormy petrels, or Mother Carey's chickens, as they are more commonly called, follow the outbound vessel in large flocks, gathering about as soon as land is lost to view, and remaining until the shore is once more sighted, unless a violent storm drives them

away. For the most part they feed upon refuse thrown overboard, but are never fat and always hungry, due undoubtedly to the fact that they are almost continually upon the wing, seldom being

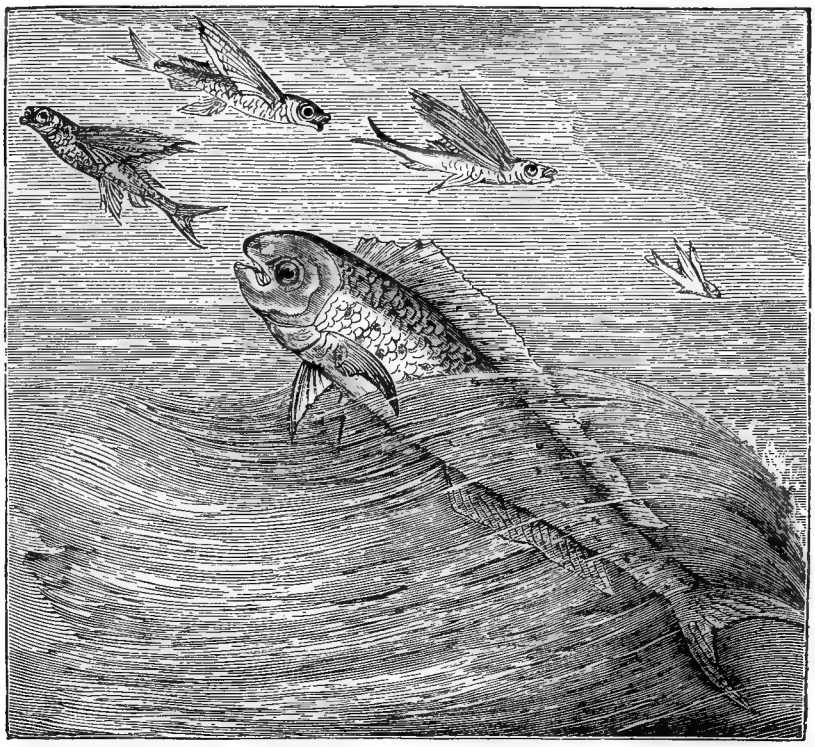

FIG. 4.—FLYING-FISH (*Exocœtus*) PURSUED BY THE DOLPHIN.

seen resting. Hovering over the food in a peculiar manner, by patting the water with its webbed feet and quickly flapping its wings, it appears to stand on the water, and, following the food as it is drifted about, to walk along. Sailors regard it with great superstition, and believe that some calamity will follow the wanton killing of this bird. They seem to have no fear of man, for they constantly flew near and aboard the vessel. Attracted by the lights, many flew aboard at night, and, striking the house, fell senseless to the deck. These birds must have a very short and irregular breeding period, for they are found several hundred miles from land, at all seasons of the year. They probably go in flocks, at different times, to their favorite breeding-place, and after a short period, having raised one brood, they return.

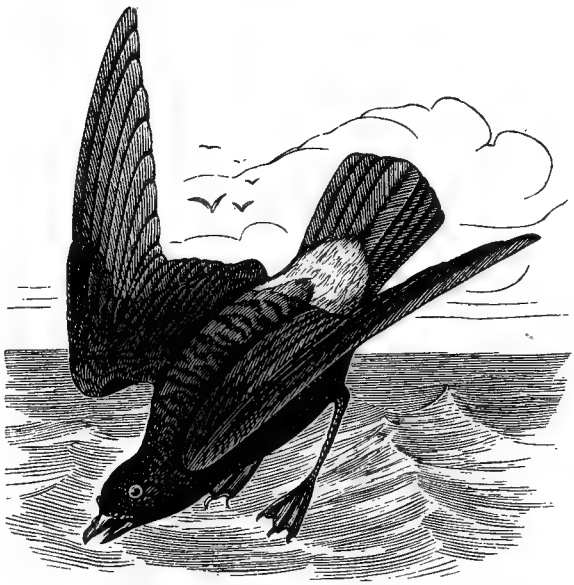

FIG. 5.—STORMY PETREL (*Thalassidroma pelagica*).

Physalia, the Portuguese man-of-war, with its beautiful blue float, may at times be seen on all sides. The float, filled with air, serves to keep the animal on the surface, and, driven by the wind, to bear it from place to place. It is a curious animal, or rather cluster of animals we should say, for naturalists now consider it to be a group of individuals, having different functions, but working for the same general cause—that of supporting the mass. They say that in this group there are some whose sole purpose is to obtain food, some to digest, others to reproduce, etc., yet each is an individual animal working for the good of the whole, that the whole may work for its good, and that in conjunction they may perform all the functions of life necessary to the well-being and general welfare of the whole united colony. The cluster has most remarkable defensive powers, being well furnished with lasso cells or stinging organs. These consist of little barbed, arrow-like points, fastened to thread-like arms, each of which is coiled up in a little cell. Whenever it is necessary to use them they are hurled out with violence, and each barb, striking the object, penetrates, for it has the power of "working into" flesh, and, being covered with a sort of poison, it in conjunction with many others benumbs the prey and renders it harmless. That the *Physalia* possesses this property to a marked degree, some of the sailors of the Albatross can testify, for they incautiously placed their hands in a tub of water containing one, and the shock they received was compared in violence to a strong shock from a Leyden jar. Sea-anemones possess this same property, although the common shore species can affect only very tender animals. I have seen a deep-sea anemone, six inches in length, by this means kill and afterward swallow a lively fish a foot long, that was placed in the aquarium with it. The fish barely touched the anemone, then seemed incapable of moving farther, and after a few struggles became paralyzed. These arrow-points possess the power of motion for several hours after being detached from the animal. Lasso cells can be replaced when lost, and in a very short time. On a square foot there are millions of cells. It is a curious fact that all well-defended animals

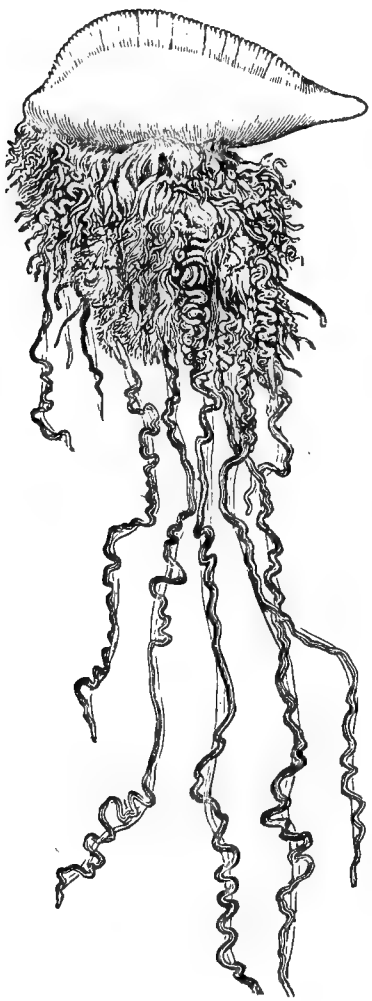

FIG. 6.—PORTUGUESE MAN-OF-WAR (*Physalia arethusa*).

—I speak with particular reference to the lower marine animals—are usually brilliantly colored. This can be seen in the case of sea-anemones, tropical shells, and crabs. Those with little or no defense are inconspicuous and resemble surrounding objects. The reason for all this is plain, for if inconspicuous they easily escape the notice of their enemies. Brilliant, well-defended animals have little fear of enemies, but by their bright colors will attract curious animals within reach of their deadly powers.

Like the *Physalia* in general structure, and in the fact that they possess stinging cells, are the jelly-fishes, which are present in the Gulf Stream in a great abundance of forms. There are

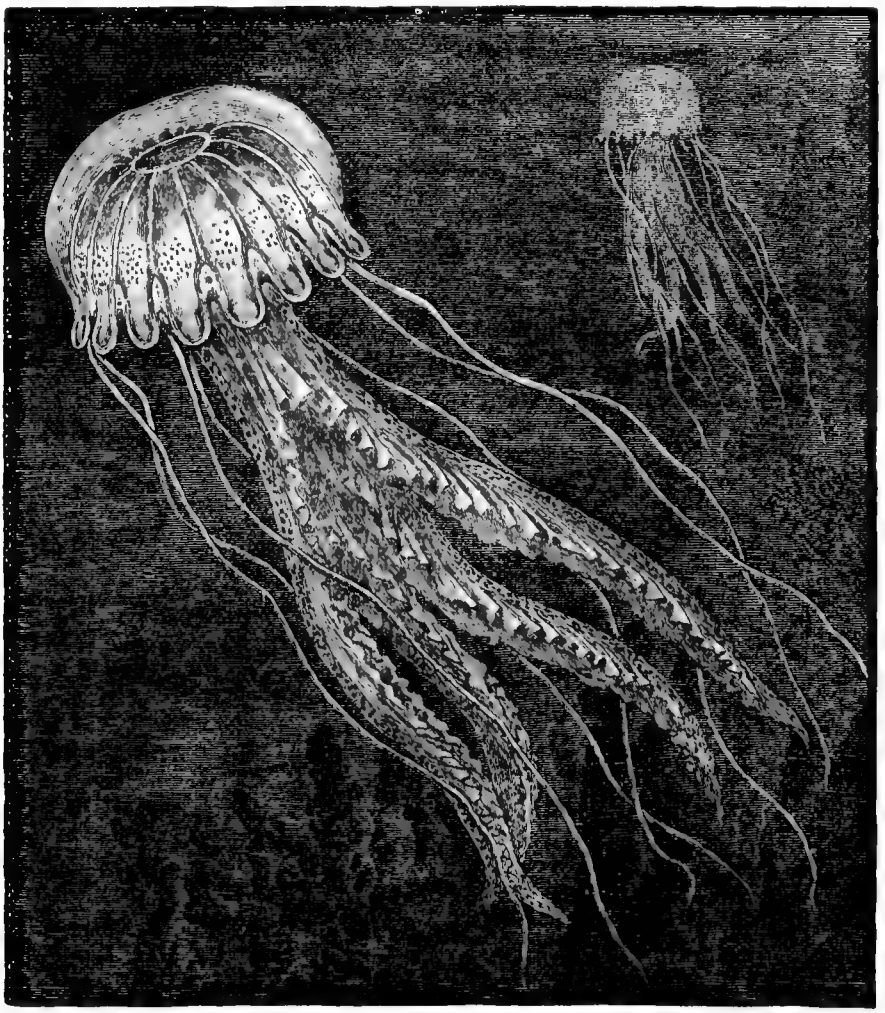

FIG. 7.—A JELLY-FISH SWIMMING.

bell-shaped, tubular, spherical, discoidal, and many other forms, most being transparent, but some very brilliantly colored. One of the disk-like forms is colored with deep purple and orange bands radiating from the center, while from the entire circumference hang many transparent tentacles. The mouth of most jelly-fishes is beneath, in the center of the bell, and is surrounded by tentacles which procure food. These are also furnished with stinging cells by which the food is killed. Their modes of repro-

duction are curious. In some a portion of the body of the parent begins to grow out, and this continues until a perfect bud-like protuberance is the result, and then the bud drops off and, after various interesting changes, becomes a fully formed jelly-fish. Sometimes the parent begins to divide, and actually splits into two parts, each of which becomes a perfect animal.

So great is the transparency of most jelly-fishes that they are scarcely visible; but at night, what a change takes place! When a school is passed, the water becomes suddenly transformed to a mass of liquid fire, composed of individual balls that together, on account of their great number, appear as one vast sheet of light. When they are disturbed, their brilliancy is increased. Far different from the jelly-fish in structure, but resembling it in its phosphorescence, is *Pyrosoma,* a colony of animals often found in these warm waters, which together form a fleshy mass, possessing no remarkable points by day, but at night becoming most brilliantly phosphorescent. In the mass, six inches in length, there are hundreds of separate animals, each like the others, all massed together in a common colony. They are very curious, for, while most of the young remain to help build the mother colony, some become entirely separate, and, after swimming about for a while, begin a new cluster that soon takes the form of the parent group. Each group has a regular shape just like the original one. The same is true of corals and most other clusters formed of more than one individual.

In our surface towings we find many beautiful animals, but none have impressed me so strongly as the so-called sea-butterflies. They are small, usually, and seldom found in abundance, and, being thus inconspicuous, are not likely to be seen by those not specially searching for them. Every color is found in these beautiful forms, and, as they float upon the surface, with their wing-like expansions spread out to catch the wind, but a small amount of imagination is needed to transform them into true butterflies accidentally fallen into the water. They have a very light and beautiful shell, with an air-chamber above to serve as a float, while from a lower compartment the wings are expanded. When startled, their sails are withdrawn into this chamber, and the oddly shaped shell is alone exposed to view. Sea-butterflies can, by arranging their sails so as to utilize the wind in the most effective manner, guide their course to a certain extent, just as the ship can proceed against a head wind. Their shells, which are often taken without the animal, present many very peculiar forms, from the nearly round to the long, sharply pointed ones, some with spines, others perfectly smooth; and we can see them in every conceivable color, the glassy, transparent kinds, the milk-white, and masses of the most brilliant colors, so confusing

and varied as to defy all comparison or description. These little animals, living in the water and moving from place to place, are as perfect and sea-worthy ships in miniature as the best modern vessels, and built upon as improved a pattern as our vessels which have been so long evolving. They have for centuries plowed the open seas in their vessels, never seeking port and never suffering disaster. With their air-float above, in addition to buoyancy, perfect stability is obtained. Their body below serves as ballast, and their membranous wings are good sails, that can be furled or hoisted at the animal's will. No masts to be carried away, no anchor needed, but perfect safety always. How well adapted for their surroundings—indeed, how well all Nature's creatures are adapted for their mode of life! How many ideas in modern architecture and engineering, but just discovered as the result of long study and experiment, have been in use for centuries untold among the lower animals which we are so wont to regard as unworthy of life! The ant, the bee, the spider, and hundreds of others are to-day using principles which man has yet to learn. The properties of the arch and dome, if not first learned from animals, might have been, much to man's advantage, long before he discovered them.

On very rare occasions the nautilus is found, and at times we also fall in with the *Argonauta,* or paper nautilus. They are both related to cuttle-fishes, differing from them in having shelly coverings and in some other more technical points. Each has a row of arms, with suckers around the mouth, and they move in the same manner as true cuttle-fishes do—by ejecting a quantity of water through a tube with such force as to drive the animal backward. The nautilus, as it grows, builds the shell larger to accommodate the growing body, building on the edge and continuing the spiral, and at the same time forming a partition across the rear. If a nautilus-shell is cut longitudinally, it will be found to be made up of a large anterior chamber, which the animal occupied just before it died, and behind a large number of chambers separated from each other by transverse partitions, and connected together only by a small circular hole that exists in each partition. When the nautilus is alive, a fleshy tube runs through all these chambers, passing through the holes, and forms the only connection between the animal and the rear chambers once inhabited by it. It is thought that by means of this tube the rear compartments can be filled with water or emptied at the animal's will, thus allowing it either to rise to the surface or to sink to any required depth. *Argonauta* is a pure white, ridged shell, thin and delicate, the animal being very much like the nautilus; but in this case the female alone has the covering, while the male is entirely without a shell. In many cases, among the lower forms of ani-

mal life, the male is unprotected, while the female is covered by some very perfect shell, or is otherwise well fitted for self-protection, all undoubtedly for the preservation of the young. The higher we ascend in the animal kingdom the more we see the opposite extreme, the male being the best fitted to defend, and hence assuming both its own protection and that of the weaker sex. Far back in remote geological periods animals resembling

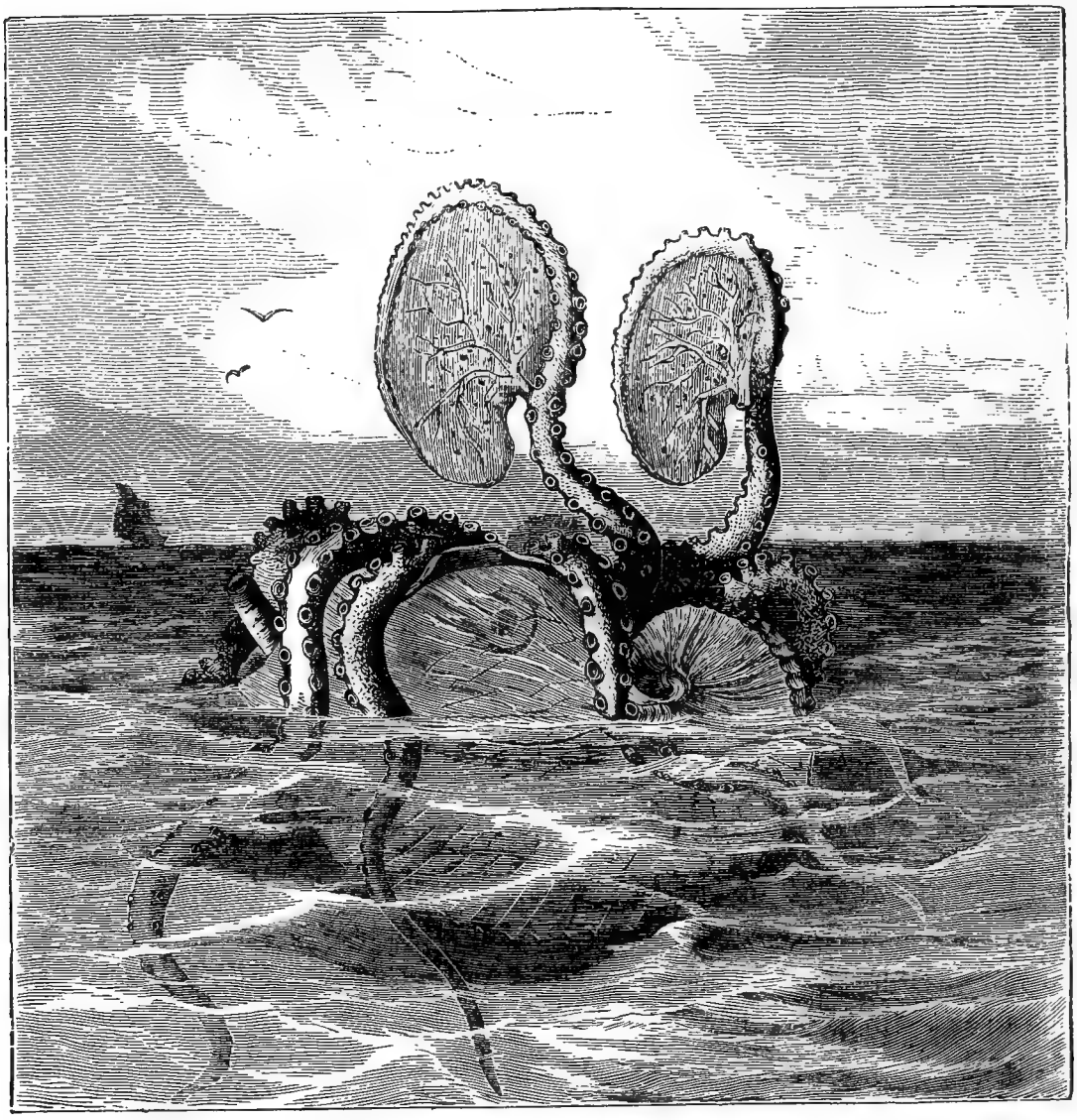

FIG. 8.—THE ARGONAUT.

the nautilus and *Argonauta* were extremely abundant, and also forms even more primitive than these; but to-day we have only a very few as representatives of this large group of fossil animals.

The surface-waters in the Gulf Stream teem with minute life of all kinds. There the young of larger animals exist, microscopic in size; and adult animals which never grow large enough to be plainly visible to the naked eye occur in immense quantities. By dragging a fine silk net behind the vessel, these minute forms are easily taken, and when placed in glass dishes millions uncount-

ed are seen swimming backward and forward. When looked at through a microscope we see young jelly-fishes, the young of barnacles, crabs, and shrimps, besides the adult microscopic species, which are very abundant. The toothless whale finds in these his only food. Rushing through the water, with mouth wide open, by means of his whalebone strainers the minute forms are separated from the water. Swallowing those obtained after a short period of straining, he repeats the operation. The abundance of this kind of life can be judged from the fact that nearly all kinds of whales exist exclusively upon these animals, most of them so small that they are not noticed on the surface. Prominent among the animals obtained from the surface towings is *Sapharina*, a small crustacean which is remarkably iridescent, flashing in the sunlight with metallic colors. It darts swiftly about, now green, now blue, and very conspicuous on account of its ever-changing hues. Another similar form is red. At all times, and in nearly all places, both in the Gulf Stream and in the warmer waters outside, there is an interesting transparent animal called *Salpa*. At first glance it would appear to be structureless, but, if carefully studied, a mouth, a stomach, and other organs will be found, which place it among the higher invertebrate animals. They swim around in large schools, but on account of their great transparency are scarcely visible. Whether or not they serve as food for other animals I do not know, but it seems that a meal made of them would be rather unsatisfactory on account of the great quantity of salt water that enters into their construction. They often have a curious blue parasite inside the body walls, and this is about the only visible sign of structure. Very few animals are free from parasites, and in the fishes they are numerous, burrowing into the gills, in the roof of the mouth, and all over the external portions of the body. On sharks we sometimes find them four inches long, an inch of which extends into the flesh. There is one called *Penella*, which is very long, and has a hairy tuft on the outer end. In most cases this parasite has attached to the external stem a species of barnacle, which itself has small parasites. Parasitic tendencies degenerate an animal, so that many of the once essential organs become useless and are lost. We see this well illustrated in *Penella*, which is an ally to the shrimp, but has so changed, by losing its feet and other organs, as to bear but little resemblance to these higher crustaceans. Degeneration is still

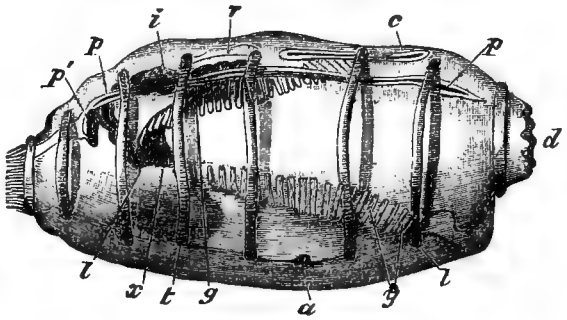

FIG. 9.—DOLIOLUM (AN ASCIDIAN ALLIED TO THE SALPA).

better illustrated by certain worm-like animals which live in the stomachs of sharks and other fishes. Being placed where food is ground up fine and all ready for assimilation, there is no need of a mouth, and but little need of a stomach, so both of these organs are lost, and all food is absorbed into the system through the outer walls of the body. Eyes are also lost, and the animal becomes a mere stomach; but, as for that matter, most animals are a mere stomach, with a few necessary organs to assist it. Some true fishes can be classed as parasites, while many use other animals as a means of attachment and protection. Under the dome of the true bell-shaped jelly-fish, a species of fish is generally found that is never taken under other conditions. It appears not to be affected by the stinging cells of the animal, but will stay near the mouth while the darts are exerting their deadly powers upon some brother-fish, and after this fish is dead will pick up enough for a meal from what the jelly-fish does not eat. What benefit this fish is to the jelly-fish it would be impossible to say, but in such cases some service is usually returned, such, for example, as that of warning the friend in case of danger. This habit of commensalism, or eating at the same table, is seen in other animals, as the oyster-crab, pilot-fish, and others. They seem to recognize their friends, and not only do not harm but even protect them. The oyster-crab could, if so inclined, devour the oyster without trouble, but it never offers to. Under such conditions certain apparently deadly powers have no effect, and these animals may even be entirely unharmed by digestive fluids. Fish are sometimes found in very odd places. One burrows into the side of a larger fish and stays there, as in a house, catching what food passes by. Another fastens itself on to the sides of a fish by means of a sucker, and, assuming a similar color to that of the larger one, is easily overlooked by its enemies. One of these, the lump-fish, is a very pretty green in color. There are certain fishes that always stay in the surf near shore, being able to remain there without being cast ashore, and never seeking quiet water.

Among the patches of sea-weed which float in the Gulf Stream there are numerous small fishes very prettily colored. One among these has a curious mode of defense, and because of this is called the file-fish. Normally folded down upon its back is a rather long spine. Whenever danger is apprehended, this spine suddenly springs upright, and is held there by a little bone behind it near the base and under the skin. If this bone is touched with a knife, it can be pressed down, and then the spine will fold back; but, unless the bone is removed, the spine will remain rigidly upright. The fish possesses the power of raising or lowering the spine at will. We sometimes see flying-fish jump out of the water and scale along the surface for many feet. Chased by their enemies,

they seek safety in the air, and, after darting as far as possible, will strike the water again and then dash off in another direction. They present a very odd appearance, skipping out of the water and passing through the air by means of their wing-like fins, and then again disappearing. While trying to escape their finny enemies they often fly right into the claws of an albatross or some other large sea-bird, jumping, so to speak, "from the frying-pan into the fire." A hard lot is theirs in this struggle for existence, eating smaller animals only to be themselves eaten. The panic which a shark will cause in a school of mackerel or menhaden, or a dolphin among flying-fish, can hardly be described. Another curious fish that we sometimes meet with is the *Hippocampus*, or sea-horse. These little creatures are most interesting to watch in an aquarium. They curl their tails about any object which will hold them in place, and then assume an upright position. With their peculiarly shaped head and large, intelligent eyes, an almost perfect miniature resemblance to a horse is plainly seen. There

FIG. 10.—SEA-HORSE (*Hippocampus brevirostris*).

FIG. 11.—GOOSE BARNACLES ON A BOTTLE.

it sits motionless, rolling its prominent eyes backward and forward until a small animal comes too near, when a sudden dive is made, which generally ends fatally to the intended prey, and then the same grave indifference is assumed. Altogether it reminds me of a toad watching for its food.

Floating around on all sides are numerous patches of gulf-weed filled with life of all kinds. Here good-sized crabs and shrimps flee for refuge from larger foes, and feed upon their more minute brethren also seeking safety under the floating weed. Here the goose barnacle is found in great numbers attached to everything that floats. This is the animal which is such an enemy to shipmasters sailing from tropical ports. Although the vessel's

bottom is scraped just before leaving port, young goose barnacles attach themselves in such numbers that, owing to their rapid growth, they seriously retard the ship's progress. There is no remedy but to sail on, letting them grow as fast as they will, and removing them when port is reached. Norwegian sailors believe that the barnacle goose hatches out of the goose barnacle, and many have asserted that they have seen the young just on the point of flying out. This belief probably arises from the peculiar scooping motion of the fringed feet of the barnacle while it is obtaining food. Even then a good imagination needs some stretching to be able to see a resemblance to a young bird. When a barnacle is young, it is free-swimming, and resembles a shrimp; but, as it grows older, it attaches itself to some object by a sort of cement, and becomes so changed that, unless its anatomy is carefully studied, no affinities to a shrimp would be imagined. Indeed, early naturalists considered it to be a shell-fish or mollusk. Odd as it may seem, many kinds of animals, at first possessed of free motion, voluntarily attach themselves to some object, and are from that moment imprisoned, having no power of moving from place to place.

Insects are seldom seen in a natural state far from land, but we find a few young forms a little nearer shore, and one of these, a fly larva (*Chironomus*), is more interesting than the others on account of its remarkable powers of endurance. Experiments were tried, and we found that it would live after being taken out of a vial of alcohol in which it had been kept several hours. Most animals, under similar conditions, will die in five minutes, and the most hardy in twenty. Different poisons were tried, and none were effective. Even caustic potash was resisted for nearly an hour. In the mean time the creature would swim around lively. Such hardiness is probably found in no other animal. In addition to these more interesting forms, there are hundreds of species each presenting some especial peculiarity which distinguishes it from the rest, and all have interesting habits and points of structure. The waters of the Gulf Stream gradually merge into those of the ocean on either side, and, while there are some peculiarly tropical forms which never go outside of the warm water, most are likely to be taken on either side in the colder waters, and there are many which are found both near shore and in the Gulf Stream. After long-continued southerly winds, tropical forms are at times cast on shore; and vessels passing through the Gulf Stream frequently bring into port, attached to their bottoms, crabs and shrimps which normally do not live in the inner region. The warm waters of this part of the ocean are very favorable to rapid growth, and the animals there are tropical. Washing the shores of Florida, the Gulf Stream serves to transport its

animals to Europe, and the many kinds which we have been considering are thus carried from place to place without their own guidance. Thus it is that the tropical faunæ of the two sides of the Atlantic so closely resemble each other. The Gulf Stream, then, serves not only to modify the climate of naturally cold regions, but also to distribute life equally on two different shores, which, without some such communication, would have animals as decidedly different as are those of Asia from American east coast species.

HUXLEY AND PASTEUR ON THE PREVENTION OF HYDROPHOBIA.

AT the call of the Lord Mayor, a meeting was held at the Mansion House, in London, on the 1st of July, to hear statements from men of science with regard to the recent increase of rabies in England and the efficacy of the treatment discovered by M. Pasteur for the prevention of hydrophobia. Among several letters that were read, the following, one from Prof. Huxley and the other from M. Pasteur himself, are of especial interest:

"MONTE GENERASO, SWITZERLAND, *June 25, 1889.*

"MY LORD MAYOR: I greatly regret my inability to be present at the meeting which is to be held under your lordship's auspices in reference to M. Pasteur and his institute. The unremitting labors of that eminent Frenchman during the last half-century have yielded rich harvests of new truths, and are models of exact and refined research. As such they deserve and have received all the honors which those who are the best judges of their purely scientific merits are able to bestow. But it so happens that these subtle and patient searchings out of the ways of the infinitely little—of that swarming life where the creature that measures one thousandth part of an inch is a giant—have also yielded results of supreme practical importance. The path of M. Pasteur's investigations is strewed with gifts of vast monetary value to the silk-trader, the brewer, and the wine merchant. And, this being so, it might well be a proper and a graceful act on the part of the representatives of trade and commerce in its greatest center to make some public recognition of M. Pasteur's services even if there were nothing further to be said about them. But there is much more to be said. M. Pasteur's direct and indirect contributions to our knowledge of the causes of diseased states, and of the means of preventing their occurrence, are not measurable by money values, but by those of healthy life and diminished suffering to men. Medicine, surgery, and hygiene have all been pow-

erfully affected by M. Pasteur's work, which has culminated in his method of treating hydrophobia. I can not conceive that any competently instructed person can consider M. Pasteur's labors in this direction without arriving at the conclusion that, if any man has earned the praise and honor of his fellows, he has. I find it no less difficult to imagine that our wealthy country should be other than ashamed to continue to allow its citizens to profit by the treatment freely given at the institute without contributing to its support. Opposition to the proposals which your lordship sanctions would be equally inconceivable if it arose out of nothing but the facts of the case thus presented. But the opposition which, as I see from the English papers, is threatened, has really for the most part nothing on earth to do either with M. Pasteur's merits or with the efficacy of his method of treating hydrophobia. It proceeds partly from the fanatics of *laissez faire*, who think it better to rot and die than to be kept whole and lively by state interference, partly from the blind opponents of properly conducted physiological experimentation, who prefer that men should suffer rather than rabbits or dogs, and partly from those who for other but not less powerful motives hate everything which contributes to prove the value of strictly scientific methods of inquiry in all those questions which affect the welfare of society. I sincerely trust that the good sense of the meeting over which your lordship will preside will preserve it from being influenced by these unworthy antagonisms, and that the just and benevolent enterprise you have undertaken may have a happy issue.

"I am, my Lord Mayor, your obedient servant,

"THOMAS H. HUXLEY.

"The Right Hon. the Lord Mayor, Mansion House, E. C."

The following letter from M. Pasteur, dated Paris, the 27th ult., was read by Sir H. Roscoe:

"DEAR COLLEAGUE AND FRIEND: I am obliged by your sending me a copy of the letter of invitation issued by the Lord Mayor for the meeting on July 1st. Its perusal has given me great pleasure. The questions relating to the prophylactic treatment for hydrophobia in persons who have been bitten and the steps which ought to be taken to stamp out the disease are discussed in a manner both exact and judicious. Seeing that hydrophobia has existed in England for a long time, and that medical science has failed to ward off the occurrence even of the premonitory symptoms, it is clear that the prophylactic method of treating this malady which I have discovered ought to be adopted in the case of every person bitten by a rabid animal. The treatment required by this method is painless during the whole of its course and not disagreeable. In the early days of the application of this method,

contradictions such as invariably take place with every new discovery were found to occur, and especially for the reason that it is not every bite by a rabid animal which gives rise to a fatal outburst of hydrophobia. Hence prejudiced people may pretend that all the successful cases of treatment were cases in which the natural contagion of the disease had not taken effect. This specious reasoning has gradually lost its force with the continually increasing number of persons treated. To-day, and speaking solely for the one anti-rabic laboratory of Paris, this total number exceeds 7,000, or exactly, up to the 31st of May, 1889, 6,950. Of these the total number of deaths was only seventy-one. It is only by palpable and willful misrepresentation that a number differing from the above, and differing by more than double, has been published by those who are systematic enemies of the method. In short, the general mortality applicable to the whole of the operations is one per cent, and if we subtract from the total number of deaths those of persons in whom the symptoms of hydrophobia appeared a few days after the treatment—that is to say, cases in which hydrophobia had burst out (often owing to delay in arrival) before the curative process was completed—the general mortality is reduced to 0·68 per cent. But let us for the present only consider the facts relating to the English subjects whom we have treated in Paris. Up to May 31, 1889, their total number was two hundred and fourteen. Of these there have been five unsuccessful cases after completion of the treatment and two more during treatment, or a total mortality of 3·2 per cent, or more properly 2·3 per cent. But the method of treatment has been continually undergoing improvement, so that in 1888 and 1889, on a total of sixty-four English persons bitten by mad dogs and treated in Paris, not a single case has succumbed, although among these sixty-four there were ten individuals bitten on the head and fifty-four bitten on the limbs, often to a very serious extent. I have already said that the Lord Mayor in his invitation has treated the subject in a judicious manner, from the double point of view of prophylaxis after the bite and of the extinction of the disease by administrative measures. It is also my own profound conviction that a rigorous observance of simple police regulations would altogether stamp out hydrophobia in a country like the British Isles. Why am I so confident of this? Because, in spite of an old-fashioned and wide-spread prejudice, to which even science has sometimes given a mistaken countenance, rabies is never spontaneous. It is caused, without a single exception, by the bite of an animal affected with the malady. It is needless to say that in the beginning there must have been a first case of hydrophobia. This is certain; but to try to solve this problem is to raise uselessly the question of the origin of life itself. It is sufficient for me here, in

order to prove the truth of my assertion, to remind you that neither in Norway, nor in Sweden, nor in Australia, does rabies exist; and yet nothing would be easier than to introduce this terrible disease into those countries by importing a few mad dogs. Let England, which has exterminated its wolves, make a vigorous effort and it will easily succeed in extirpating rabies. If firmly resolved to do so, your country may secure this great benefit in a few years; but, until that has been accomplished, and in the present state of science, it is absolutely necessary that all persons bitten by mad dogs should be compelled to undergo the anti-rabic treatment. Such, it seems, is a summary of the statement of the case by the Lord Mayor. The Pasteur Institute is profoundly touched by the movement in support of the meeting. The interest which his Royal Highness the Prince of Wales has evinced in the proposed manifestation is of itself enough to secure its success. Allow me, my dear colleague, to express my feelings of affectionate devotion."—*Nature.*

ORIGIN OF THE RIGHTS OF PROPERTY.

By HENRY J. PHILPOTT.

IN the joint enterprise of making a living, human beings not only potentiate but they also stimulate one another. The power and the stimulus are often combined, just as some foods furnish at the same time nutrition and stimulation to the human body. Sometimes we may distinguish between the two elements. It is so in the case of property. Wealth is power. Property is a stimulant. In order to make this distinction clear, we draw another. We must explain the difference in meaning between wealth and property. This will not be a hard task. Property is ownership, and wealth is the thing owned. Wealth is a thing, property a right to it. Wealth is mine and thine, property mineness and thineness. True, we often confuse the terms, and speak of the thing itself as property; especially do we speak of a body of real estate as a piece of property. This is justified by usage and by the dictionaries. For the present, however, I should like to confine the term to its original meaning. In this I shall follow Macleod, who says:

"When we understand the true meaning of the word property, it will throw a blaze of light over the whole science of economics, and clear up difficulties to which the word wealth has given rise; in fact, the meaning of the word property is the key to all economics.

"Most persons, when they hear the word property, think of

some material things, such as lands, houses, money, corn, cattle, etc. But that is not the true and original meaning of the word property.

"Property, in its true and original meaning, is not any material substance, but the absolute right to something."

It is in the same sense that the socialists use the word. When they demand the abolition of property they do not mean the abolition of lands, houses, etc. They are as anxious as anybody that wealth shall be increased. But they want it to be *ours*, not mine or thine. Wealth which belongs to the whole people is not property in the economic sense of the term. It is conceivable, though not practically ascertainable, that property might be totally abolished without any diminution of wealth. So property may be increased without any increase of wealth. There would be just as much land-surface on the earth if nobody owned a rood of it. There were as many negroes after as before the abolition of property in man. The abolition proclamation did not obliterate a single acre of land, a house, a shred of clothing, or a mouthful of food. But it did obliterate a vast amount of property; so does a commercial panic. "And yet," says Prof. Newcomb, using the panic of 1837 as an illustration, "if we look at the case from a common-sense point of view, we shall see that no wealth was destroyed. There were just as many suits of clothes in the country the day after the crisis as there were before, and they were just as well fitted for wearing. The mills and factories were all in as good order, the farms as fertile, and the crops as large after the supposed hurricane as before. The houses remained standing, the wood was in the wood-sheds ready for burning, and the food in the larder ready for cooking, just as it had been left. In a word, every appliance for the continued enjoyment of the fruits of labor remained as perfect as it ever was."

Prof. F. A. Walker, in calling attention to the distinction between wealth and property, says that "the neglect of this distinction has caused great confusion." But he soon dismisses the subject with the remark that "we might say that 'property' is not a word with which the political economist has anything to do. It is legal, not economical, in its significance." I can not concur in that opinion. I think the socialistic theory, which relates primarily to the institution of property, is an economic theory, as truly as monometalism, or free trade, or Malthusianism. The whole subject of distribution, to which Prof. Walker devotes a hundred pages, and which is certainly one of the most important in this or any other science, is a question of whose shall be the wealth produced; that is, it is a question of the distribution of property in the wealth, rather than of the wealth itself. Whether two fishermen jointly carve out a partnership boat, or whether one furnishes

the capital and the other the labor, the boat is not "distributed"; but the ownership of it is, and presumably according to economic principles. So there may often be distribution of property more or less than commensurate with the distribution of wealth; and it is the distribution of property which, in fact, most concerns the economist.

A great deal has been written about this subject of private property. The world is filling with people, and it is filling with good things which these people like and want. Shall the people as a body own the goods in a lump, or shall the ownership and enjoyment of the goods be divided among the human beings in proportion to the ability of each to get hold of them by hard work, or skillful work, or monopoly, or trickery, or any good or bad superiority which helps to constitute him one of the "fittest" and most likely to survive in such a contest? Shall even the planet itself, crowding with the less fit, be parceled out among these good and bad "fittest"? Can there be a more momentous question than this? Can there be one which more deeply concerns the economist as such? On the very day on which I write, four men are to hang for committing murder in answer to this question. The mere presence in the community of a considerable and clamorous element which denies the right of property has its grave economic effects, and hence is a matter of great moment to the economist. Hanging four men, or a hundred men, will not silence that element.

This, however, is not the only aspect of the question that concerns us, though most writers seem to have thought so. The orthodox have been content to prove, or perhaps only assert, that the right of property is the greatest of all the stimuli to labor and frugality, just as Proudhon, on the other hand, was content to show that property is robbery. If any distinction has been made as to the comparative validity of titles to different kinds of property, it has usually been thought sufficient to distinguish between owning the earth and owning its products. But it is not so simple a matter as this. Our great danger is not the theoretical denial of the right of property in general. We are daily called upon to defend it against attack in detail. Bastiat saw this half a century ago, when he was in the thick of the hottest battle that has ever raged about the citadel of property. And now that the contest has broken out in that quarter again, and under the inspiration of being interrupted in the midst of this very sentence by a bulletin announcing that the condemned anarchists have just been hanged, it would be easy to write a book from the following text, which is to be found in the eighth chapter of the "Harmonies of Economics":

"A mere theoretical war against property is by no means the

most virulent or the most dangerous. Since the beginning of the world there has existed a practical conspiracy against it which is not likely soon to cease. War, slavery. imposture, oppressive imposts, monopolies, privileges, commercial frauds, colonies, right to employment, right to credit, right to assistance, right to instruction, progressive taxation imposed in direct or inverse proportion to our power of bearing it, are so many battering-rams directed against the tottering edifice; and if the truth must come out, would you tell me whether there are many men in France, even among those who think themselves conservative, who do not, in one form or another, lend a hand to this work of destruction?"

In America, at the present time, this interminable war on the instinct and institution of private property has taken on all these forms, and many more, which will be treated of in their proper places. The four anarchists, who are at this moment hanging by their necks, were in the van of the procession. When we carefully study the relation of all these doctrines to the antiquated notion of a sacred and absolute right of private property, those who openly deny the right of property in land, as being itself a denial of property in the products of labor, are seen to be far toward the rear. To that study let us now devote our attention; and, in order that it may be a scientific and not a partisan study, we must not let private ownership be to us for the nonce either a fetich or a bugbear. We must analyze it dispassionately, as if it concerned us only as a matter of curiosity, though, in fact, our analysis will show that it is in all respects our chief concern. And we must not neglect to note the economic consequences of its being to us and to our fellow-beings a fetich on the one hand, or on the other a bugbear.

What is property? We have said it is not wealth; but that is not saying what it is. We have said it is ownership, but a synonym is not a definition. What constitutes ownership? What is the exact meaning of the words *mine* and *thine*, in the sense of ownership? There is none. Few words are more indefinite in their meaning. There are degrees of mineness and thineness. These apply respectively to different communities at different periods of their history, and to different subjects of property at the same period and in the same community. Thus there have been times and places in which the phrase "my wife" expressed a property relation. The phrase is still everywhere used, but not in the same sense of property. And yet it seems that among us a man has property in his wife's affections, for he has an action for damages against the man who "alienates" them. Yesterday I received a copy of an interesting paper, read before the American Water-Works Association, under the title "Is Water Property?" This question of what is and what is not ownership or property

is one with which the courts of Christendom are engaged in an interminable wrestle. Their anxiety shows that they regard the settlement of that question in any particular case as a great point gained one way or the other.

I have said that property is a right to something. It is rather, as Macleod says, "an aggregate or bundle of rights." This aggregate is not the same for all classes of property. Hence in order to define property we must classify it. Before attempting this, let us inquire how it comes about that there is such an institution existing among men. We can all feel, if we can not formulate, a definition which will suffice for this purpose. I do not exactly know the limits of my property-rights, nor which of the rights that I have to-day may be taken away from me to-morrow, but I am severely conscious of the fact that I am chiefly occupied in a struggle to make that mine to-morrow which is not mine to-day, and I want to know how I came to be engaged in this struggle; how the universe happens to be divided into the mine and the not-mine; and by what warrant the one is transmuted into the other?

I know of but one economist who introduces the science of political economy by founding it upon the right of property. The late Prof. J. M. Sturtevant begins his text-book of "Economics" in this wise:

"The science we are about to expound is the logical development and application to a special group of phenomena, of a single law of nature, as truly as physical astronomy is the logical development and application to the phenomena of the solar system, of the law of gravitation. The law of nature to which we refer may be thus enunciated:

"*Every man owns himself, and all which he produces by the voluntary exertion of his own powers.*

"Every science must assume something. Ours must assume that the idea of ownership is perfectly clear and intelligible to every one. It is a simple intuition, which originates in the spontaneous action of every human mind, and is therefore indefinable. It ranks in this respect with the idea of personality of moral obligation and of causation."

This statement of the case must be rejected. Property may be universal among human beings, though this is extremely doubtful. But certainly the idea is not clear and intelligible to every one. It would be nearer the truth to say that it is not yet clear to any one. Even the notion that every man owns himself is not universal. A great many human beings are still owned by masters, and millions more by their kings. The conscripted soldiers of Europe do not own themselves. They are owned by the state. And this ownership by the state, by a king, by a slaveholder, is

considered perfectly normal in the communities where it prevails. I have heard it preached from a Northern pulpit that denial to the Southern black of the right of property in himself was a divine institution. The assertion of that right, and of the idea which Prof. Sturtevant calls a "simple intuition, originating in the spontaneous action of every human mind," drove many of the stronger abolitionists into open rejection of the sacred writings of Christianity, which nowhere furnished them a text for their side of the argument. The poorest slave may own something, but he does not own himself.

Neither does every man, in any community, own all the products of his voluntary efforts. Wage-workers never do. They are increasing in proportionate numbers. Hence the second part of the assumed law of nature on which it is proposed to rest the whole science of political economy is less and less true every year, and the whole present progress of civilization is away from it. The belief that it *ought* to be true is the foundation of the creed of those anarchists who have just been hanged, and of those who mourn them. "Labor produces all the wealth, and labor ought to own it," is their familiar cry. Since few things are produced by the efforts of single-handed men; since, as I have shown in the second paper of this series, nearly all production is by combination—ownership of product by producers, if it is to be universal and complete, must also be in combination, or, as we say, in common. This is the straight read to communism, and the first guide-board on the way is this doctrine that property in anything springs certainly and exclusively from effort expended in its production. Yet it is a doctrine which has often been laid down by the most conservative economists and philosophers. Locke stated it two hundred years ago in these terms: "Whatsoever, then, he removes out of the state that Nature hath provided, and left it in, he hath mixed his labor with it, and joined to it something that is his own, and thereby makes it his property." McCulloch says,* "All have been impressed with the reasonableness of the maxim which teaches that the produce of a man's labor and the work of his hands are exclusively his own."

So Laveleye† says that "property in all the fruits of his work must be guaranteed to the worker." Bonamy Price‡ is equally emphatic: "I made it and it is mine, is a sentiment which asserts property in every human soul." Imagine the navvies who build a railroad saying this! And Herbert Spencer# even informs us that, "from the beginning, things identified as products of a man's

* "Principles of Political Economy," chap. ii, section 1.

† "Elements of Political Economy," chap. iii, section 9.

‡ "Practical Political Economy," chap. vi.

"Principles of Sociology," section 541.

own labor are recognized as his." On the island where Mr. Spencer lives, we might say that almost from the beginning the product, and part of the time both producer and product, have been recognized as belonging to the lord of the manor. At present the bulk of the products belong to the lords of the factories—the "captains of industry"—and nobody but the socialist fails to recognize both the fact and its propriety.

So in the first chapter of Dr. Chapin's recast of Wayland's "Political Economy" we find it stated, as the third of the fundamental principles of the science, that "the exertion of labor establishes a right of property in the fruits of labor, and the idea of exclusive possession is a necessary consequence." And Mark Hopkins, in his "Law of Love" (chapter iii), says that "with no right to the product of his labor, no man would make a tool or a garment, or build a shelter, or raise a crop. There could be no industry and no progress."

Now we must accept or reject the theory supported by this formidable and indefinitely extensible array of authority, because it does or does not conform to the facts; not because it leads to the conclusion that property ought to keep even pace with production in its development toward communism; not because it justifies some in opposing property in land on the ground that land is not a product of labor; not because it leads Prof. Perry and his school into confusion in their effort to prove that property in land is right because the value of land *is* the product of the labor of its owner. If production confers on the producer the divine or otherwise particularly sacred right of property in the product, I propose to accept the truth as soon as convinced of it, whatever agreeable or disagreeable conclusions it may lead to. I do not know that there is any absolute and infallible criterion of truth or reality. Perhaps "persistence in consciousness" may be one. But, at any rate, I have lived long enough to know that "agreeableness" is not."

The fact known to everybody is that the vast army of those who work for wages or salaries do not acquire the slightest proprietary interest in the particular things with which they "mix their labor." Neither do the transportation companies nor the draymen of the streets. It may be said, in defense of the theory, that their interest is bought off in advance, or that, having sold their labor, it is no longer theirs, but does, in fact, belong to the owner of the product.

But this is not the statement of the economists and philosophers we have quoted, and would slur over the laws by which the rate of pay for salaried services is governed. It is much less confusing and more rational to look at the matter as the great majority of people look at it—as all look at it, in fact, until they are

influenced by the labor agitators, who base their arguments on the unguarded utterances of the great thinkers quoted above.

It is all as plain as day. What the wage-worker acquires by his work is not a proprietary interest in the thing he has worked on, but a right of action against the person who employed him to work on it. It is not a *jus in re*, but a *jus in personam*. It is a claim against his employer. It is not a claim for any particular chattel or product, but for legal-tender money of a certain total amount. This amount is determined, not, or at any rate not directly, by the value of the thing produced, nor yet by the value that his work added to it, but by the demand and supply of his kind of labor. The legal claim itself is a subject of property. It can be bought and sold. The community stands ready to enforce it, and thus gives it all its value. Property in this claim, or right of action at law, is just as truly property as is property in the material product, and it is often more reliable; for it lives on, even though the capitalist's property in his factory and its unsold products is wholly destroyed by fire, or its value partially destroyed by a tumble in the market.

The theory we started out to combat consists, in fact, of four propositions, and we have refuted three of them. We have proved that it is not true that every man owns himself; that it is not true that every man owns his products, or the things with which he has mixed his labor, nor that he gets thereby any proprietary interest in them; and that not the affirmative but the negative of these propositions has been most generally accepted by mankind as the true and natural state of the case. So much for what *is*. It remains to inquire what *ought* to be? What would be absolute justice in the matter? Would it be universal private ownership of self and of the products of the labor of one's self? To any such question as this there are three possible answers. There is the answer "Yes," there is the answer "No," and there is the answer that it makes no practical difference what is absolutely just, since absolute justice is unattainable or undesirable. If justice, like perpetual motion, is beyond our reach, the most economical thing to do is to find that out and cease to hope and struggle for it. Meantime economy of motion or of force is an approach toward perpetual motion, and so we may find something, or conclude we want nothing, that will be an approach toward absolute justice.

Now, justice, like property, is an undefined, and quite likely undefinable, term. Our ideas of it change from age to age. It is related to the term and the thing "equality," and this we can all understand. When it is said that two things equal each other, we know exactly what is meant. The proposition that all men ought to be equally rich and happy is perfectly clear. That would be absolute equality. The idea of justice bears about the same rela-

tion to equality that the mathematical statement of a proportion does to that of a simple equation. We may say it would be absolute justice for all men to be rich and happy in proportion to their deserts, whatever that last word may mean; perhaps it would mean that they ought to be rich and happy in proportion to the *pains* of the work they do, perhaps in proportion to its *results*.

The former seems to me to be the true meaning. If there be such a thing as deserving, it seems to me that the woman who heroically wears herself out as a half-hand deserves more than the man by her side who does a hand's work with ease and pleasure—supposing, of course, that they have both previously made the same heroic efforts to acquire skill and efficiency. Absolute justice, if there were such a thing, would give her several times his wages. But could society afford thus to reward people in proportion to their incurable incompetency? If we say "No," then we decide that absolute justice is undesirable at the present stage of evolution. It can be desirable only under the condition of a perfect equality of gifts; and since this condition is most nearly approached by the lowest savages, we are almost forced to the conclusion that absolute justice is a thing to be avoided rather than courted—at any rate, for the present, and until the course of evolution (or progressive creation) is changed. Such seems to be the real view of everybody, whether he has thought little or much upon the subject; and yet everybody denies it, and claims to be in favor of absolute justice, or the nearest possible approach to it. Nay, and he is sincere in his claim. The difference between what people believe and what they think they believe is always important, but nowhere more so than in this study of political economy.

Any system of private property which bestows its blessings in proportion to efficiency in work and management, is unjust to the man who, with a heroic disposition to do his best, is held down, by circumstances over which he has no control, to a life of hard work and little pay. That those who get the least pay have the most irksome work is notoriously not the exception, but the rule. But this is an injustice which it would be fatal to the very life of society to mend, even if it could be done. We can never estimate relative irksomeness; and, if we could, it would be fatal to put a premium on the incapacity which makes the task irksome. Capacity to work and inclination to work are both important. Both must be developed. Nature's way of doing this was gradually to develop in the human mind the institution of property, as we have it to-day. She planted it there long before any of her creatures ever thought of asking why or how or with what probable result; and she planted it deep, and nurtured its roots to deeper and deeper growth. And she planted by its side a restless long-

ing for something we call justice. Both were, and both still are, blind sentiments, working out Nature's "plans" as involuntarily as do our breathing or loving. Our ideas alike of justice and of the right of private property correspond to the age and community in which we live. They may never coincide. At present they do not, in any mind with which I have come in contact.

And yet we must take account of both of them, or lose our reckoning. We shall find among the causes which have contributed to that confusion of ideas regarding the right of property which now confronts and perplexes us, in all our legislation, as well as in our pursuit of theoretical knowledge, the following:

1. That the origin of the right of property is not one, but several. Ownership of self arose in one way, of means of sustenance in another, of land in another, and of fellow-beings in another.

2. That most writers have failed to draw the line between *possession* maintained by force, or not subject to contest, and *ownership* which depends absolutely on the recognition by our fellow-beings of our right to the things we call our own. As is remarked by T. E. Cliffe Leslie, in his introduction to Laveleye's "Primitive Property":

"No mere psychological explanation of the origin of property is, I venture to affirm, admissible, though writers of great authority have attempted to discover its germs by that process in the lower animals. A dog, it has been said, shows an elementary proprietary sentiment when he hides a bone, or keeps watch over his master's goods. But property has not its root in the love of possession. All living beings like and desire certain things, and, if Nature has armed them with any weapons, are prone to use them in order to get and keep what they want. What requires explanation is not the want or desire of certain things on the part of individuals, but the fact that other individuals, with similar wants and desires, should leave them in undisturbed possession, or allot to them a share, of such things. It is the conduct of the community, not the inclination of individuals, that needs investigation. The mere desire for particular articles, so far from accounting for settled and peaceful ownership, tends in the opposite direction, namely, to conflict and the right of the strongest. No small amount of error in several departments of social philosophy, and especially in political economy, has arisen from reasoning from the desires of the individual, instead of from the history of the community."

This is one of the profoundest observations ever made on the subject under consideration. The error to which it is an answer is shared by so great an authority as Herbert Spencer, and repeated in his "Principles of Sociology" (section 536).

"The fact referred to in § 292, that even intelligent animals display a sense of proprietorship, negatives the belief propounded by some, that individual property was not recognized by primitive men. When we see the claim of exclusive possession understood by a dog, so that he fights in defense of his master's clothes if left in charge of them, it becomes impossible to suppose that even in their lowest state men were devoid of those ideas and emotions which initiate private ownership. All that may be fairly assumed is that these ideas and sentiments were at first less developed than they have since become."

And again (section 541), Mr. Spencer says:

"The desire to appropriate, and to keep that which has been appropriated, lies deep, not in human nature only, but in animal nature: being, indeed, a condition to survival."

Nevertheless, individual ownership does not prevail among the social insects, and yet their industry and frugality have been, even from Bible times, held up as a lesson for man. "Go to the ant, thou sluggard," and learn among other things that animals, unlike men, may be aroused to intense and untiring activity and close frugality by purely social instincts, their own sustenance being swallowed up in social sustenance.

In the following passage from the same section, Mr. Spencer reaches, only to drop it, the point insisted on by Mr. Leslie:

"The consciousness that conflict, and consequent injury, may probably result from the endeavor to take that which is held by another, ever tends to establish and strengthen the custom of leaving each in possession of whatever he has obtained by labor; and this custom takes among primitive men the shape of an overtly-admitted claim."

Perhaps this explains also the custom of leaving each in possession of what he obtains without labor. At any rate, the claim to ownership comes to be admitted, and then only *is* it ownership or property, whether founded on participation in production or, as Lieber ("Property and Labor") insists, on appropriation or what not.

PROF. JOSEPH LE CONTE has suggested that the custom of deducing the relative mortality from different diseases by comparison with the total mortality, instead of the number of persons still living, is liable to lead to erroneous conclusions. Even estimates of general mortality by comparing the total annual deaths with the number of persons at all ages may mislead. Thus the apparent low rate of mortality in San Francisco as compared with Eastern cities arises from the abnormal proportion of adults to children there, and not from general conditions unusually favorable to health. The true coefficient of mortality from cholera infantum is expressed by the ratio of the number of deaths from the disease to the number of persons liable to be attacked by it—or to the number of children under three years of age.

ARCTIC ICE AND ITS NAVIGATION.

By ALBERT A. ACKERMAN,
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FEW people can understand the fascination of summer life in the arctic regions for those who have once gone through the experience without disaster.

It is an awe-inspiring land. The massive, dreamy beauty of the slumbering icebergs, the sharp outlines and sheer height of the basalt coast cliffs, the mysterious expanse of the glacier, and the ceaseless motion of the ice-floes grinding and clashing together, produce upon all men emotions of awe and delight.

Elsewhere, Nature moves as well with power and grandeur, but more slowly and with much less amplitude of action; there, the changes that in a temperate climate require months take place tumultuously in a few days.

The breaking up and floating away of the ice-field, the *débâcle* of the glaciers and disgorging of the fiords, impress man with his utter insignificance and weakness in the presence of such mighty forces. Fleets of lofty icebergs drift southward, urged on by deep under-currents, and plow their way through thinner ice, splitting, colliding, and overturning, always maintaining a certain sphinx-like dignity—majestic and mysterious. Vast outreaching tongues of ice extend from their hidden bases, as hard as rock and as dangerous to the unwary navigator, while to leeward drifts a convoy of smaller bergs, the *débris* of the first—a jostling following too rough for safe companionship. Over all this glistening mass of marble white hover myriads of white gulls, and in the blue translucent caverns at the water's edge reverberate the swash of the sea and the music of cascades.

Amid such surroundings men can test themselves, where the brave have confessed fear and the hardy and strong confessed weakness; and so long as men are brave and strong, so will there be volunteers for expeditions, the northern limit of which depends alone upon the extent to which fortune favors their strength and judgment. Arctic exploration is not dependent, however, upon the vanity of adventurers; the world throngs with eager students of Nature, and from these must spring the motive which alone can lead to success. Rarely does it happen that robust health and love of adventure accompany the knowledge of generalization only acquired by years of study, and so essential in localities where there is little that is familiar and unworthy of record; to this, and not only to the disasters from which hardly an expedition has escaped, is due the fact that, notwithstanding the treas-

ure expended in arctic exploration, so little is known and so many of the popular ideas are erroneous.

Most arctic travelers will agree in saying that careful study of all the works on the subject will form but a meager preparation for a prospective explorer. It is a new world; impressions are so strange and vivid that no fixed plan of description will suffice.

In the narrow Greenland waters each successive headland, island, or mountain stands as the mark of farthest progress and blasted hopes of brave old-time navigators. Can anything be more pathetic than the quaint log-book of that stanch old seaman, Captain John Davis, with its account of protracted struggles and final disappointment? He sailed in the time of Raleigh and Blake. Now, but a few miles beyond a black, ram-shaped cape, that he named Sanderson's Hoop, lies the Danish trading-post of Upernavik, and every summer ten powerful steam whalers smash through the ice, which at this point turned back his small sailing vessels. For hundreds of years, dating back to the time of Davis and Frobisher, the art of ice navigation has been constantly improving, until now it is a very rare thing for either a Dundee whaler or a St. John sealer to meet with serious disaster while pursuing its legitimate calling.

With our own Bering Sea whalers the case is different—there are important differences between the ice encountered in Greenland waters and that north of Alaska. A description of the circumstances affecting the formation of the various kinds of berg and floe ice will make this clear.

The natural form of an iceberg is a regular prism, broken from the face of the glacier as its onward motion forces it down along the bottom of the inclosing fiord, by the buoyant action of the water. Through the tides the upward pressure of the water varies constantly, and has much to do with the production of internal strains and fissures, which form planes of cleavage parallel to the face of the glacier; one of these ultimately marks the boundary of the berg, the others are weak spots which may develop afterward. Where glaciers approach the sea at a steep grade, they move more rapidly, are subjected to greater stresses, there is less opportunity for the exhibition of the viscous property of ice at the freezing-point, *débâcles* occur more frequently, and the bergs are smaller and more irregular. Under such conditions the ice is full of partly cemented cracks and curved fissures, so that in a short time water-markings, ice-scorings and scratches, and the melting of snow-spots, produce the most fantastic and airy shapes. More durable than clouds, they still rival them in variety of design and change of form, as successive beauties are revealed in passing. Apparently free from all the requisitions of

equilibrium, owing to the preponderance of the part submerged, bold spurs and flying arches spring from their walls, and hanging balconies ornament their crests.

In Greenland, as in the antarctic, there is either a great continent or a congeries of islands, covered with an ice-field of such gradual inclination through great distance that the movement of its face is very slow, and the *débâcles* and avalanches occur less frequently, so that the bergs are of enormous size and regular shape, having a height of from one to two hundred feet in the northern and three hundred feet in the southern hemisphere. The Alaskan glaciers are of comparatively small extent, the ice-field of which the Muir and Davidson glaciers are spurs being only four hundred miles wide; owing to the inclination of their containing valleys, they move with great rapidity, *débâcles* are occurring continually; the bergs, falling into shallow water, quickly go to pieces, and the fragments which at last escape through the intricacies of fiords and archipelagoes are very small. In addition, the comparatively shallow water along the coast of Siberia prevents floe-bergs of any great size passing through Bering Strait, while a seventeen-fathom bank, north of Wrangell Island, bars the way to all rectangular bergs over twenty-three fathoms thick that have drifted across the arctic. In this way it happens that the Bering Sea whalers never see the great icebergs which play so important a part in the navigation of those in Greenland waters.

Perhaps the continual excitement in the confined waters of the latter land, and the natural desire to classify the new and mysterious with the old and commonplace, make the mind quick to see resemblances. However that may be, the bergs seem subject to some laws of form. Capitals, sphinxes, castles, and cathedrals are frequently met with; at times, whole menageries would troop past—lions couchant, mushrooms, and flowers occur in profusion—the small fragments of ice, through the washing of water and scoring of surrounding floes, showing a greater variety of forms than the large bergs.

On the east side of Melville Bay in north Greenland is a headland called, from its peculiar shape, "The Devil's Thumb." It is a remarkable column, resembling a closed hand with the thumb projecting upward, and bears stout testimony to the toughness of the granite composing it, which has withstood in this sharp outline all the disintegrating forces of that climate for centuries. It is about seven hundred feet high. In June, 1884, a photograph was taken of a very lofty iceberg, grounded in its vicinity, which was an almost perfect representation of a hand and wrist, the index-finger pointing heavenward. A connection between the black, time-stained Devil's Thumb and this beautiful marble-like shaft

was at once made in the minds of every one present, and the iceberg was named "The Hand of Providence."

The pack ice of one winter's growth is met and fought by the whalers on both sides of the continent, until, with the assistance of the summer sun, it is conquered, and no longer forms an obstacle to progress northward.

Hayes states that the formation of new ice in Foulk Fiord during one winter in still water was thirteen feet thick. It is highly improbable that any additions at that depth would be made during even extraordinary cold periods; it has since been surmised by experienced arctic travelers that a portion of this thickness was due to snow deposits. Ordinarily, this ice will not be found thicker than seven feet. Early in summer it breaks up and floats away in immense floes as pack ice; sometimes, through pressure, becoming hummocked or piled in thicknesses of three or four fold into the size of small bergs or crushed into fragments, until it finally melts out of sight away to the southward. This ice can be distinguished, even when hummocked, from that formed by broken-up bergs by its opaque-white color, due to the presence of innumerable air-cells, its method of formation rendering it softer and more porous than glacier ice, which is subjected to years of pressure and concentration through infiltrating streams of freezing water.

Before the immense floes are broken up, however, they are extremely dangerous in the confined Greenland waters, where they are continually subjected to terrible pressures by the winds and surface currents. The eastern whalers, through superior equipment and working in company, escape many of the disasters of the Americans in the Pacific, while their proximity to land or fast ice and numerous villages of Eskimos gives them strong hopes of rescue, even though their vessel may be lost. After arriving at their station they have little to fear but floating bergs and hummocks, their powerful steamers crushing the then rotten floe ice with ease. As the whales leave the vicinity of Pond's Inlet early in the summer, the whalers strive to get there as quickly as possible; a large reward being often given by the owners to the crew of the vessel first reaching that point. They can afford this, as her cargo may consist largely of whalebone collected by the Eskimos in the vicinity. These men are, in consequence, the best ice-navigators in the world.

Our own American whalers have no such incentive; they are no less hardy or brave than any seamen in the world. Their life is a hard one; in case of disaster, there is no such way of escape as that open to the Scotchmen in the east; and yet it would be comparatively easy to establish a life-saving station on the north coast of Alaska, which would repay perhaps more than any other

on our coasts. There is but one narrow passage for the Bering floes, and the ice after passing through the strait scatters and becomes easier to avoid. The pack is not confined and caused to revolve between immense icebergs or many narrow passages, as in Greenland or eastern waters, so that the recent employment of steam whalers, instead of the old-time sailing vessels, has been dictated more by a desire for increased profits than by actual necessity.

But there is another and more dangerous ice than floe ice, as it takes many years for its formation. It is met with in isolated floes, but rarely if ever in pack below Smith's Sound, and the Scotch whalers seldom encounter it. Ships have been nipped hundreds of times in floe ice and escaped, but few if any have ever freed themselves from the fierce grasp of the ancient ice of the arctic, called by Nares floe-berg or paleocrystic ice. This bears evidence of great age, the part above water being from fifteen to forty-five feet in thickness, which would make its depth from one hundred and thirty-five to four hundred and five feet; the stoutest-built ship that ever put to sea would be crushed into matchsticks by the pressure of two such floes upon her sides. This ice forms the northern limit of the cruising-grounds of the American whalers north of Alaska. Some years it moves to the southward and closes up on them; again, it recedes, disclosing more of the mystery of the farther north. Scattered here and there through it are *polynias*, or lakes of ice, of one year's growth, inclosed by heavy floes arched and keyed together.

Paleocrystic ice is old pack ice built up by successive deposits of snow during a long period of time, thus giving it an appearance of stratification. There is an alternation of soft white and hard blue ice, representing, respectively, compressed snow and water formed during the sunshine by thaws, and frozen at night or when cloudy. (It is a remarkable fact that snow will melt and seep through floe ice in sunlight though the thermometer may record far below the freezing-point.) Eventually, during the long summer day, the floe is left bare and dry, but soft and porous, unless so far north that the snow-storms continue all the year round. Over some strata are layers of atmospheric dust, such as Nordenskiöld found on the Greenland glaciers; also the gradual decrease of the thickness of the layers—due to pressure and increase of blue ice—because of greater infiltration, as the lower part of the berg is approached, make certain the progressive nature of the formation.

Beyond the Melville Bay pack, averaging six feet in thickness, lies the "north water" of the whalers, corresponding to the open space usually found between the paleocrystic pack and Bering Strait. This is dotted with hummocks, rubble ice, or broken-up

bergs, and icebergs of enormous size, which it is easy to avoid except in the frequent fogs of the summer months. These icebergs break from the immense glaciers bounding Melville Bay and Kennedy Channel, which occasionally rise two hundred feet above the water. It is apparent that the bergs breaking off irregularly might, through a bulky form of the submerged part, attain a still greater height. Hayes mentions a berg over three hundred feet high in the "north water"; the Proteus on her last trip sighted one a hundred and fifty feet high, six miles long, and a little more than a mile wide. These immense bergs are most important agents in breaking up the ice-fields in early spring, for, being propelled by deep under-currents, their motion is often contrary to that of the floe ice moved by the wind and surface currents.

The wind also plays an important part, a southwest gale sending the packs and hummocks upon the edge of the fast or land ice, and crushing it for some distance, after which any northerly wind disengages the free ice, leaving an open space, called the inshore lead, which the earliest whalers always follow. It is, of course, dangerous, as a south wind sends the pack back, and imprisons if it does not crush them. In July the quicker way through "the middle passage" of the Melville Bay pack is used, as the ice is then comparatively harmless, although vessels are sometimes nipped and rather severely handled.

No stronger vessels than those of the Dundee whalers are built; they are from four hundred to one thousand tons displacement, have powerful, well-secured engines to resist the shock of ramming or stoppage of the propeller by ice, and are built with an eye to the easy and rapid replacement of rudder, propeller, and propeller-shaft if damaged, these parts being carried in duplicate. Above all other considerations, they possess strength for ramming as well as resistance to lateral pressure when nipped.

Another very important feature is that the bow shall have considerable inclination, which permits the vessel, when ramming very heavy ice, to lift slightly and slide on it, thus easing the shock and assisting the cutting action of the bow with the downward crushing weight of the ship. In this way it is possible for these steamers at full speed to ram ice over twenty feet thick, and receive no immediate incapacitating damage.

If the ice is not too heavy, the shear-like rise and fall of the bow is repeated several times as the vessel steams powerfully ahead until her headway is checked. The difficulty then is to extract the ship from the dock she has cut by her advance: the floes press on her sides, cakes of ice and slush fill her wake, and there is nothing but the ice-hampered propeller with which to overcome her inertia and draw back out of the nip. Frequently this is insufficient, and the ship may be crushed.

In breaking up a floe of great extent and thickness, which is rarely attempted, as the coal and labor thus expended might be saved by a movement of the ice in a few hours, two vessels work to great advantage in concert, striking alternate blows at an angle with each other, thus breaking off wedge-shaped sections, which are shoved out of the way as fast as an advance is made into the floe.

Various other methods are employed for breaking a way through the ice or relieving the pressure on the ship, but they are all insignificant compared with the mighty results of dashing and fearless ramming. Without it, in spite of the utmost exertions of officers and men, Greely would not have been rescued. The dispersive effect of explosives in water-soaked ice is small, and placing the torpedoes requires time; the ice-saw is clumsy, slow, and rapidly exhausts an already overwrought crew, while warping and towing floes are but the last safeguards from despair.

The Dundee skippers are not held to too strict account for damages that the vessels may sustain during their short but exciting cruise. Desperate risks are taken every day; the man who fears responsibility would never succeed, while another hesitating or lacking resource would quickly lose his ship. Starting from Dundee in April, they generally reach Godhavn, in latitude 69° 15′ north, before June, but from that point to their destination it is a long and plucky fight with the ice. Continually following up the breaches made in the solid field by storms and tides, their only fear, though surrounded by floes capable of crushing the ships if taken unawares, is that the lead will open in some other place, leaving them inclosed by vast immovable floes until some rare northwest wind loosens the pack, or the summer's sun so weakens it that the ship is able to smash through and escape.

On the approach of a gale, when the ice may be expected to move rapidly and through its great weight and extent accumulate pressure, a fine solid floe is selected in which to form a protected dock. In it the ship is rammed as far as possible, if necessary the slip being deepened with the ice-saw; so long as the floe holds together the ship will be subjected to the pressure of only those small fragments that may be forced into the entrance to the dock.

To take advantage of every little patch of open water in breaking through the pack, a pilot is stationed aloft in the "crow's nest"; this is a large cask, with a trap-door in the bottom for entrance, secured to the mast. It is sometimes quite cozy, being fitted with a wind-screen, rest for the long glass, engine-room bell pull or indicator, helm-director, and compass. The height of the observer is about one hundred and fifteen feet, and the greatest distance at which ordinary pack ice is visible from that height is less than seven miles; it is evident, then, how much experience and

judgment are necessary in directing the movements of the ship, the only indications at times being doubtful ice-blinks and undecided water-skies.

The ice-blink is frequently a very weak indication in summer, appearing as a narrow belt of a little lighter and yellowish sky just above the horizon. So faint is its appearance at times that it would not be recognized except by comparison with known water-sky. The latter is dark and gloomy, much resembling that preceding a thunder-storm.

In the pack itself it is generally calm, a slight breeze being almost certain evidence of the close proximity of considerable open water.

The sealers of Dundee and St. John, Newfoundland, rendezvous at the latter port and start almost in the same half-hour about midnight of some day in March. The date is fixed by law, in order to protect the seals during their bearing period. They have a less venturesome voyage than the whalers, though starting earlier, their hope being to meet the first great ice-floes in the open sea where they are subjected to very little pressure, though the fogs and dark nights make it difficult to avoid collision with one of the numerous icebergs.

The sealers depend in a great measure on luck to strike the floes on which the hair-seal is found in great numbers; a few of the oldest captains are supposed to possess a prescience or peculiar judgment, though it is by no means certain that the seals will be met with in the same part of the open sea in two consecutive seasons. In fact, out of ten or twelve sealers leaving in the same hour every year, it frequently happens that one or two of the luckiest have made two successful trips with full cargoes before some of the others have reported more or less bad luck from their first; the Proteus once brought in one hundred thousand skins from her first trip of the season alone.

On sighting the ice the steamers run along the great floes and through the leads until they find a floe on which a colony of seals have congregated; a dock is rammed into the ice at once; ice anchors are laid out ahead; the very large crew carried is landed by the Jacob's ladders dangling from the head-booms. Sometimes the crew is split up into several parties to work on different floes; in all cases the seals are surrounded as rapidly as possible and driven toward a common center. Here they crawl up on each other, barking and moaning, until they form a great heap ten feet or more in height, writhing and fighting, while the ice in every direction is dotted with the white puppy-seals so young as to be unable to move. The men at work on the ice esteem very highly the frozen hearts of these young seals, claiming that they are not only palatable, but enable them to better stand cold and fatigue.

The seals having been concentrated, the work of slaughter commences: each man is armed with a pole having a hook attached to one end, with which the seals are one by one drawn from the pile and killed by a single blow on the head. The skin is then quickly removed with the fat blubber, which is wrapped up in it; it is valueless as fur, and eventually tanned, split, and made up as imitation kid into gloves, linings of porte-monnaies, valises, shoes, etc.

In less than two months after the sealers first start out, the seals have completely disappeared; where they go is a mystery. In the fall they reappear in small groups making their way north again.

The whaling season then follows immediately after the sealing, the same steamers sometimes being employed.

Early in September, whether the season has been successful or not, the Dundee whalers start on their return voyage, following the east coast of British America and Labrador until they lose the benefit of the polar current near Newfoundland.

It is a rough trip; gales and tremendous seas are peculiar to both time of year and locality, yet it may be considered almost uneventful to the crews of those racked and bruised vessels which will require the whole winter to refit for next season's work.

A CORNER OF THE DUTCH EAST INDIES.

By Captain G. LANGEN.

THE Key or Ké Islands of the Dutch East Indies derive their name from a native word signifying "What do you say?" The native tradition runs that when Macassar traders first landed there and inquired in the Malay tongue after the name of the land they had set foot on, the natives answered, "Kay," and this expression was mistaken by the questioners for the name of the islands. The group consists of two larger islands, of which the westerly one bears the name of Nuhu-roa, or Little Key, and the easterly one Ju-ud, or Great Key, with a number of smaller islands around them. Great Key is undoubtedly geologically much older than Little Key and the other surrounding islands, and possesses elevations of from two thousand to three thousand feet, while Little Key and the other islands are very low. Great Key is principally of a rocky and volcanic formation; Little Key and the surrounding islands are formed of coral and interveined by flint and quartz. Little Key, according to the most reliable chiefs, was raised out of the sea about thirty-five years ago, during the

shocks of a severe earthquake attended by a tidal wave; after which no earthquakes occurred till April, 1884.

Every island belonging to the group is covered, down to the water's edge, with dense tropical jungle, with gigantic creepers winding from one tree to another so as to form a close network. These forests contain choice kinds of timber, the inducements offered by which have provoked the establishment of the present German colony. The southwest monsoon, which blows during our winter months, brings abundant rains; and the occasional showers of April, with the heavy dews of June, July, and August, keep the ground moist and afford ample nourishment to vegetation. In October and November, the hottest months, vegetation suffers from drought. The rain percolates through the soil quickly to the coral. The traveler will, therefore, meet with only a few pieces of marshy soil on the islands; but he is astonished at the luxuriant growth of vegetation, at the gigantic and stately trees spreading their roots to seek a firm hold around the coral, out of whose porous texture their fibers obtain nourishment; and no place on the group is entirely barren and destitute of vegetation.

The supply of fresh water is very unevenly distributed, and there are many villages where none is obtainable, and the inhabitants have to go a long distance for it. Generally, the fresh-water wells are situated close by the sea. All the fresh drinking-water contains lime in large quantities, the characteristic effects of which are neutralized by the liberal use of acid fruits. It is evident that the sea, infiltrating gradually through the pores of the coral, becomes purified and separated from all its saline ingredients on its way to the wells; and those places where fresh water is not obtainable are of quartz formation.

The islands are divided into districts, each comprising a number of villages with their surrounding land. Each district has its principal chief, or rajah, and these have in the villages under-chiefs of various ranks. All these offices are hereditary, descending to the eldest sons of the respective families. If there is no successor, a new chief is elected by the natives of the district. A chief receives no payment, but after having been acknowledged and established in office by the Resident of Amboyna, he is presented with a silver mounting for his walking-stick, on which is engraved the Dutch coat of arms. After he has held his office for twenty-five years with faultless conduct and loyalty, the silver mounting on the walking-stick is replaced by a golden one. If a chief has rendered an extraordinarily praiseworthy service to his government, he is presented with a fanciful, richly ornamented umbrella, which his servant carries before him, when he walks abroad, to prevent the sun from tanning his face.

About one third of the population are Mohammedans, and these are increasing every year, through the influence of Arabs and of natives who have returned as *hadjis* from Mecca. These men are worshiped to a certain extent by their inferior-stationed fellow-believers, and exercise such an influence upon them as to be kept for the rest of their lives in food and clothes.

The indigenes of Key are tall, strongly built, having the forehead broad and slanting backward, dark eyes with heavy black lashes, a large but well-shaped nose, high cheek-bones, and broad mouth, with the under lip more or less projecting, black and brown colored beard, and long, wavy, but fine curled black hair, mixed with several lighter or darker shades of brown, reaching to the shoulder and projecting all round the head like a mop. Their skin is rather dark, but of a lighter hue than that of the Papuans of New Guinea. Formerly, their clothing was the same as that used by the Alfueros of Ceram and Borneo; but, since the establishment of the European colony, both their clothing and manner of living have become more elaborate. Mixtures have taken place between some of them and the Papuans of New Guinea, resulting in the formation of a stock which is found in all parts of the islands.

The natives live in huts built on poles of strong and hard timber or thick bamboo; and a very few houses of chiefs are constructed of timber. The huts are built several feet above the ground, for protection against the swarms of vermin that come up during the southwest monsoon, and to secure a free current of air and consequent coolness. The sides of these houses are covered in either by *attap*, which consists of the dried leaves of the sago-palm doubled over a small bamboo about six feet long and laced tightly to it by means of split cane; or with the stems of the same palm-leaf, which, after being drilled and deprived of their thorns, are placed vertically between two boards in such a way that the hollow part of the stem fits tightly over the half-rounded part of the succeeding one. In this way a very light but water-tight outside covering is formed, and gives to the house a not unpleasant appearance, for the dried stems exhibit a brown gloss, as if they were polished. The doorway, in the middle of the front of the house, leads into a spacious room, which represents the reception-room for visitors. On the floor of this room, which is covered with split-bamboo matting of rather wide meshes, are spread out other mats, made of fine grass or bark. Belonging to each mat is a bolster, with a cover of bright calico print, having its ends ornamented with embroidery. From each side of the reception-room are openings leading into the other rooms. These rooms are divided into sitting and bed rooms, and they are adorned with fancy colored boxes made out of palm-leaves, and

having figures worked upon them with differently colored bark and beads of small shells. Placed one upon another, these boxes are good substitutes for cupboards and chests of drawers, while a strong, roughly made timber chest, provided with a clumsy lock of iron or brass, contains the family treasures, jewels, heirlooms, weapons, and emblems. An assemblage of huts or houses forms a village. The villages are surrounded by walls of coral, and are for the most part situated on the sea-shore.

Each village has an allotment of land, the boundaries of which are established by the chiefs. Here the native may fell his timber, cultivate a garden, or cut down the sago-palm, which furnishes his principal food. The cocoanut-trees, however, are regarded as general property, and are under the guardianship of chiefs, without whose orders not a nut may be plucked till harvest-time. Then, on a day appointed for this purpose, the whole village will set out to gather them, when each one will receive a number proportioned to his rank and station.

When a native child is strong enough to assist his parents in their daily occupation, he has to accompany them to the garden, the boat-building yard, or some other place of general work. Children of from three to five years of age may be seen occupied in trying their skill in carving ornamental figures such as are used for the figure-heads of boats, or in cutting out vessels and rigging them, or the boys will assist their fathers at the building of a boat or a house. Although they are without all proper drawing materials, the artistic and constructive talent is almost universally manifested among them. The children are seen trying their skill by drawing, on a smooth, flat surface of fine sand, houses, animals, steam and sailing boats, and I have been always struck by the symmetry of their work. The children are deemed marriageable at fifteen years of age, but arrangements for mating the female children are made as soon as may be after their birth.

When disputes relating to boundaries arise between different villages, each of the quarreling districts elects a person and commits him to the judgment of the god, who, it is believed, will let the party in the wrong die within three months. If no harm befalls either party after the lapse of that time, the land in dispute is divided equally.

The chief talent of the natives is for boat-building. The symmetrical construction of their vessels, large and small, would astonish a European ship-builder, and is the more remarkable as they have nothing but the most roughly shaped tools. All the tools are made by natives of Teor. In nearly every village we find a smith established, who is employed from morning till night melting rusty nails in a charcoal-fire, which is kept burning by means of a primitive pair of bellows moved by the operator's

helpmate. This apparatus consists of two bamboo cylinders, about two feet long, at the bottom of each of which a small bamboo conveys the current of air into a still smaller one, leading into the charcoal-fire. Each of these bamboo cylinders contains a spear of the same material, at the lower end of which are tied bunches of feathers. Generally a native of Key will prefer the rough workmanship of the tools made by the village blacksmith to the finely finished and polished ones imported from Europe.

The natives are largely engaged in felling and selling timber. For felling the trees the woodman uses a wedge-shaped axe only, by which he is able to cut down the largest tree. After lopping off all the branches and bark, he squares the trunk in such a skillful though wasteful manner that, as a rule, the four sides represent exactly the same dimensions. The islands produce large quantities of various kinds of very hard and soft timber, suitable for different branches of building, but the most valued sort is the *bayam*, or New Guinea teak, called by the natives by a Malay word signifying iron-wood, because of its flexibility and durability, and its immunity from the attacks of white ants. Mother-of-pearl shell is found in the bays and inlets, and other valuable shells are plentiful. Tortoise-shell is exported in very small quantity.

On the perpendicular face of a cliff on the northwest coast of Nuhu-roa are to be seen rude native drawings of various shapes and meanings, chiseled in the rock, which appear to have been once filled in with red pigment. It is a marvel how the chiseler could have been suspended over these very steep rocks, so as to be able to engrave the figures. The eye may distinctly perceive such forms as a little sailing boat, a human head, hand, foot, star-fish, tombstones, and many other objects; and it is strange that similar figures are still drawn and painted on various articles in use. Natives, on being questioned about these rock-engravings, answer that they can not account for them, nor were their fathers before them any wiser; but they think that the spirits of the dead suspend themselves over the cliffs at midnight and engrave them. All natives shun the spot, and by no means whatever can they be induced to climb the cliff in order to copy these strange drawings. No native can be persuaded to accompany a European to this spot, where, according to their belief, the spirits hold their meetings. Certain trees are also held sacred, and believed to be the abode of an invisible god, to whom the native offers sacrifice whenever any mishap occurs in his family, or when one of its members leaves home to go over the sea. The sacrifices are made in the following manner: Some cooked sago or rice is wrapped up in a palm-leaf, and, before tying the same with a piece of split cane in the shape of a parcel, the person sacrificing scrapes over

the sago or rice, by means of a knife, file, or any other sharp-edged stone, a little gold-dust off his ornaments. After this has been done, he ties the parcel together and suspends it by means of a split cane from a branch of the sacred tree, under fervent prayers to his god. In some parts of the island the traveler will find these sacred trees, ornamented from top to bottom, like a German Christmas-tree, with these odd-looking palm-leaf parcels. In other parts of the Key group there are still found public places for sacrificing, consisting of a fanciful carved box, elevated on a pole about four or five feet high. The sacrifice is conveyed through a small opening in the box. Some places are shunned by the natives, who prefer walking a long distance out of their direct way, to being obliged to pass the haunted spot where some imaginary Satan and his followers are supposed to hold their meetings.—*Abridged from the Proceedings of the Royal Geographical Society.*

SKETCH OF JOSEPH LOVERING.

A COMPANY of about one hundred and fifty gentlemen distinguished in science and literature sat down a few months ago to a banquet in the Hôtel Vendôme, Boston. The festival was one tendered by his colleagues, classmates, and friends to Prof. Joseph Lovering in honor of the distinction he enjoyed of having served for fifty years as a professor in Harvard College. He was the first professor who held that position for so long a time. Previous to entering upon this office, he had served two years as tutor; and, adding the two terms together, his was the second longest period of consecutive service recorded in the history of the institution. President Eliot presided at the banquet, and the tables were occupied by members of the Board of Overseers, the teaching faculty, and distinguished graduates and friends of the oldest American institution of learning. The speakers were too many to be specified here; and we shall have to be satisfied with saying that their names are associated with what is best in the thought and learning of the period. A similar scene was witnessed in this city at the dinner of the Harvard Club on the 21st of February, 1889, when Prof. Lovering, being a guest, received congratulations.

JOSEPH LOVERING was born in Charlestown, Mass., December 25, 1813. His father was surveyor of ice, wood, and lumber. He attended a grammar school of his native town, and seems there to have outrun the capacity of his teachers; for it is recorded of him that he went through Colburn's Algebra by himself, none of

them having any knowledge of the subject. He was afterward fitted for college under his pastor, the Rev. Dr. James Walker, subsequently Professor and President of Harvard University, to whom he recited daily, entered the sophomore class at Harvard in 1830, and was graduated in 1833. He entered the Divinity School in Cambridge in the fall of 1834, and remained there two years, but was practically employed in teaching almost constantly after graduation: in the first year, in a small private school in Charlestown; in 1834–'35, as assistant to Prof. Peirce in the instruction of the college classes in mathematics; in 1835–'36, as proctor and instructor in mathematics; in 1836–'37, as tutor in mathematics and lecturer in natural philosophy; and from 1838 to 1888, as Hollis Professor of Mathematics and Natural Philosophy. Retiring from this active professorship after fifty years of service, he became, as he still is, Hollis Professor Emeritus. He acted as Regent in 1853–'54 during Prof. Felton's absence in Europe; succeeded to that office in 1857, and held it till 1870; but passed a year's leave of absence—given to him in consideration of his long and uninterrupted services to the college—in 1868–'69, in Europe. When the Jefferson Physical Laboratory was opened in 1884, he was appointed its director, and during the four years of his administration made annual reports of its activities.

While his college duties demanded the largest share of his time and his best thoughts, he found and improved opportunities to make a good record of other work—all for the increase and dissemination of knowledge. Among these extra-collegiate exercises were nine courses, of twelve lectures each, and each lecture delivered to two different audiences in the earlier years, on astronomy and physics, at the Lowell Institute; shorter courses of lectures at the Smithsonian Institution, the Peabody Institute of Baltimore, and the Charitable Mechanics' Institution of Boston; and single lectures in different towns and cities in New England. He edited, in 1842, at the request of the author, a new edition of Farrar's "Electricity and Magnetism." One of his essays on the aurora borealis, in the "Memoirs" of the American Academy of Arts and Sciences, fills a thick quarto volume. Other memoirs, on terrestrial magnetism, the aurora, the determination of transatlantic longitudes, etc., published in the same series, attest the fertility of his researches.

As Permanent Secretary of the American Association for the Advancement of Science, from 1854 to 1873, Prof. Lovering edited fifteen volumes of its "Proceedings." Retiring from this office on being elected President of the Association for 1873, he put upon record that, when he entered upon its duties at the eighth meeting of the Association, the body had an annual income of only a few hundred dollars, and was dependent upon the gener-

osity of the cities where it met for the publication of its "Proceedings." Since that time it had been able to pay all its expenses, had acquired a valuable stock of "Proceedings," and possessed a cash balance amounting (with interest) to more than two thousand dollars. As president of the Portland meeting of 1873, he emphasized, in his reception address, as the one object of the Association, the advancement of science in the United States. "Few of us," he said, "can aspire to the honor of being discoverers of the laws of nature, in the high sense of that phrase. But no one, however humble his capacities, or however limited his opportunities, who labors for science, will fail to advance it and be rewarded by it. We meet together from year to year, the veterans in science, with the younger aspirants for distinction, and many more who long to catch the earliest tidings of the last word which Science has to say in regard to the earth under our feet or the stars above us; a few to speak but many more to listen; but each doing his part to advance science, either by active research or encouraging sympathy. Our brief meetings allow us no leisure to listen to what is old or to what may be read in books, or to glittering generalities, or ingenious speculations on the universe, unsupported by evidence and individual investigation. But any new fact, however microscopic, any new investigation, whether it concerns a planet or an atom, any new experiment in which a law of nature is made more palpable and convincing, finds with us a ready welcome." The members, he added, did not concern themselves with the utility of the truths which were communicated at these meetings. If they had no immediate practical value, it was sufficient for them that they were true and revealed the plans of the Creator. "It is impossible for the man of science to serve two masters, the Kingdom of Nature and Mammon. It is a dangerous thing for him to be thinking of the utility of his discoveries, or of the pecuniary profit which may be made out of them." In his retiring address, in 1874, which was published in the "Monthly" for December, 1874, and January, 1875, Prof. Lovering spoke of "Instruments in Physical Progress" and "Mathematical Investigations in Physics," and sketched the resources and present attitude of the physical sciences. He presented the view that "the great problem of the day is how to subject all physical phenomena to dynamical laws. With all the experimental devices and all the mathematical appliances of this generation, the human mind has been baffled in its attempts to construct a universal science of physics. But nothing will discourage it; when foiled in one direction, it will attack in another. Science is not destructive, but progressive; while its theories change, the facts remain. Its generalizations are widening and deepening from age to age. We may extend to all the theories of physical science the remark

of Grote, which Challis quotes in favor of his own: 'Its fruitfulness is its correctibility.' Instead of being disheartened by difficulties, the true man of science will congratulate himself in the words of Vauvenargues, that he lives in a world fertile in obstacles. Immortality would be no boon if there were not something left to discover as well as to love!"

THE OBSERVATORY OF HARVARD UNIVERSITY.—M. W. C. Bond started a private observatory at his house in Dorchester, where he observed eclipses and occultations, as far back as 1820. In 1840 he was induced by President Quincy to remove to Cambridge with his transit-instrument and other appointments, which were supplemented by some telescopes, sextants, etc., belonging to the college. Prof. Lovering was associated with him in the management of this primitive observatory. Its location was in a private house belonging to the college, in which Mr. Bond and Prof. Lovering took up their residence. Humboldt had induced the Royal Society of London to co-operate in making simultaneous observations on the elements of terrestrial magnetism in Great Britain and its colonies. The only stations on this Western Continent were at Toronto, Canada, and in Philadelphia and Cambridge. Prof. Bache, afterward Chief of the United States Coast Survey, conducted the observations in Philadelphia. Mr. Bond and Prof. Lovering had charge of the observations in Cambridge. These observations were to be made simultaneously all over the earth, and with instruments constructed according to the Gauss pattern. Cambridge was supplied with a set of these instruments by the generosity of the American Academy of Arts and Sciences.

As, on one day of each month, observations were to be made every five minutes on three different instruments, day and night, for the purpose of obtaining the curves of diurnal variation in the magnetic elements, the assistance of a few competent and zealous undergraduates was freely offered and gladly accepted. Of these, Thomas Hill, afterward President of Harvard College, and Benjamin A. Gould, now the distinguished astronomer, deserve special mention. Prof. Benjamin Peirce rendered valuable service, not only by assisting in the observations on the special days of each month, but in applying the Gauss theory to the calculation of the magnetic elements for Cambridge. Mr. Hill was employed in reducing the weekly means to empirical formulæ by the method of Prof. Peirce.

Profs. Peirce and Lovering were co-editors of the "Mathematical Miscellany," published at Cambridge, and devoted to pure and applied mathematics. The essays contributed by Prof. Lovering are enumerated in the annexed catalogue of his publications. A gentleman who has achieved a world-wide reputation in

science has recently written of Prof. Lovering's articles that they impressed him as few others had ever done. "It will surprise him to know it; yet it is true that the ideas then presented, and with an elegance worthy of their breadth and power, affected the whole tenor and tendency of my thoughts, and thus of my subsequent life. At this moment I could repeat by memory long passages from these articles. They were upon 'The Internal Equilibrium of Bodies,' 'The Application of Mathematical Analysis to Physical Research,' 'The Divisibility of Matter,' etc." And he compares the style of parts of them with that of the most classic passages in Babbage's "Ninth Bridgewater Treatise."

Mr. R. W. Emerson published the following notice for the "Dial":* "We rejoice in the appearance of the first number of this quarterly journal edited by Prof. Peirce. Into its mathematics we have not ventured; but the chapters on astronomy and physics we read with great advantage and refreshment. Especially we thank Prof. Lovering for the beautiful essay on the 'Internal Equilibrium and Motion of Bodies,' which is the most agreeable contribution to scientific literature which has fallen under our eye since Sir Charles Bell's book on the hand, and brings to mind the clear, transparent writings of Davy and Playfair. Surely this was not written to be read in a corner, and we anticipate the best success for this new journal."

Prof. Lovering is a member of the American Academy of Arts and Sciences in Boston; was its corresponding secretary for many years; was afterward its vice-president, and its president since 1880. He is also a member of the National Academy of Sciences, of the American Historical Society of Philadelphia, of the California Academy of Sciences, and of the Buffalo Historical Society. In connection with the work of the United States Coast Survey from 1867 to 1876, he had charge of the computations for determining differences of longitude in the United States and across the Atlantic Ocean, by means of the land and cable lines of telegraph. He was for some years one of the trustees of the Tyndall fund for the endowment of scientific research, and is now one of the trustees of the Peabody Museum of Archæology and Ethnology. Besides the papers already mentioned, Prof. Lovering contributed other articles to the "Memoirs" and "Proceedings" of the American Academy, and scientific articles and reviews to the "Proceedings of the American Association," the "American Journal of Science," the "Journal of the Franklin Institute," the "American Almanac," the "North American Review," the "Christian Examiner," "Old and New," and "The Popular Science Monthly." The following is a list of these contributions:

* Vol. iii, p. 131.

1. "An Account of the Magnetic Observations made at the Magnetic Observatory of Harvard College." In two parts ("Memoirs of the American Academy," vol. ii, 1846.)
2. "On the Secular Periodicity of the Aurora Borealis" (ibid., vol. ix).
3. "On the Determination of Transatlantic Longitudes by Means of the Telegraphic Cables" (ibid., 1867).
4. "Catalogue of Auroras observed, mostly at Cambridge, after 1838" (ibid., vol. x, 1868).
5. "On the Periodicity of the Aurora Borealis." In two parts (ibid., with plates, 1868).
6. "On the Causes of the Difference in the Strength of Ordinary Magnets and Electro-Magnets, of the same Size and Shape." ("Proceedings of the American Academy," vol. ii).
7. "On the Law of Continuity" (ibid.).
8. "On the Aneroid Barometer" (ibid.).
9. "Electrical Experiment" (ibid., vol. iv).
10. "On the Connection of Electricity with Tornadoes" (ibid., vol. ii).
11. "On Coronæ and Halos" (ibid.).
12. "On the Spectroscope" (ibid., vol. iii).
13. "On the Bioscope" (ibid.).
14. "Apparatus for Rapid Rotations" (ibid.).
15. "Shape of Luminous Spots in Solar Eclipses" (ibid.).
16. "Notice of the Death of John Farrar" (ibid.).
17. "Notice of the Death of Melloni" (ibid.).
18. "New Apparatus and Experiments in Optics and Acoustics" (ibid.).
19. "Arago's Opinion of Table-Moving" (ibid.).
20. "On Fessel's Gyroscope" (ibid.).
21. "Apparatus to regulate the Electric Light" (ibid.).
22. "Does the Mississippi River flow Up-hill?" (ibid.).
23. "Report on Hedgcock's Quadrant" (ibid.).
24. "On the Boomerang" (ibid., vol. iv).
25. "Report on Meteorological Observations" (ibid.).
26. "On the Ocean Cable" (ibid.).
27. "On the Polarization of the Light of Comets" (ibid.).
28. "Report on the Polar Expedition of Dr. I. I. Hayes" (ibid.).
29. "On Records of the Aurora Borealis" (ibid.).
30. "First Observations on the Aurora in New England" (ibid.).
31. "Notice of the Death of Biot" (ibid., vol. ii).
32. "On the Velocity of Light and the Sun's Distance" (ibid.).
33. "Notice of the Death of O. M. Mitchell" (ibid.).
34. "On the Optical Method of studying Sound" (ibid., vol. vii).
35. "On the Periodicity of the Aurora Borealis" (ibid., vol. viii, 1873).
36. "On the French Republican Calendar" (ibid.).
37. "Application of Electricity to the Motion of Tuning-Forks" (ibid.).
38. "On Optical Meteorology" (ibid.).
39. "On Transatlantic Longitudes" (ibid.).
40. "Notice of the Death of William Mitchell" (ibid.).
41. "Notice of the Death of Faraday" (ibid).
42. "Notice of the Death of David Brewster" (ibid.).
43. "Notice of the Death of J. W. F. Herschel" (ibid.).
44. "Notice of the Death of Christopher Hansteen" (ibid., vol. ix).

45. "Notice of the Death of Auguste A. de la Rive" (ibid.).
46. "Notice of the Death of James Walker" (ibid., vol. x).
47. "Notice of the Death of Joseph Winlock" (ibid., vol. xi).
48. "Notice of the Death of Alexis Caswell" (ibid., vol. xiii).
49. "Notice of the Death of John H. Temple" (ibid., vol. xiii).
50. "Notice of the Death of Joseph Henry" (ibid., vol. xiv).
51. "Notice of the Death of H. W. Dove" (ibid., vol. xv).
52. "Address as President on presenting the Rumford Medal to J. Willard Gibbs" (ibid., vol. xvi).
53. "Anticipations of the Lissajous Curves" (ibid.).
54. "Notices of the Deaths of Richard H. Dana, of Edward Desor, and of John W. Draper" (ibid., vol. xvii).
55. "Notice of the Death of Sir Edward Sabine" (ibid., vol. xix).
56. "Address of the President on Presenting the Rumford Medal to H. A. Rowland" (ibid.).
57. "Address as President on presenting the Rumford Medal to S. P. Langley" (ibid., vol. xxii).
58. "Notice of the Death of Gustav Robert Kirchhoff" (ibid., vol. xxiii).
58*. "Address as President on presenting the Rumford Medal to A. A. Michelson" (ibid., vol. xxiv).
58**. "The 'Mécanique Céleste' of Laplace, and its Translation by Bowditch" (ibid., vol. xxiv).
59. "On the Electro-dynamic Forces" ("Proceedings of the American Association for the Advancement of Science" (vol. ii).
60. "On a Curious Phenomenon relating to Vision" (ibid.).
61. "On a Singular Case of Interference in the Eye itself" (ibid., vol. vii).
62. "On a Modification of Soleil's Polarizing Apparatus" (ibid.).
63. "On the Australian Weapon called the Boomerang" (ibid., vol. xii).
64. "On the Optical Method of studying Sound" (ibid., vol. xvi).
65. "On the Periodicity of the Aurora Borealis" (ibid., vol. xvi, 1868).
66. "Sympathetic Vibrations between Tuning-Forks and Stretched Cords" (ibid., vol. xvi).
67. "On Methods of Illustrating Optical Meteorology" (ibid., vol. xix, 1871).
68. "On Sympathetic Vibrations" (ibid., vol. xxi, and "Journal of the Franklin Institute," May, 1873).
69. "Addresses as President at the Portland Meeting" (Proceedings of the A. A. A. S., vol. xxiii).
70. "On a New Way of illustrating the Vibrations of Air in Organ-Pipes" (ibid., vol. xxiii).
71. "Address as Retiring President, A. A. A. S." (ibid., vol. xxiii, republished in "The Popular Science Monthly," "American Journal of Science," and the "London Philosophical Magazine").
72. "On a New Method of measuring the Velocity of Electricity" ("Proceedings of the American Association for the Advancement of Science," vol. xxiv, also "Journal de Physique," tome vi).
73. "Shooting Stars" ("American Journal of Science," vol. xxxv).
74. "The American Prime Meridian" (ibid., N. S., vol. ix, 1850).
75. "The Aneroid Barometer" (ibid., N. S., vol. ix, 1850.)
76. "On the Velocity of Light and the Sun's Distance" (ibid., N. S., vol. xxxvi).
77. "Melloni's Researches on Radiant Heat" ("American Almanac," 1850).

78. "Animal Electricity" (ibid., 1851).
79. "Recent Discoveries in Astronomy" (ibid., 1852).
80. "Comets" (ibid., 1853).
81. "Atmospherical Electricity" (ibid., 1854 and 1855).
82. "Lightning and Lightning-Rods" (ibid., 1856).
83. "Terrestrial Magnetism" (ibid., 1857).
84. "Theories of Terrestrial Magnetism" (ibid., 1858).
85. "On the Boomerang" (ibid., 1859).
86. "On the Aurora Borealis and Australis" (ibid., 1860).
87. "On Meteorology" (ibid., 1861).
88. "On the Pressure of the Atmosphere and the Barometer" (ibid., 1862).

REVIEWS, ETC.

89. "Guyot's Physical Geography" ("Christian Examiner," vol. xlvii).
90. "Humboldt's Cosmos" (ibid., vol. xlviii).
91. "Skepticism in Science" (ibid., vol. li).
92. "Spiritual Mechanics" (ibid., vol. lv).
93. "Thompson and Kaemtz on Meteorology" ("North American Review," vol. lxxi).
94. "Elementary Works on Physical Science" (ibid., vol. lxxii).
95. "Michael Faraday" ("Old and New," vol. i).
96. "Reports on Lighthouses." By Benjamin Peirce and Joseph Lovering ("Journal of the Franklin Institute," vol. xviii).
97. "On the Internal Equilibrium and Motion of Bodies" ("Cambridge Mathematical Miscellany," vol. i).
98. "On the Application of Mathematical Analysis to Researches in the Physical Sciences" (ibid.).
99. "Encke's Comet" (ibid.).
100. "The Divisibility of Matter" (ibid.).
101. "Boston and Science" ("Memorial History of Boston," vol. iv).
102. "Article on the Telegraph" ("American Cyclopædia," last edition).
103. "Address at the Dedication of the Mural Monument to the Memory of Dr. James Walker," in the Harvard Church, Charlestown.

SUBJECTS OF LECTURES AT THE LOWELL INSTITUTE.

1840–'41. "Electricity and Magnetism."
1841–'42. "Mechanics."
1842–'43. "Astronomy."
1843–'44. "Optics."
1845–'46. "Astronomy."
1853–'54. "Electricity and Magnetism."
1859–'60. "Astronomy."
1865–'66. "Light and Sound."
1879–'80. "Connection of the Physical Sciences."

Prof. Lovering also edited six volumes, from V to X inclusive, and part of Volume XI, of the "Memoirs" of the American Academy of Arts and Sciences; also the "Proceedings" of the same Academy, Volumes VII, VIII, and XVII.

EDITOR'S TABLE.

MR. WALLACE ON "DARWINISM."

THE recently published work of Mr. Alfred Russel Wallace on "Dar winism" furnishes a timely and weighty answer to those who, following the rash lead of the Duke of Argyll, have lately been maintaining that the doctrine of natural selection is wholly unable to explain the development of species, and that, as a theory, it has had its day. Far from conceding anything to this noisy school, Mr. Wallace is disposed to make even larger claims for the potency of this principle than Darwin himself did, and certainly larger than Mr. Spencer is to-day disposed to allow. He holds that we only have to look closely enough at the facts in order to see the influence of natural selection everywhere, and to convince ourselves that it alone has presided over the whole development of vegetable and animal forms. It is needless to say that Mr. Wallace is a naturalist of the very first rank, and that his reasonings do not lack for facts and illustrations to enforce them. The work he has now given to the world is an exceedingly valuable repertory of information bearing on the questions he discusses, and is written in a style at once popular and exact. In giving it the title "Darwinism," he once more evidences the generosity of nature which led him thirty years ago to waive the claims he might have urged as discoverer of the principle of the variation of species by means of natural selection. He recognizes that Darwin has made that whole field of investigation peculiarly his own; and he is, therefore, very willing that Darwin's name should stand indissolubly and exclusively connected with the great revolution in speculative biology which our generation has witnessed.

The two principal questions which Mr. Wallace's work will bring into prominence are (1) whether the extremely wide claims he puts forth on behalf of natural selection are fully made good; and (2) whether his views in regard to the mode of development of man's higher intellectual and moral nature are well founded. Upon the first point, as we have already hinted, Mr. Wallace comes into direct collision with Mr. Spencer. The latter considers that the doctrine of natural selection can not account for certain cases of variation, and that we must have recourse to the supplementary doctrine of use and disuse. Mr. Wallace takes up the instances cited by Mr. Spencer, and endeavors to show that they may be explained without calling in any other law than that of natural selection. He admits that, as regards those "lower organisms which consist of simple cells and formless masses of protoplasm," the action of the environment is very marked, and that the variations it produces on individual forms may be transmitted by inheritance; but he does not consider that we can argue from cases in which the environment acts thus powerfully on the whole life of the organism, and, of course, necessarily on its reproductive system, so far as it can be said to have a system, to cases where the outward structure alone of well-established types is affected by change of habit. Such modifications he does not think are transmissible by inheritance; spontaneous variation and natural selection alone are adequate, in his opinion, to produce permanent variation. The question is manifestly an obscure one, calling for patient and exhaustive investigation. If changes produced by the environment in the very lowest forms may be transmitted by inheritance, as Wallace admits, then the

question is, at what point the line is to be drawn. How far down may we come in the development of type before this principle ceases to act? Again, how can it be positively ascertained that changes of nutrition, or changes in the general balance of function, may not act on the reproductive system so as to produce inheritable variation? Mr. Wallace does well to stand up for the doctrine of natural selection, and to insist that it shall not needlessly be put aside; but the general doctrine of evolution would not suffer if the exceptions to the action of natural selection contended for by Mr. Spencer should ultimately be maintained.

Refusing to admit any other general law than that of natural selection as a key to the development of species, and finding, as he asserts, that law inadequate to explain man's moral and intellectual nature, or rather the extreme differences existing between individuals in respect to moral and intellectual qualities, Mr. Wallace summons to his assistance the theory of a special "spiritual essence of nature, capable of progressive development under favorable conditions." To explain an unknown thing by one still more unknown has never been considered a quite satisfactory logical performance; and we can not help feeling a little surprised that, in a purely scientific treatise, our author should resort to such a method. "On the hypothesis," he says, "of this spiritual nature superadded to the animal nature of man we are able to understand much that is otherwise mysterious or unintelligible in regard to him." The trouble is that "this spiritual nature," as it does not lend itself to definition, is not and can not be an object of knowledge, and therefore can not serve as a scientific hypothesis at all. It may, however, be questioned whether Mr. Wallace is not untrue to his own principles when he says that the differences in moral and intellectual attributes between different individuals are greater than can exist under the rule of natural selection. Who is to set the limits of spontaneous variation in any species, and, above all, in the most complex and highly organized species, man? In the lower tribes individuals departing in a marked manner from the average type are generally doomed to destruction; but in human society it is different. Human society is itself an organism of ever-increasing complexity as we pass from the lower to the higher races; and in the social organism there is room for an infinite variety of tastes, accomplishments, aptitudes, and powers. A man need not be a great mathematical genius or have a surpassing talent for music in order to survive; neither does an extraordinary development in either direction necessarily lead to his extinction. A place can generally be found for every man whose nature is not absolutely anti-social. Thus extreme variations are preserved, and the qualities they imply are kept, as it were, in circulation in the social body, ready to manifest themselves under suitable conditions. The range of variation in men would probably be greater than it is were it not for the fact that the law of natural selection is at work more or less at all times in suppressing both superiorities and inferiorities. It was an old pastime of a certain venerable race to stone their prophets; and one of their wisest men has left on record the caution: "Be not righteous overmuch, neither make thyself overwise: why shouldst thou destroy thyself?" Nor has the danger of excessive righteousness altogether vanished in our own time, as Mr. Spencer in his essay on "The Morals of Trade" bears impressive witness. But, on the other hand, there are dangers in excessive inferiority. After uttering his caution against over-righteousness the Hebrew moralist goes on to say: "Be not overmuch wicked, neither be thou foolish: why shouldst thou die before thy time?" And to-day, as then, the man who is

overmuch wicked or foolish generally meets an early fate. The law of natural selection is, therefore, manifestly at work in controlling the moral and intellectual development of society; and if, in spite of this, there is a much wider variation between human individuals than obtains in the lower orders of animal life, that is just what, considering the extreme complexity of the social organism, we should have expected.

THE COACH OF CIVILIZATION.

The author of that popular book "Looking Backward" has given a graphic description of present-day civilization, as he understands it, by comparing it to a coach in or on which the wealthy classes ride while the working classes drag it over heavy roads and up steep ascents. It would almost seem as if the author had been more concerned to write what the French call *une belle page* than to represent things as they really are, otherwise the picture would have been somewhat differently drawn. Nothing is told us of the means whereby seats on the coach are obtained nor of the means by which they are lost. There is no hint that frugality, prudence, self-control, readiness of resource, and social usefulness, are in general the qualities by which men rise to competence, or that it is the lack of these qualities, and often of any disposition to possess them, that consigns some men to the labor of the rope. We do not read that the man who is on the coach has often helped to make better conditions of life for multitudes of his fellow-men, nor is a hint dropped that many of those who get the credit of riding are really themselves laboring hard to help the vehicle forward. There is nothing in the whole description that answers to the case of those intelligent, efficient, and self-respecting workers who, without reaping wealth, obtain a large measure of comfort and ample means of self-improvement. We get no hint of social vices that do more to make the lot of their victims difficult, if not hopeless, than anything in the constitution of society. Mr. Bellamy might, had he chosen, have introduced these points. They are so obvious that he could not have overlooked them, and we must therefore conclude that he omitted them on literary grounds. The way to be tiresome, said Voltaire, is to say everything; and Mr. Bellamy did not want to be tiresome, so he simply gave us a picture of a coach crowded with idlers and dragged by the industrious under the lash of hunger. Well, Mr. Bellamy has produced the effects he aimed at. His coach has been very widely talked about and considerably admired; so perhaps now he might take into consideration those who are not so impatient of details as to prefer a misleading comparison, dashed off with a few bold strokes, to a more correct one carefully elaborated. We know he could make another coach for us if he tried, and we should very much like him to try.

Far be it from us to say that society as we see it to-day has reached the acme of perfection; there is much in it we are deeply persuaded that is faulty and that might be improved. We want greater economy in production and—no one need hesitate to say—greater equality in distribution. We want a greater sense of social responsibility on the part of the holders of wealth, and we want especially a diminution of the senseless passion for display. These things we believe are now on the way, though it might be hard to discern the signs of the one last mentioned. Society is becoming every day more closely knit in the bonds of a common sympathy; the self-respect of the average man is daily increasing and public opinion is becoming at once more rational and more humane. What we have chiefly to contend with to-day is not the idleness or extravagance of a few, but a general lack of knowledge as to the best methods of social co-operation. Where Mr. Bellamy

errs, in our opinion, is in making the wealthy portion of society a simple burden upon the poor. Such is not the case. On the contrary, it is the men of wealth who have done more than any other class to direct labor into useful channels and generally to vivify and fertilize the industry of the world. If Mr. Bellamy could amend his story of the coach so as to bring this undoubted fact into prominence, he would do more justice to the century in which he lives, and take a little of the sting from the diatribes of his Dr. Barton.

LITERARY NOTICES.

EDUCATION IN THE UNITED STATES: ITS HISTORY FROM THE EARLIEST SETTLEMENTS. By RICHARD G. BOONE. New York: D. Appleton & Co. Pp. 402. Price, $1.50.

THIS is the eleventh volume of the "International Education Series," and is characterized by the general editor of that series as the first noteworthy attempt to present the subject, and as forming "a tolerably complete inventory of what exists, as well as an account of its origin and development." We find it a systematic and comprehensive treatise, presenting the important facts in their bearing upon one another and their relations to contemporary conditions. The history is divided into the Colonial and the Revolutionary periods and the period of Reorganization, to which is added a review of "Current Educational Interests." The discussion of "The Colonial Period" comprises the history of the earliest American schools, of colonial colleges, and of colonial school systems. Under "The Revolutionary Period" are sketched the conditions of elementary, secondary, and collegiate education during the time included. The third part, "The Period of Reorganization," includes accounts of the transition from the old to the new, with its centralizing tendencies, the agencies and methods for the preparation of teachers, the development of the course of instruction in the more recent colleges, the aspects of professional, technological, and special education, the growth of supplemental institutions, learned societies and libraries, and the relations of Government and education. "Current Educational Interests" embrace "Compulsory School Attendance," "The Gradation of Schools," "Education in the South," and "The Higher Education of Women." To each chapter is appended a bibliography. The author's aim has been "to suggest lines of thought for the teacher and sources of information, and, avoiding mere description on the one side and personal criticism on the other, to exhibit faithfully the development of contemporary institutions and educational forces, with something of their national setting." The editor, Dr. Harris, sees in the trend of the educational movement, as disclosed in this history, a tendency from private, endowed, and parochial schools, toward the assumption of education by the state, away from isolated efforts and toward system and supervision, and in methods toward the adaptation of the matter of instruction to the mind of the child and toward improved discipline. The entire educational idea of the people, too, "has progressed in the direction of divine charity," as is exemplified in the greater attention paid to the education of women and to institutions for unfortunates. The author finds our educational system still very imperfect, and notices as problems yet unsolved or not provided for the means of securing a supply of qualified teachers; a way, while shaping the understanding mind, of bringing up youth with sound bodies and a love for truth; the relation which the public schools should sustain to industrial training; questions concerning infant and primary and free public higher and professional education; extra-school training; and the constitution of a citizenship education. A hopeful outlook is discerned in the fact that common-school questions are being studied by college presidents and professors as related to their own labors, and by economists and historians.

INDOOR STUDIES. By JOHN BURROUGHS. Boston and New York: Houghton, Mifflin & Co. Pp. 256. Price, $1.25.

MR. BURROUGHS is best known as a writer about Nature, or outdoor subjects. In that department he has gained a position among the select representative authors of our country. Completely at home amid rural sur-

roundings, communing with Nature, and then drawing from the hidden stores of his mind what he has absorbed from her, independent in thought and thoroughly American, and pithy and vigorous in expression, he found an audience as soon as he took the platform from which he was best fitted to speak; and that audience has been growing ever since. In the "Egotistical Chapter," which forms one of the "studies," he relates how, like many other authors who have afterward achieved success, he groped in unlucky experiments before he found his proper place. He began by reading books of essays and trying to catch their style; and wrote essayish papers on subjects whose interest was so universal that it was spread out very thin, to have them sent back by the journals to which he offered them; and finally took to outdoor themes "to break the spell of Emerson's influence, and get upon ground of his own." His style, which is of the most forcible, and in which strong thoughts are condensed into few words of most direct meaning, is the result of much study and discipline, in which, he says, "I have taught myself always to get down to the quick of my mind at once, and not fumble about amid the husks at the surface." Of late years he has been giving more attention to literary topics and subjects of scientific discussion, although in these also the nature-side appears most prominent to his view. The present volume is largely made up of articles of this character. In them he displays the same independence that characterized his earlier work—a determination to say what he thinks, without giving himself worry concerning what others may have said or thought. In two of the longer essays—"Matthew Arnold's Criticism" and "Arnold's View of Emerson and Carlyle"—the literary side is alone conspicuous; in two others, "Henry D. Thoreau" and "Gilbert White's Book," we have the student of nature appreciating and criticising his two most illustrious co-workers in the same line. "Science and Literature" is an attempt to measure the value of science in culture, in which the author indicates that "the final value of physical science is its capability to foster in us noble ideals, and to lead us to new and larger views of moral and spiritual truths. The extent to which it is able to do this measures its value to the spirit—measures its value to the educator. That the great sciences can do this, that they are capable of becoming instruments of pure culture, instruments to refine and spiritualize the whole moral nature, is no doubt true; but that they can ever usurp the place of the humanities or general literature in this respect is one of those mistaken notions which seem to be gaining ground so fast in our time." In "Science and the Poets" Emerson is held up as the poet whose work has been most influenced by science. "A Malformed Giant" is a brave criticism of Victor Hugo's excesses of style and manner. Of the eight "Brief Essays," "The Biologist's Tree of Life" touches a scientific subject, and "An Open Door" relates to the question of a superintending Providence.

RIVERSIDE LIBRARY FOR YOUNG PEOPLE. No. 3. BIRDS THROUGH AN OPERA-GLASS. By FLORENCE A. MERRIAM. Pp. 223. UP AND DOWN THE BROOKS. By MARY E. BAMFORD. Pp. 222. Boston: Houghton, Mifflin & Co. Price, 75 cents each.

THE "Riverside Library" series is designed especially for boys and girls who are laying the foundation of private libraries, and is intended to consist not of ephemeral publications, but of "books that will last." It will comprise principally books of history, biography, mechanics, travel, natural history, adventure, and kindred themes, with fiction not excluded, presenting the various subjects in an attractive manner, but not in the "*Childese* dialect." The author of "Birds through an Opera-Glass," recognizing the perplexities of young observers, has tried to supply their wants, the chief of which in studying birds is the means of distinguishing and identifying them without having to become ornithologists or to grapple with the technical terms in the text-books. The opera-glass supplies a means of looking at the creatures as if from a shorter distance than it is possible to approach them, and will or should supply the points by which they are to be recognized. To these points are added such facts as lie within reach of the young observer's opportunities respecting the song, nesting, and general behavior of the bird. The robin supplies the standard by which all the other birds are com-

pared. Some simple and easily followed rules for observation are given. With these, the opera-glass, and his own good sense, the young observer is introduced by the aid of the pleasing descriptions to some seventy species. To these are added a table, which the author calls "pigeon-holes," for the classification of the birds, synopses of general family characteristics and of arbitrary classifications, and a list of books for reference.

"Up and Down the Brooks" is the story told in a similar spirit of the insect life in and upon the water. The specimens serving as types were collected in the brooks of one of the counties of California; but the author judges rightly that members of the same families may be found by almost any brook East or West, and that her accounts will serve for all. These insects are such as every one sees dancing upon the water, swimming in it, or flying above it; but few have any real acquaintance with their nature, mode of growth, habits of life, or affiliations. To those who wish to know about them, this little series of sketches will be convenient and instructive as well as entertaining.

DAYS OUT OF DOORS. By CHARLES C. ABBOTT. New York: D. Appleton & Co. Pp. 323. Price, $1.50.

A BOOK about Nature by Dr. Abbott by this time needs no special introduction to the readers of the "Monthly." They have all had a taste of the author's quality as an observer and describer of outdoor life, and know that he is capable of transmitting to any others who will listen to him or read him the variety and enjoyment that he finds there. As the

> "ragged cliff
> Has thousand faces in a thousand hours,"

Dr. Abbott finds the same to be "true of the tamest pasture, where not even the clover and buttercups of one side are the twins of the buttercups and clover of the other"; and where through the succeeding changes of the year objects of interest "never repeat themselves, or else I am daily a new creature. Nor sight nor sound but has the freshness of novelty, and one rambler, at least, in his maturer years is still a boy at heart." These changes by the month and season enter into the plan of the present book, which presents a kind of naturalist's calendar or diary of the months. The birds figure as the principal characters, though other objects of life are not unregarded, and the story of their coming and going, or sometimes staying, their working, sporting, cooing, nest-breeding, and initiation into the experiences of life, is recorded consecutively from January through the winter, spring, summer, and autumn months, till December closes the cycle and ends at the time when a new series is to begin. Other people find novelties and things of ever refreshing interest abroad. Dr. Abbott does not deny them the pleasure, for he can do and has done the same; but he can find, too, all that is needed to make life worth living on the banks of his unpretending creek and modest river to which it is ever his pleasure to return. Therefore he holds "that one need not mope because he has to stay at home. Trees grow here as suggestively as in California, and the water of our river is very wet. Remember, too, if trees are not tall enough to suit your whim, to lie down beneath the branches of every one of them, and, as you look up, the topmost twig pierces the sky. There is not an oak but will become a gigantic *Sequoia* in this way. One need learn no magic to bring the antipodes home to him." This is, perhaps, the principal lesson taught in the book, and it is made extremely palatable by the spice of familiar illustration, incident, adventure, personal delineations, old lore of history and tradition, and pictures of the brook and fields and their incessantly changing life.

PHYSICAL REALISM. By THOMAS CASE, M. A. London and New York: Longmans, Green & Co. One vol. 8vo. Pp. 387. Price, $5.

THIS is an able and scholarly work, well worthy the attention of those familiar with the course of philosophical thought and fond of philosophical discussion. The argument of the author is that we sensibly perceive an internal but physical world—physical objects of sense in the internal nervous system—from which we infer an external and physical world. This is "physical realism." It is opposed to intuitive or natural realism, which declares that we directly perceive an external physical world; and to cosmothetic idealism, which concludes that we are sen-

sible of a psychical, but infer a physical world. It also controverts all the strictly idealistic hypotheses. The treatise is divided into two parts, the first containing the "General Proof of Physical Realism," and the second dealing with "Psychological Idealism." This last embraces in successive chapters criticisms of the philosophies of Descartes, Locke, Berkeley, Hume, and Kant, from the author's point of view. These discussions are very acute and interesting. In general, it may be said that the negative part of the work, or the refutation of idealistic doctrines, is more successful and more valuable than the constructive portion which involves the substantiation of the author's theory.

PSYCHOLOGY AS A NATURAL SCIENCE, APPLIED TO THE SOLUTION OF OCCULT PSYCHIC PHENOMENA. By G. C. RAUE, M. D. Philadelphia: Porter & Coates. 8vo. Pp. 541, 1 vol.

THIS is a disappointing book. Its psychology is crude, and as "applied to the solution of occult psychic phenomena," it does not appear to solve anything. The occult phenomena, indeed, are not reached till page 380, and the part relating to them is largely taken up with extracts from well-known authors (like those belonging to the Society for Psychical Research, Mesmer, Braid, Fahnestock, and others), upon which Dr. Raue makes, it must be said, some interesting comments; but he adds nothing, so far as we are able to make out, to the store of human knowledge upon the subject. What explanation he does give is an application of his psychology, which is based upon or rather an exposition of that of Dr. Friedrich Eduard Beneke, who, the author thinks, has been undeservedly neglected by succeeding thinkers. In this notion we can not agree with Dr. Raue, because there is nothing sufficiently significant in Beneke's work to make it worth while for students of the present time to recur to his writings. A sample of this applied psychology is found in the explanation of "thought-transference." The latter may be understood, according to the author, if we suppose that the soul actually consists of different systems of substantial primitive forces, having "mobile elements," and producing different mental modifications which are *spaceless*, "and consequently not restricted by any corporeal distance or interference, so that they can reach a similar psychic modification in another mind as well as in their own, and impart to it their own state of excitement and make it conscious." But how, pray, are we able to conceive of motion without space or "room" for motion? And if thought is thus excited in one person by the attraction of similar excitation in another, there being motion from the one to the other, what more is this than a statement that there is some subtle power of thought-transfer which we do not understand? To make such an averment we hardly need Dr. Raue's book.

Thus, while the scholar will always find much to interest him, and much to approve in any work of this character, prepared with serious purpose, we can not recommend it to those who are only able to give a limited amount of attention to the topics of which it treats, being persuaded that they can more profitably spend their time upon something else.

It is a little singular that no mention is made in this book (written by a Philadelphian) of the very interesting and valuable report by the Seybert Commission of the University of Pennsylvania upon some of the most curious of these "occult psychic phenomena."

THE PHILOSOPHY OF KANT; AS CONTAINED IN EXTRACTS FROM HIS OWN WRITINGS. Selected and translated by JOHN WATSON, LL. D., Professor in Queen's College, Kingston, Canada. One vol. Pp. 356. Macmillan & Co. Price, $1.75.

KANT'S KRITIK OF THE PURE REASON EXPLAINED AND DEFENDED. Being Vol. I of Kant's "Critical Philosophy for English Readers." By JOHN P. MAHAFFY, D. D., and JOHN H. BERNARD, B. D. Pp. 389. Macmillan & Co. Price, $1.75.

THE demand for a return to Kant, which has been evident in the philosophical world for a few years past, has issued in a good deal of new and valuable Kantian literature, and there is likely to be more; for it can not be denied that this return to the study of Kant has produced an increase of his authoritative influence. Whatever our views may be of the wisdom of pursuing philosophy under the chief guidance of the Königsberg sage, and whatever may be our opinion of the value of his principles and method, there is no doubt that a thorough study of his

works is indispensable, not only for scholarship's sake but also to secure a proper mental equilibrium in forming a theory of knowledge, on the part of those especially who have been educated to rely on *a posteriori* methods. For the reason just given the scientific student can least of all afford to neglect Kant, and if he has a contempt for this philosopher he may be assured that there is still opportunity for creditable achievement in the way of refuting the author of the "Kritik" on many important points still left for the ambitious controversialist.

The two works above mentioned are excellent, each in its own way, for the purpose of making the student acquainted with Kantian philosophy.* Prof. Watson's idea is to present to a class of more advanced students a series of carefully selected extracts from the chief treatises of Kant, "The Critique of Pure Reason," "The Metaphysic of Morality," "The Critique of Practical Reason," and "The Critique of Judgment"; then to aid these students by the discussions of the class-room, using the extracts as a text-book. It must be borne in mind that, except possibly where a student is devoting himself exclusively to philosophy, never could he hope to go over the whole of the four works just named under the teacher's class instruction. The advantage, then, of a work like Prof. Watson's is very apparent, if the selections have been so judiciously made as to present connectedly the most important parts of the treatises. In accomplishing this the editor has been very successful. He has made good his claim that the volume "contains all the main ideas of Kant in their systematic connection," and he has produced a very useful book for those who have not the time to devote to Kant's works in full, and also an excellent preparatory course for those who intend to go further in studying that philosopher.

Prof. Mahaffy's book is a good one for the student to read in connection with a text-book like Prof. Watson's. It is expository and critical; we regret to say it is also polemical, the latter quality constituting its chief weakness. In a somewhat extravagant preface Prof. Mahaffy expresses his conviction that Kant is "certainly the greatest" of all metaphysicians, "and perhaps the most imperfectly understood." We do not think the writers of this volume have added anything to Kant's greatness, whatever it may be, but we do consider that they have contributed something to a better understanding of him. For the most part they have correctly apprehended their master's meaning, and have clearly interpreted him in a style of diction which is very agreeable and well calculated to hold the student's attention. This volume is to be followed by a second, containing the "Prolegomena" of Kant.

STATE OF NEW YORK. TWENTY-SECOND ANNUAL REPORT OF THE STATE BOARD OF CHARITIES, 1888. CHARLES S. HOYT, Secretary. Pp. 608.

THE visitorial powers of this board extend to all charitable, correctional, and eleemosynary institutions, excepting State prisons, supported wholly or in part by the State, or by cities, counties, incorporated benevolent associations, or otherwise. Its executive duties are the supervision of the support, care, and removal of State paupers; the examination and removal of alien paupers to their homes in different countries of Europe; watch of the care of the insane; the approval and certification of incorporations for the custody and care of dependent children; and the oversight and control of insane Indians on the several reservations of the State. It has also authority to require reports from the various institutions subject to its visitation. The institutions included within this jurisdiction have in all $54,310,658 of property; return as the year's receipts, $14,591,817, and $13,315,698 expended; and care for 64,322 persons. The report gives a picture of their general condition and operations.

"WAR WITH CRIME." Being a Selection of Reprinted Papers on Crime, Reformatories, etc. By the late T. BARWICK LL. BARKER, Esq. Edited by HERBERT PHILIPS and EDMUND VERNEY. London and New York: Longmans, Green & Co. Pp. 299. Price, $4.

MR. BARKER, who died in December, 1886, is described as having been a man of diligent thought, who sought out the principles that underlie the practical side of every question. "A country squire of moderate wealth, he studied the duties incumbent on him in that

station of life; a country magistrate, he felt bound to inquire into the causes of crime, and to use for the benefit of the community the experience gained on the bench; a poor-law guardian, he was drawn into personal sympathy with the poor, the outcast, and the destitute." The papers he left behind him, from which the selection of those in the present volume was made, embody his well-digested thought on a variety of subjects, and many of them deal with problems still unsolved. Of those here presented, three deal with the prevention of crime generally; others present as a practical measure for that object the apportionment of sentences to crimes on a scientific principle which should be made clearly understood, of "cumulative punishment." This means gradation according to the antecedents of the offender and the number of repetitions of the offense, with a term of police supervision added, under which the man might be encouraged to try to regain his character in honest employment. Other papers deal with adult reformatories; the imprisonment of children, which is advocated under certain conditions; jail labor; reformatories; measures for just dealing with vagrants; ecclesiastical questions; education; labor and wages; and the prisons bill (Mr. Cross's of 1876).

EXPLORATION OF THE CHEST IN HEALTH AND DISEASE. By STEPHEN SMITH BURT, M. D. New York: D. Appleton & Co. Pp. 206. Price, $1.50.

THIS manual, which embodies the methods pursued by the author with his classes, is intended to aid the student in learning the significance of physical signs and their mode of development. Dr. Burt states that he has made no attempt to establish distinctive signs of disease, because he is convinced that "precision in diagnosis is more surely attained by treating each sign as subordinate to the various combinations of signs which are found in the different maladies." The text is illustrated with cuts showing the position of the heart and lungs with reference to each other and to the chest-walls, the forms of instruments, etc. In describing the different forms of stethoscopes, the author expresses a preference for one which engages both ears. He has discovered, by means of the double stethoscope, what he deems a demonstration of the dual function of the ears, viz., for perceiving the direction of sounds. When listening to the ticking of a watch with a binaural stethoscope having arms of soft rubber tubing, if one arm is closed by pinching it, the watch seems to have been removed to the ear which still hears its ticking. If the tube is released and the other one is closed, the watch appears to be transferred, not to its actual place, but to the other ear.

ANNUAL REPORT OF THE CHIEF SIGNAL-OFFICER OF THE ARMY TO THE SECRETARY OF WAR FOR THE YEAR 1888. By A. W. GREELY. Washington: Government Printing-Office. Pp. 418.

ON the military side of his functions, the Chief Signal-Officer records the steps he has taken to secure a suitable heliograph apparatus, the selection of field-glasses for army use, and experiments with homing pigeons. The inadequacy of the present methods to insure instruction in military signaling is lamented, with the declaration that "there is not an average of two officers to a regiment who are competent to transmit signals —by sun, flag, and torch—day and night, except those who have passed through a regular course of instruction in connection with this office." A valuable report by Lieutenant Thompson on foreign organizations and appliances for signaling forms one of the appendixes of the volume. In the matter of the weather service, credit is accorded to three of the principal newspapers of the country for the assistance given by their meteorological editors in supplementing the general predictions made by the office by their own local predictions, and to other journals for publishing meteorological data of local interest. Of the storm-signals, 77·4 per cent were verified; the system of cold-wave observations was continued successfully and satisfactorily. Observations on atmospheric electricity were continued at four stations. Bulletins showing the effect of the weather on the crops were issued weekly. The railway bulletin service has decreased, having been largely superseded by the State services, which are well spoken of. The question of river observations, in relation to dangerous floods and the stages of navigation, engaged attention. A system of rainfall stations was instituted in July, 1887, at

suitable points in the great water-sheds, near the sources of the principal tributaries of the largest rivers. Improvements in the organization of the service are shown to be much needed to make it as efficient as it should be.

FUNDAMENTAL PROBLEMS. THE METHOD OF PHILOSOPHY AS A SYSTEMATIC ARRANGEMENT OF KNOWLEDGE. By Dr. PAUL CARUS. Chicago: The Open Court Publishing Company. Pp. 267. Price, $1.

THE papers presented in this volume, constituting a constructive series of philosophical essays, first appeared for the most part in the editorial columns of "The Open Court." They were there subjected to criticism and discussion which the author has turned to advantage in revising and rearranging and adding to them. Philosophy is regarded, from a point of view both radical and conservative, as the most practical and important science, whose problems lie at the bottom of all the single sciences, of which religion and ethics are applications. The view is radical, because the issues of philosophic thought are presented in their rigidity without trying to conceal the consequences to which the argument leads, with the old and long-cherished errors faced and critically explained; and conservative, because the historical connection with the work of our ancestors is regarded, and progress is sought through a development from the past, not by a rupture with it. "A philosophy of most radical free thought" is presented, "that is no negativism, no agnosticism, and no metaphysical mysticism, but a systematic arrangement of positive facts." This philosophy is monism, or a conception of all existence as one. This is complemented by meliorism, or the conception of a purified, higher view of life.

HOME GYMNASTICS FOR THE WELL AND THE SICK. Edited by E. ANGERSTEIN, M. D., and by G. ECKLER. Translated from the Eighth German Edition. Boston: Houghton, Mifflin & Co. Pp. 94. Price, $1.50.

WHILE setting forth in no uncertain terms the invigorating effects of systematic bodily exercise, the authors of this manual frankly caution the reader against resorting to gymnastics for the cure of serious diseases, certainly not without previous consultation with a physician, and they warn him also not to impatiently expect striking results after a few weeks' practice. The book comprises some general rules and information about home gymnastics, which is followed by detailed descriptions of sixty-nine exercises, most of which need no apparatus, while for the others dumb-bells, a wand, and a chair are the only articles required. Fifty-two cuts illustrate the descriptions. General directions and specific lists of exercises are then given for the use of boys and girls of different ages, for young men, young women, mature men and women, and for old age. Similar directions and groups of exercises are given adapted to certain conditions of ill-health or imperfect development, such as general weakness, weak chest, stagnation in the abdominal organs, corpulence, bent carriage, etc. A large sheet containing all the cuts, and a list of the exercises, accompanies the volume.

STATE OF NEW YORK. THIRTY-FIFTH ANNUAL REPORT OF THE STATE SUPERINTENDENT OF PUBLIC INSTRUCTION, 1889. ANDREW S. DRAPER. Pp. about 1,000.

THE year covered by this report is described as having been one of marked educational activity. A new interest in educational work was manifested, and showed itself most intelligently in directions which promise the best results. The rivalries and antagonisms between different classes of educational workers are disappearing. The criticisms of the public schools have prompted examination of deficiencies and the search for means of remedying them. More study is given to the history and philosophy of education than ever before; and "on every side a new and healthful interest in public-school work, on the part of those charged with the carrying on of that work, is apparent." The cost per capita of educating the children of the State is put at various amounts, according to the rule by which it is estimated, but the real cost, for the children actually attending the schools, is ultimately fixed at $15.19. The expense per capita of the whole population was $3.08. The statistics of attendance are claimed to show that, while it is relatively smaller than formerly, the school work of the State has grown somewhat in substantial character during the last thirty years. Since 1865 the average attendance in the cities has

advanced about evenly with the advance in total enrollment, and in the towns it has increased twenty per cent, while the total enrollment has fallen off nine per cent. The results of inquiries into the compulsory educational methods of England, France, and Germany are reported. More attention to purely professional work in the examination of teachers is recommended. The superintendent is accustomed, in accordance with the law of the State, to indorse the certificates and diplomas issued by State superintendents and normal schools in other States; and he has had some correspondence with other superintendents with reference to a general understanding on this matter. The responses have not been as general or as satisfactory as was desired. The superintendent believes that the movement in favor of the manual-training system has been retarded by the fact that "the kinds of industrial work which have been pushed forward were such as seemed incongruous with school work and gave small promise of assimilating with it"; and he regards free-hand drawing as offering a simple and practicable means of reaching the same end. Considerable space in the report is occupied with the discussion of questions concerning school libraries. Several valuable documents are included among the "Exhibits" and in the appendix.

THE MODERN SCIENCE ESSAYIST. Monthly. Boston: The New Ideal Publishing Company. Ten cents a number, one dollar a volume of twelve numbers.

THIS periodical has been established as a medium for the publication of essays and lectures presenting the modern scientific or evolutionary aspect of various subjects. Each number contains one essay. The six numbers before us contain the first six of the fifteen lectures on different phases of evolution, delivered before the Brooklyn Ethical Association last winter. These lectures followed a logical order. The first two were biographical sketches of the two great men whose names are most intimately associated with the evolution hypothesis—Herbert Spencer and Charles Robert Darwin, the former by Daniel G. Thompson and the latter by Rev. John W. Chadwick. The third is on "Solar and Planetary Evolution," by Garrett P. Serviss, and is illustrated. This is followed by "Evolution of the Earth," by Lewis G. Janes; "Evolution of Vegetal Life," by William Potts; and "Evolution of Animal Life," by Rossiter W. Raymond. The plan of the series included lectures on the descent of man, evolution of mind, society, theology, and morals; proofs of evolution, its philosophy, and its relations to religious thought and the coming civilization. In undertaking to present to its members and the public in a popular form the leadlng ideas of the evolution philosophy, this association has entered upon a work in harmony with the most enlightened spirit of the time, which can not fail to produce beneficial and gratifying results. The lectures of last winter were delivered by men having special fitness for dealing with the subjects assigned to them, and each furnishes an excellent introduction to a course of reading on its special topic. We learn that the association is to conduct a similar series of lectures next season, and that its success has led to the formation of similar organizations in various parts of the country.

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION, for the Year ending June 30, 1886. Part I. Washington: Government Printing-Office. Pp. 878, with Plates.

BESIDES the operations of the Institution itself and of the National Museum and Bureau of Ethnology, which are regularly under its charge, this report includes sketches of the work of the United States Fish Commission and Geological Survey, which, though independent of the Institution, are related to it in line of work. Not so much as usual is recorded in the way of explorations—partly because the work has been completed in many of the districts, and partly because means have been lacking for beginning new enterprises of any magnitude. The list of publications, besides bibliographies and catalogues, includes several works and monographs of importance and general interest. The development of the National Museum, as measured by the acquisition of fifteen hundred lots of specimens, was unexpectedly great. Besides the central reference library of the museum, sectional libraries have been established in the scientific departments. In

the Bureau of Ethnology, the field work includes mound explorations, explorations in ancient and modern stone villages, and general field studies in institutions, linguistics, etc.; the office work has consisted largely in giving literary form to the results of the field work. The operations of the Geological Survey and the Fish Commission are presented in brief summaries. The summaries and "occasional papers" in the appendix include ten papers relating to anthropology; an article on "Certain Parasites, Commensals, and Domiciliaires in the Pearl Oysters," by R. E. C. Stearns; "Time Reckoning in the Twentieth Century," by Sandford Fleming; and a "Report on Astronomical Observations," by George H. Boehmer.

EXAMINATION OF WATER FOR SANITARY AND TECHNICAL PURPOSES. By HENRY LEFFMANN, M. D., Ph. D., and WILLIAM BEAM, A. M. Philadelphia: P. Blakiston, Son & Co. Pp. 106. Price, $1.25.

THE aim of this manual is to present processes which are trustworthy and practicable, without any useless matter. Certain processes which have long held prominent places are not admitted to this volume, for instance, the soap test for hardness, which is rejected on the authority of Hehner, who has declared it inaccurate, and has devised the method here presented. The colorimetric tests for nitrates and nitrites are described to the exclusion of the processes heretofore in use. Besides the descriptions of analytical operations, the text includes a chapter on the interpretation of results, dealing with the action of water on lead, living organisms in water, identification of the source of water, and the purification of drinking and boiler waters. Tables of various analytical data are appended, there are several pictures of apparatus, and a number of sheets of labels accompany the volume.

COLLEGE BOTANY. By EDSON S. BASTIN, Professor of Botany, Materia Medica, and Microscopy in the Chicago College of Pharmacy. Chicago: G. P. Engelhard & Co. Pp. 451. Price, $3.

AS indicated by its title, this work is adapted to students of some maturity. The first subject taken up in it is "Organography," the organs being divided into those of vegetation and those of reproduction. In describing the organs something is told of their functions, although a short division of the volume is devoted to "Vegetable Physiology," after "Vegetable Histology," which is the second subject treated. Appended to the chapters on histology are directions for the use of the microscope and accessory apparatus. Suggestions for laboratory work follow each chapter in these three divisions of the book. The fourth and closing part is occupied with "Vegetable Taxonomy," ending with a brief account of the succession of plants in geologic time. The text is illustrated by nearly six hundred cuts, largely from drawings by the author, and a glossary of botanical terms is appended. The volume is somewhat marred by typographical errors.

In the *Introduction to Sawyer's Bible*, the *Rev. Leicester A. Sawyer*, of Whitesboro, N. Y., in view of a new translation in course of publication by him, sets forth his views respecting the character, authenticity, date, and purpose of the several books of Scripture. He holds that if the prodigies and miracles of both Testaments are explained in the light of modern science, and if the judgment of the ancients is tested by the laws of evidence ruling in the courts, they will be found "to have been attested only by incompetent witnesses, and by supposed proofs that are entirely sophistical"; and claims that his work will show many of the supposed facts to have been fictions, and of the prophecies to have been written and antedated after the event had occurred. He finds many errors which the late revision has failed to correct, but concerning which he expects to contribute to the formation of right views; and hopes also that his scheme may be adapted to facilitate more successful Bible study than has been generally possible hitherto by readers of English Bibles.

Vol. IX of the *Observations of the National Argentine Observatory* covers the work done during the year 1876, which was directed by *Juan M. Thorne*, in the absence of Dr. Benjamin A. Gould. The volume contains 18,021 determinations of the positions of southern stars.

No. V of Vol. XVIII of the *Annals of Harvard College Observatory* records the observations of the total eclipse of the sun, Au-

gust 29, 1886, made by Prof. *W. H. Pickering*, with the aid of volunteer assistants, on the island of Grenada, in the West Indies. The account is accompanied by four plates. No. VII of the same volume is a record of *A Photographic Determination of the Brightness of the Stars*, all of the measures involved in this work, the identification of the stars, and the numerical computations having been made, with few exceptions, by Mrs. *M. Fleming*. The paper contains a catalogue of 1,009 close polar stars, one of 420 stars in the Pleiades, and one of 1,131 equatorial stars. Part I of Vol. XX is a record of *Observations made at the Blue Hill Meteorological Observatory in the Year 1887*, and is introduced by a description of the observatory and its work, by *A. Lawrence Rotch*, S. B., its proprietor and director. Mr. *H. Helm Clayton* is the observer. The Observatory of Harvard College now co-operates with the Blue Hill Observatory by publishing the observations of the latter, and a consolidation of the two institutions is contemplated. The present record comprises tables of hourly values of atmospheric pressure, air temperatures, wind azimuths and movements, precipitation, bright sunshine, cloud observations, etc., etc. There are six plates showing tracings by self-registering instruments, and a view of the observatory. The Third Annual Report of the *Photographic Study of Stellar Spectra*, conducted at the Harvard College Observatory, and constituting the Henry Draper Memorial, sketches briefly the progress of the work during 1888.

The fourth number of the *Proceedings of the American Society for Psychical Research* (Damrell & Upham, $1) is a pamphlet of about three hundred pages, nearly a third of which is devoted to the report of the committee on phantasms and presentiments, by Prof. J. Royce. The report contains accounts of a large number of cases, with corroborative evidence, and an estimate of their value. A record of experiments in thought transference is contributed by Mr. and Mrs. John F. Brown, and a report upon "the diagram tests," by Prof. C. S. Minot. The theory of telepathy is discussed by Mr. Hodgson and Prof. Minot. The report of the committee on mediumistic phenomena is instructive, in spite of its brevity, for it mentions as an obstacle to this work that mediums which have been recommended to the attention of the committee are constantly being shown up as impostors. Still, the committee has made some investigations, which it is not ready to report, and hopes to make more.

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Austin, Peter T., New Brunswick, N. J. Address on Scientific Agriculture. Pp. 16.—Chemical Lecture Notes: Specimen pages.—Hypochlorous Acid in Alkaline Solution. Pp. 4.—Lecture Experiments with Nitrous Acid. Pp. 6.—Lecture Experiments. Pp. 4.—Dark Rooms and Developers. Pp. 8.—The Relation of Fertilizers to Fruits. Pp. 8.—A Vexatious Mixture for Qualitative Analysis. Pp. 3.—English Examinations. Pp. 5.—A Handy Record-Book. P. 1.—Petroleum as an Explosive. P. 1.

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POPULAR MISCELLANY.

Practical and Moral Instruction in Schools. — What shall be taught in the schools, says the New York State Superintendent, in his last report, is a difficult question to answer. The law leaves it to each locality to settle for itself. "The tendency of the times, particularly in the larger places, is to undertake too much. It ought to be remembered that it does not devolve upon the public schools to put into the child's head all that he will ever be expected to know. . . . It is better to create a desire for knowledge, and supply the implements with which to gain it." The trial of manual training is commended, and this, it is observed, need not be confined to carpentry work with boys and making aprons and dresses with girls. Free-hand or industrial drawing may train the hand and the eye more effectually than handling a saw or a needle. Every school in the State may undertake this without difficulty. The importance of a pervading moral influence in the school-room is insisted upon. "There is, unfortunately," the superintendent remarks, "but little done to stimulate patriotism among children in the public schools, or outside of them. A generation ago it was common to use the masterpieces of our national oratory for the purposes of recitation and declamation in the schools, and the resultant influences were of no small consequence in arousing and cultivating patriotic ardor in the rising generations. Then every child was required to take part in the exercises. But even this is no longer common. The modern fashion is to take pupils who give promise of special success as orators and readers and train them elaborately for show upon public occasions. The older custom might be revived with profit." The normal schools continue to grow in size and extent and to improve in the character and quality of the work performed; and they are gradually confining themselves more and more closely to their legitimate work, the preparation of teachers for the public schools.

Methods of Transportation.—The development of the art of carrying is considered by Prof. O. T. Mason in a paper in the "American Anthropologist" on "The Beginnings of the Carrying Industry." Twenty distinct forms of the art are enumerated by him as preceding the modern inventions of transportation by the power of machinery. Among them are carrying in the hand, which is universal; with both hands, when the load is divided and balanced; on the fingers—the method of the ancient royal cup-bearers; with a baldric; with the load hung to a belt—chiefly employed in carrying treasure; hung to the arm, as when a basket is used; hung from the shoulders, on the shoulder, on the scapulæ, on the back, on the head, on the forehead or bregma, in pockets, by men combined, by hauling, by throwing or tossing, by caravans, with relays, and by couriers. Primitive commerce, says the author, "and all the

carrying and running involved in primeval arts connected with food, shelter, clothing, rest, enjoyment, and war, were accomplished on the heads or foreheads, shoulders or backs, or in the hands of men and women; and civilization, while it has invented many ways of burden-bearing, finds also an endless variety of uses for the old methods. . . . It is, for instance, only a few years since the invention of the passenger and freight elevator began to supplant that caravan of hod-carriers who have been since the beginning of architecture carrying upward to its completion every wooden and brick structure in the world. . . . The back is the natural resting-place for the burden. The lowest savages know this, and inventive genius early began to devise apparatus for harnessing this part of the body. In Africa, on the Andes, in Mexico, throughout the civilized world, the peaceable carrier bears on his back the commerce of the race."

Mexican Porters. —Mr. W. A. Croffut relates, in the "American Anthropologist," that of half a dozen porters whom he saw resting at a Mexican railway station—"One had a sofa on his shoulders, strapped on I could not see how; another bore a tower of chairs locked into each other and rising not less than eight feet above his head; another carried a hen-coop with a dozen or twenty hens, and others were conveying laden barrels and various household goods. They had come, they said, from San Luis Potosi, not less than fifty miles distant." The carriers were almost always in sight from the car-windows of the Mexican National Railroad, and were declared by President Purdy to be its rivals. If it were not for them, the country would treble its railroads in the next year, and the roads would double their profits. "We are combating the custom of centuries. Those fellows carry on their backs to Mexico the entire crops of great *haciendas* far over the mountains."

Monthly Distribution of Incendiary Fires.—Mr. Franklin Webster has found that the prevalence of incendiarism is susceptible of being graphically represented systematically according to the season. The monthly curves for the four years ending in 1886 show that there are more criminal fires in January than in February; that the number increases through March, April, and May, falls off in June, and then increases again till November, to fall off again in December. Taking the years separately, there appears to be an extraordinary regularity in the number of criminal fires in the first six months, while the chief irregularities and widest fluctuations are in the last half of the year; and in this period, criminal fires, taking the whole country, are excessive compared with the earlier months. In the farming districts they are more frequent when the greatest activity prevails, and are especially numerous in the time devoted to harvest; while, during the months when most of the great crops are growing, there is a lull in the reports of incendiarism. Mr. Webster concludes that incendiary fires for the sake of collecting insurance are rare as compared with other fires of criminal origin.

California's Thermal Springs.—According to a paper read by Prof. W. F. McNutt before the International Medical Congress, more than two hundred localities are known in California where waters of temperatures rising to 212° F., and charged with salts and gases of high therapeutic value, pour forth from the earth in great profusion. The number of individual springs in different localities ranges from one to thirty, each varying in composition, temperature, and possibly other as yet undetermined qualities. Although the character of these springs is known, only a few of them have, as yet, been carefully analyzed, and at still fewer have patients been under a competent observer's care. The seven *aguas calientes* springs at Warner's Ranch, fifty miles from San Diego, vary in temperature from 58° to 142°. An account is given of a wonderful little valley near Elsinore, containing altogether one hundred and eighty-six springs of hot and cold water, sulphur, soda, white sulphur, magnesia, iron, borax, hot mud, fresh water, etc. The Arrowhead hot springs, at an altitude of over two thousand feet, vary in temperature from 140° to 210°. An immense petroleum spring is mentioned as being some ten miles west of Santa Barbara, situated in the bed of the ocean, about a mile and a half from the shore, the product of which

continually rises to the surface of the water and floats upon it over an area of many miles. At the thermal acid springs in the Coso Range, Inyo County, thousands of tons of pure sulphur cover the ground, which were deposited there in former times, when the water must have contained large quantities of sulphureted hydrogen. Owens Lake is a remarkable body of water, which is more than twice as salt as the Atlantic Ocean. Volcanic mineral springs are lugubriously situated in Death Valley, and Saratoga Springs at the south end of Funeral Range, south of Death Valley. Mono Lake, in many of its features, resembles the Dead Sea. Of Byron Springs, in Contra Costa County, one, called "Surprise," is both cathartic and emetic. Some of the springs are sparkling with carbonic acid; others contain sulphureted and phosphureted hydrogen; and there are hot mud-baths. Lassen County is full of hot (boiling) springs, having a temperature of from 200° to 212°.

Alpine Funerals.—A clew to the origin of the Irish wake and other funeral pomposities, which we are sometimes inclined to regard as relics of barbarism, may be found in the funeral customs of some of the Alpine regions. The circle of acquaintance of the more prosperous people of the villages often extends over miles of country; and the friends of a deceased proprietor will make long journeys to attend his funeral. The dictates of hospitality require that their physical wants be provided for; or, if not, they will meet at the inn and naturally have something very like a feast. In some districts, even before death occurs and the patient is in his last agonies, all around are informed of the fact and expected to make a ceremonial last visit. They enter the sick-room, take a long look at the dying man, and go their ways. After death, when the body has been prepared for burial, a table is spread covered with refreshments, and open house is held till the funeral. Whoever comes is invited to eat and drink. Two candles are kept burning by the coffin, and two women are employed to watch and pass their time in prayer. After the funeral a hot meal is given to the guests. In Carinthia, while perfect quiet and decency are preserved, the friends are invited to come in and say a prayer for the soul of their late friend, at stated hours, or during the whole time; and occasionally one of them repeats the prayer aloud, while the others join in. On leaving the room, each of the visitors is offered a piece of bread and a glass of wine or spirits, and is expected to accept. Such customs, perfectly simple and proper in their origin, may easily, when carried to excess or abused by unworthy persons or intruders, degenerate into the repulsive wake.

The Girl's Kitchen-Garden.—The Girl's Kitchen-Garden, a practical development of the Kindergarten in adaptation to English or American habits, is an institution for teaching girls from very childhood those things which pertain to good house-work and good housekeeping, by a series of illustrative lessons which are made as attractive as possible. It includes a graduated series of three courses. In the first course the girls are taught methodical daily work, by being taken step by step through the series of duties, to the accompaniment of lively songs, bright object-lessons, and little toy models for table-setting and bed-making. The second course includes washing, ironing, and house-cleaning; in the third course, the parts of beef and mutton, pie-making, baby-dressing with dolly, and "waiting on the door." An English journal observes, respecting the possible utility of the institution: "One can not but notice how happy little girls are if allowed to dust mother's chairs or to iron the stockings and handkerchiefs; how deftly they manage the sweeping-broom with a handle about twice as tall as themselves; how delighted to have a small piece of dough and make grimy little editions of mother's tarts. And one can not but be struck, too, by the fact that as these same little girls grow older they lose this taste, and come to look upon domestic work as drudgery, preferring, when they leave school, any occupation but house-work. Is not this, in a great measure, due to the fact that this natural womanly taste is neglected, and its cultivation left out of the girl's education, with the result that our girls go out as little maids-of-all-work with such profound ignorance and want of method that they are a torment to the mistress and a misery to themselves?" The kitchen-garden is intended to help remedy this evil.

Flirtation in Battak-Land.—The Battaks are a people of common origin with the Malays and resembling them in many respects, who live along the western coast and in the interior of the island of Sumatra. The district chiefs form a confederation, the strongest one among them residing near the Toba Lake. They have enjoyed the advantages of civilization, are good agriculturists, have an original system of writing, and take care to have their children instructed in such arts and knowledge as they appreciate; and yet they eat enemies who are taken armed, and criminals of a certain class, and adorn their tombs with obscene figures. As sentimental people in Western countries practice in a "language of flowers," so the young people of either sex among the Battaks correspond by means of a language of leaves. The leaves themselves have no significance, but their names, modified, perhaps, within the bounds of poetic license, indicate or rhyme with the word which the correspondent wishes to suggest. Besides leaves, corals, bells, ants, and the figures of all sorts of objects are employed for the same purpose. Dr. Van der Tunk, who has studied the Battak language, tells of another method of sentimental communication among them, by means of quatrains, which are called by them *endes* or *umpana*. In these the first two lines are suggested by the language of the leaves, which is employed to suggest their catchword. They, however, have no particular significance, but lead up to the second pair of lines, in which is embodied the sentiment that the lover wishes to express. To be expert in the use of these *endes*, it is necessary to know a considerable number of them by heart. The young maidens are usually better versed in this lore than the young men, and there are often in the Battak villages some who make a business of supplying and interpreting them. It is one of the customs of the people that girls, as soon as they reach a marriageable age, shall leave the houses of their parents and go to live with some other unmarried woman (a widow or grass-widow). A strict surveillance is pretended to be kept over them, which is usually more honored in the relaxation than in the exact observance; and they are by no means debarred the society of young men during this period, nor ignorant of the art of flirtation. While occupied here in weaving mats and making tobacco-boxes and *sirih*-bags, they teach one another the *endes* which they have learned from their grandmothers and other old women, and for retaining which their memories possess enormous capacities.

Atmospheric Tides.—The question of the tides similar to ocean tides that may be created in the atmosphere by the moon has engaged the attention of many physicists since Newton. The longest series of studies on the subject is that of Eisenlohr, which includes thirty-two thousand observations distributed through twenty-three consecutive years. The author concluded that a certain equalization of atmospheric pressure is produced during a revolution of the moon around the earth. According to M. Maurice Guist, a later observer, the equalization is not brought about by the movement of masses of air, but by a kind of expansion of the atmosphere, which only sets in motion distinct particles of the whole mass. Since, in this way, the density of the air at any given point does not change much during a revolution of the moon, the temperature and hygrometric condition are no more influenced; neither the barometer nor other meteorological instruments, therefore, give proof of an atmospheric tide, although, in other points of view, the influence of the moon may be well marked by the instruments. The action of the sun must be still weaker than that of the moon. The equalization of pressure, in this view, takes place the more easily as the difference is less between the augmentation and diminution of density. These conditions exist when the regions of less and of greater density are near one another. Thus the equalization can take place at the quadratures rather than the syzygies; or when the sun and moon are 90° apart their influence is not cumulative as it is at the syzygies. This is fully confirmed by observations. Every culmination of the moon is preceded, for any meridian, by a barometric height inferior to the mean, and is followed by a superior height. The increase of pressure after the culmination is explained by the fact that the atmosphere, not being so much sustained by the moon, bears more heavily upon the mercury in the barometer, while the inverse phenomenon

occurs previous to the culmination. These two inverse variations of pressure may, however, be masked by meteorological conditions, as when there is an ascending or a descending current. During the winter months the mean pressure in the hours following the culmination of the moon is greater than in the hours preceding it. A current of rising air could mask the phenomenon, but there rarely is one at this season. During the summer months the variation is less marked. Finally, if we take account of the action of the sun, we shall find that these differences are more accentuated at the syzygies than at the quadratures, corresponding with what has been observed above. The results of observation thus prove that there really exists an atmospheric tide. It is hardly sensible to our instruments, because we are at the bottom of the ocean, subject to the action of the moon and the sun, and because the elastic force of the air is constantly tending to equalization of pressures.

Art and Fun of the Eskimos.—Much as has been written of the Eskimos, says Mr. E. F. Payne, in a paper read before the Canadian Institute, we find in almost every writing something new to interest us. Mr. Payne's own essay bears out the assertion. In building their *igloos* the Eskimos take advantage of the tendency of the snow to drift on the southeastern sides of the hills, so that the author, on visiting a village after a snow-storm, was struck with its resemblance to a lot of mole-hills. Nothing could be seen but a little snow thrown up on each side of a hole by which a passage led to the *igloo;* but, on a nearer approach, windows could be seen a little below the surface, from which the snow had been removed. Upon entering some of those *igloos*, passageways were found cut through the drifted snow, so connecting the huts as to give the appearance of an underground village. The people are not destitute of the art-sense, but have an inborn love of sketching, and are proficient in carving. Good models of *kyacks*, animals, and birds in ivory are made, especially on the north side of the strait, where the artists vie with one another in trying to make the smallest models. The art of drawing is confined for the most part to describing figures on the level surface of the snow, either with a piece of stick, or in larger figures with the feet. In several instances correct drawings of their own people were made by slowly moving along with the feet close together, and afterward dexterously adding details with one foot. Perspective was a great mystery to them; and even those who were accustomed to look daily at the pictures on the walls of the author's house could not understand it. Involuntarily their hands would steal up to the picture and feel for the objects that seemed to project; while other persons would shift their heads to look behind screens or doors in the picture. Amusements are few, and only one or two excite interest. Throwing the harpoon has the greatest attraction for the men, and wrestling and running are occasionally practiced till the weaker side loses interest. Foot-ball was played with the blown bladder of a walrus covered with leather. "Men, women, and children all took part in it, and no quarter was allowed. Here a woman, carrying her child on her back, might be seen running at full speed after the ball, and the next moment she might be lying at full length with her naked child floundering in the snow a few feet beyond her. A minute later the child would be again in its place, and nearly choking with laughter she would be seen elbowing her way after the ball again. Boys make small spears and throw them at marks; and girls have dolls and keep them till they are married, and they play at housekeeping and going a-visiting just like United States girls.

The Otter at Home.—The otter, as he may be seen sunning himself on a tree-trunk, looks like a large cat which has been thrown into the water and crawled out. Some people think that the fur of the otter throws the water off like the feathers on a duck's back. That is not the case; his fur protects his body in a different way. Any one who has seen a water-rat come up on a bank after a dive will have a good idea of the general appearance of the otter's fur. Now he gives his coat a shake and combs his fur a bit with his short, webbed feet. His head looks for the moment just like that of an infuriated tiger in miniature, as, with ears drawn close to his head, he snarls

and shows his teeth. When properly treated, the otter is easily converted into an affectionate and playful pet. He is a trifle larger than a cat, having a very similar head, only flatter, which is provided with a fine set of teeth, and he can use them with terrible force for his size. On his lip he has a lot of strong bristles. His eyes are small and have a watchful look about them; the neck is almost as thick as his chest; his body is long and round; the legs are very short, strong, and flexible; the toes webbed for a great part of their length, and the claws on them sharp. The tail is thick at the root, and tapers off to a point. It is very powerful, and is, in fact, his swimming-machine. In color he is dark brown, as a rule, with the sides of his head and throat brownish gray. On land the otter moves with a peculiar loping gait. When he comes up out of the water, there is first a little swell on the surface, then his head appears, and if everything is quiet he silently crawls up on a log or bank. When startled, he makes one gliding plunge, and the water closes over him with scarcely a ripple.

The Value of Human Variation. — Mr. Francis Galton, addressing the Anthropological Institute recently, said that anthropologists ought to give more consideration to variety than they have hitherto bestowed upon it. They commonly devote their inquiries to the mean values of different groups, while the variety of the individuals who constitute those groups is too often passed over with contented neglect. An average man is morally and intellectually a very uninteresting being. The class to which he belongs is bulky, and no doubt serves to keep social life in motion. It also affords, by its inertia, a regulator that, like the fly-wheel to the steam-engine, resists sudden and irregular changes. But the average man is of no direct help toward evolution, which appears to our dim vision to be the primary purpose, so to speak, of all living existence. Evolution is an unresting progression; the nature of the average individual is essentially unprogressive. His children tend to resemble him exactly, whereas the children of exceptional persons tend to regress toward mediocrity. The Hebrew race, whose average worth is not especially notable, is mainly of interest on account of its variability, which in ancient and modern times seems to have been extraordinarily great. It has been able to supply men, time after time, who have towered high above their fellows, and left enduring marks on the history of the world. In a mob of mediocrities, the general standard of thought and morals must be mediocre, and, what is worse, contentedly so. The lack of living men to afford lofty examples and to educate the virtue of reverence would leave an irremediable blank. All men would find themselves at nearly the same dead average level, each as meanly endowed as his neighbor. These remarks apply with obvious modifications to variety in the physical faculties. Peculiar gifts, moreover, afford an especial justification for division of labor, each man doing that which he can do best.

The Interdependence of Life.—The doctrine of the dependence of life on external conditions, says General R. Strachey, includes life itself as an important concurrent agency in the general results observed. Thus, in order to supply the food and other requirements of animals, the presence of vegetables or other animals is necessary. To some animals, as well as to some plants, the shelter of forests or particular forms of plants is essential. Parasites need for their sustenance living plants and animals. The fertilization and hence the propagation of plants is a development of life not deviating in any particular direction from that which follows the hereditary principle. It rather appears that the existing face of nature is the result of a succession of incidents, unimportant in themselves, which by some very slight alteration of local circumstances might have been turned in a different direction. For instance, a difference in the constitution or sequence of the substrata at some locality might have determined the elevation of mountains where a hollow filled by the sea was actually formed, or the converse, whereby the climatal and other conditions of a particular area would have been changed, and a different impulse there given to the development of life. All that we see or know to have existed upon the earth has been controlled to its most minute details by

the original constitution of the matter which was drawn together to form our planet. The character of all inorganic substances, as of all living creatures, is only consistent with the actual constitution and proportion of the various substances of which the earth is composed. Other proportions than those present in the constituents of the atmosphere would have required a different organization in all air-breathing animals, and probably in all plants. Any considerable difference in the quantity of water, either in the sea or distributed as vapor, must have involved corresponding changes in the constitution of living creatures.

The Medium of Electro-magnetic Action. —It was decided by experiment, during 1888, according to Prof. G. F. Fitzgerald, in the British Association, that electro-magnetic action takes place, not at a distance, but through an intervening medium. The experiments were made by Hertz in Germany, who observed the interference of electro-magnetic waves quite analogous to those of light, and proved that electro-magnetic actions are propagated in air with the velocity of light. "By a beautiful device Hertz has produced rapidly alternating currents of such frequency that their wave-length is only about two metres. I may pause for a minute to call your attention to what that means. If they vibrated three hundred thousand times a second, the waves would be each a kilometre long. This rate of vibration is much higher than the highest audible note, and yet the waves are much too long to be manageable. We want a vibration about a thousand times as fast again, with waves about a metre long. Hertz produced such vibrations, vibrating more than a hundred million times a second." While this rate is too slow for visibility or light, and the vibrations are also inaudible, the experimenter was able to detect them by resonance. He constructed a circuit whose period of vibration for electric currents was the same as that of his generating vibrator, and "was able to see sparks, due to the induced vibration, leaping across a small air-space in this resonant circuit." By this combination—of a vibrating generating circuit with a resonant receiving circuit—which the author had recommended at the Southport meeting of the Association to be used for this very investigation, Hertz was able to observe the interference between waves incident on a wall and the reflected waves. The phenomenon is the same as what are known as Lloyd's bands, in optics, which are due to the interference between a direct and a reflected wave. "It follows, hence, that just as Young's and Fresnel's researches on the interference of light prove the undulatory theory of optics, so Hertz's experiment proves the ethereal theory of electro-magnetism. It is a splendid result. Henceforth I hope no learner will fail to be impressed with the theory—hypothesis no longer—that electro-magnetic actions are due to a medium pervading all space, and that it is the same medium as the one by which light is conducted."

Washing Men and Children by Machinery.—One of the latest inventions in sanitation is machinery for personal washing. A French colonel, according to Mr. Edwin Chadwick, ascertained that he could wash his men with, tepid water for a centime, or one tenth of a penny a head, soap included. The man undresses, steps into a tray of water, and soaps himself, when a jet of tepid water is played upon him. He then dries and dresses himself in five minutes, against twenty minutes in the bath, and with five gallons of water against seventy in the usual bath. In Germany they have an arrangement under which half a million of soldiers are regularly washed. By an adaptation of apparatus to the use of schools, a child may be completely washed in three minutes.

Modern Deterioration of Eye-sight.—Dr. R. Brudenell Carter, when questioned about the causes of modern deterioration of eye-sight, replied that the circumstances of civilization are unfavorable to the cultivation of eye-sight. We are not as dependent on keenness of vision as our ancestors were. Much of the work of dwellers in towns is done upon objects close to them, from which they obtain large retinal images, whence they become comparatively insensible to small ones. They often work by defective light, and are thus driven to approach the object still more closely; and it is by such approximation that the malformation which produces short sight is mainly brought about. The increase

of the malformation is provided by itself: "structurally it is handed down to posterity, and mechanically it is increased by the practice which it compels of turning the eyes inward to combine upon a very near point." Among the consequences of short-sightedness are failure to develop the power of observation; blindness to the expression of the human face; an acuteness expending itself upon details with but a restricted power of grasping principles. The remedies proposed for the defect include testing of visual power and limitations of tasks to capabilities, and, in reading matter, large type with the upper part of the letters cut with particular clearness.

A Tame Gorilla.—An English trader at Ngove, on the southwest coast of Africa, Mr. J. J. Jones, has had for some time a young female gorilla whose docility is most remarkable. Jeannie, as the baby gorilla has been named, sleeps with her master, and follows him wherever he goes, weeping like a child if left behind. She recently accompanied him on a journey of twenty miles or more, walking all the way. She has acquired many civilized tastes and habits, and will drink tea, ale, brandy, etc., out of a cup or glass, displaying the utmost carefulness not to break the vessel. She will, in fact, do almost anything her master wishes, and is surprisingly intelligent and affectionate. This is by no means a solitary instance of the facility with which young gorillas can be tamed. The experience of others who have lived in the Fernand Vaz corroborates this statement as to their tractable disposition when treated with kindness, as well as the distress they exhibit if scolded for misconduct.

Proposed Storage of Nile Floods.—Mr. Cope Whitehouse presented before the British Association at Bath a plan, which he has been advocating for several years, for storing the surplus waters of the floods of the Nile in the depression called the Raian basin—which he believes to be the site of ancient Lake Moeris—to be drawn off again to irrigate the land of Egypt in the dry season. He computes that a reservoir capable of supplying low Nile with 50,000,000 cubic metres of water a day for 100 days can be made for £500,000. The canal of escape for the excess of the Nile flood, to be used as the canal of supply and discharge, can be opened in 300 days, by the excavation and handling of 3,000,000 cubic metres of sand, clay, and soft rock. The area and productive wealth of Egypt would be increased by more than one third. No burden would be imposed upon the present tax-payers. The works would be mainly the utilization and restoration of dikes, canals, and physical characteristics in actual use for the same purpose during 2,000 years, and, in part, in continuous operation from B. C. 1800 to the present time.

NOTES.

THE National Geographic Society has been organized at Washington "to increase and diffuse geographical knowledge," and will hold fortnightly meetings. It projects a physical atlas of the United States, and has begun the publication of the "National Geographical Magazine." It will give prominence to the educational aspect of geographical matters, and will endeavor to stimulate interest in original sources of information. It was organized in January, 1888, has about two hundred active members, and has formed itself into five sections: those of the geography of the land; of the sea; of the air; of the geographic distribution of life; and of abstract geographic art (map-making, etc.). Mr. Gardner G. Hubbard is president, and Mr. George Kennan Washington, corresponding secretary of the society.

THE British Government has yielded to popular clamor so far as to assent to a new and thorough investigation of the merits of vaccination. While assenting to this, it allows it to be given out that it sees no necessity, in any new facts that have been discovered, for such an investigation. It is suggested, in connection with a report that has been made to the effect that small-pox hospitals for isolation are a positive and deadly nuisance to those around them, that the question be also asked whether persons or communities have a right to concentrate a disease which they may easily avoid by congregating patients in such hospitals, to the serious risk of those who live outside.

PROF. EDWARD S. MORSE has been elected a corresponding member of the Society of Ethnology, Anthropology, and Archæology, of which Prof. Rudolf Virchow is president.

THE biography, papers, and letters of the late John Ericsson are to be edited by Colonel Church, of the "Army and Navy Journal." The Swedes have decided to erect a statue in Stockholm in honor of their distinguished countryman.

HYDROGRAPHER Dyer, of the Navy Department, reports that testimonials are constantly received of the efficiency and usefulness of the pilot charts and supplements. The record of floating vessels affords an excellent opportunity for studying the various phases of ocean currents. The supplement is issued whenever subjects of special interest demand it. Such supplements have been sent out descriptive of West Indian hurricanes and the law of storms; on the best transatlantic routes and the winter storm-belt of the Atlantic; and on water-spouts off the Atlantic coast. Reports of marine meteorology are received regularly from forty-six Government vessels and five hundred and forty-four of the mercantile marine. Many favorable reports have been received on the efficacy of oil in smoothing the waves.

A REMARK is made by Dr. A. G. Auld upon the strange fact that the effects of tobacco are so commonly overlooked in computing the causes of disease—for it is one of the most virulent poisons known, continually at work in the systems of those who use it, and a poison whose physical reactions have never been accurately determined. Dr. Auld is impressed that it is responsible for a variety of functional derangements which there is no reason to aver can not terminate in organic disease. Among these are albuminuria of which he has traced cases to the tobacco habit; and certain fibrillary twitchings, often excessive, that occur most frequently about the trunk and upper arms. When such symptoms are found in association with tobacco-smoking, it will not suffice merely to indulge less in the practice, but tobacco must be dispensed with entirely.

CONCERNING flamingoes straddling their nests, which Mr. Henry A. Blake has disputed ("Popular Science Monthly," March, 1888), Mr. E. J. Dunn, of Melbourne, has written in "Nature" that he has seen in Bushmanland numbers of the tall nests that are described and pictured in the books. They are conical, about eighteen inches high and six inches in diameter at the top, with a shallow, basin-like cavity for the eggs, were built in the water where it was a few inches deep, and could not have been sat upon unless they were straddled over.

THE London Diocesan Conference has suggested legal measures to meet the evil of too early marriages, and Dr. Matthews Duncan asserts that the age at which marriage takes place is one of the most important factors in the matter of defects of the reproductive function. He believes that fertility is surest and safest, and most happy in its results, at between twenty and twenty-five years in women, and twenty-five and thirty years in men; and regards the conditions as more precarious at an earlier than at a later age. The social and economical conditions are also not to be overlooked.

DR. BATTY TUKE insists upon the importance of giving more attention to efforts to cure insanity. This thought has been subordinated under the operation of the asylum system, which was begun for protection rather than cure, and of the theory of the psychological nature of insanity. The London County Council has now before it a proposition to appoint a committee to inquire concerning the expediency of complementing the existing system of treatment with a hospital and medical staff having a curative course in view.

A REMARK in the report of Principal Bliss, of the Detroit High School, on overwork, touches what is incontestably one of the weak points of the public schools. It should be remembered, he says, "that overwork is a continued rush. Our classes are large and our recitation periods short. The good of a class can not be sacrificed for that of an individual. In the hurry of our daily work, some boy or girl who is not strong enough to do our work may be overlooked. Have the public schools so far assumed the duties of parents that parents can be excused for not calling our attention to such a case?"

AFTER twelve years of experimental work at Rothamsted, Dr. Gilbert has found the old views confirmed respecting the value of a due apportionment of nitrogenous and mineral substance in the cultivation of potatoes. The present practices of good farmers with barn-yard manures are sustained, while mineral manures alone are of little effect. Although liberal manuring increases the tendency to disease, the effect is thought to be offset by the advantage of a heavy crop. The continuous growth of potatoes in the same land does not appear to render the crop more liable to disease, but rather the reverse. Thus, during three periods, of four years each, the percentage of disease in the various plots was reduced successively from 5·14–12·82 to 1·63–4·95, and 1·43–1·73.

A BIOLOGICAL survey of Kansas is in progress, under the direction of members of Washburn College, the eighth report of which is given in the Bulletin of the Laboratory of Natural History. It includes a fourth series of notes on fishes, by Dr. C. H. Gilbert, and Mr. B. B. Smyth's catalogue of flowering plants and ferns, in which 1,602 species and varieties are named.

POROUS rebaked porcelain has been found by Dr. C. G. Currier to be the best substance for domestic filters. If thick and strong enough to allow the use of a large surface, and the substance remains perfect, it may yield a fair flow of clear water, free from all bacteria; yet under the ordinary Croton pressure, the yield is only in rapid drops, unless the apparatus be complex. The filter should be occasionally sterilized throughout, by steaming or other means.

Dr. Ogle, an English statistician, while admitting to the full extent alleged the movement, in England and the United States, toward the towns and cities, denies that it is attended by a depopulation of the rural districts. He has found that the rural population in England did not decrease between 1851 and 1881 by more than one per cent, a rate quite within the limit of allowance for error. The author believes that the rural population is only stationary, and is ample, with the modern improvements in farming, for the tillage of the land, while only its increase and surplus pour into the towns; but the continuous migration of the most vigorous and energetic to the manufacturing districts, and the higher mortality there, may be producing a gradual deterioration.

While asserting that attention has hitherto been largely paid to the preservation of the unfit members of society by not allowing them to disappear according to natural causes, and thus propagating unfitness, Dr. Thomas Searcy, of Tuscaloosa, Ala., suggests that a higher field of effort lies in the direction of increasing the proportionate numbers in society of the more fit. Apparently, in modern society, the object of effort is to reach such a degree of competency that one's children will not have to strive. Degeneracy then sets in. The first generation may succeed by force of the brain-power transmitted from its parents, but the after-generations have no bottom to stand upon.

In a recent lecture on the education of girls, Mr. James Oliphant condemned the impression that the education of the two sexes should be governed by the same rule. Physical deterioration, he said, could best be prevented by a suitable distribution of studies during the day, and by allowing hourly short interludes of muscular exercise. There was, in our modern plan of study, too much reiteration and too little thought, a consequent sense of drudgery, and a lack of the interest which comes of using the reasoning power. Home lesson work had become a sort of tyranny. The possession of special aptitudes did not justify the preference often given to them in cultivation, at the expense of less developed faculties.

In the lack of any national registry of vital statistics, the Superintendent of the Census of 1890 will rely upon the physicians to furnish an approximate estimate of the birth and death rates of most of the country. He is accordingly issuing to the medical profession "Physicians' Registers," with blanks, which they are invited to fill, and thus furnish more accurate returns than it is possible for the enumerators to make. In order that the returns of farm products and live stock may be as full and complete as possible, farmers are requested to keep accounts of such matters from June 1, 1889, to May 31, 1890.

The demand for its leather, which is so pleasant for summer shoes, has brought the kangaroo into imminent danger of extinction; and the Australians are contemplating measures for restricting the slaughter of the animal.

Dr. Koch's theories respecting the functions and work of the cholera bacillus, which have been disputed, and even discredited by certain commissions, have now been confirmed in their most important points by the researches of Drs. Neil Macleod and Milles. These gentlemen, who practice in a part of the British Empire where cholera is endemic, have identified, isolated, and cultivated Koch's spirillum, and confirm his original statement as to its pathogenic character.

Out of more than five hundred letters received by the Principal of the Detroit High School in answer to questions concerning the effect of the studies on the health of the children, 87·81 per cent sustain the work of the school. The sixty-two complaints are of various character, and refer among other things to "hard studies," bad air, long lessons, and worry. In fourteen of the cases of complaint the pupils were doing more than the regular work; and requests to be allowed to do this had in some instances followed complaints.

According to Dr. Ozeretskofski, hysteria exists among Russian soldiers, and presents as various diversities of form as it does among women.

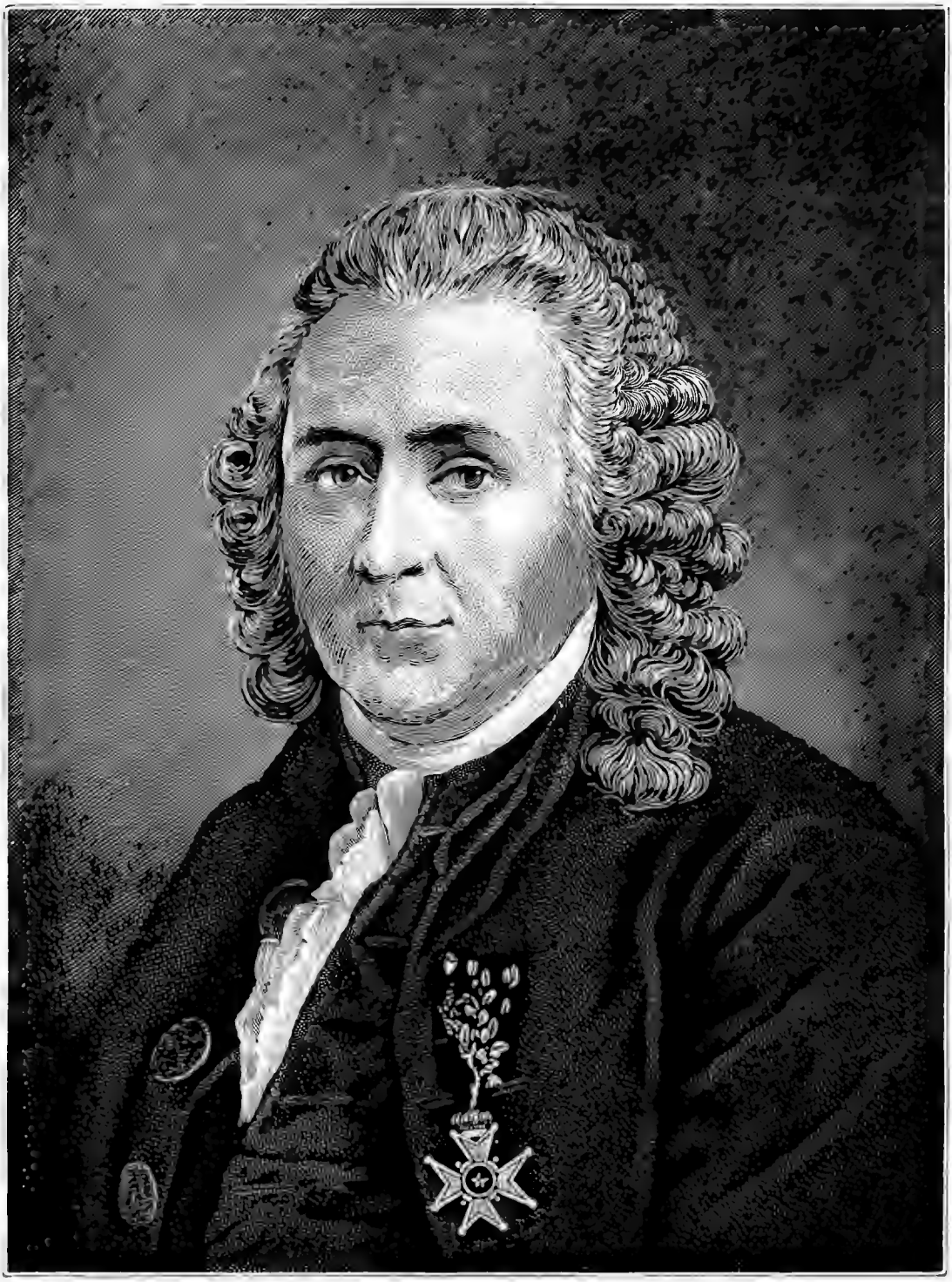
OBITUARY NOTES.

Eugen Ferdinand von Hameyer, an eminent ornithologist, and President of the Ornithological Society of Berlin, died in Stolp, Prussia, June 1st, at eighty years of age. He was the author of several books, and possessed the largest existing collection of European birds.

Mr. John F. La Trobe Bateman, the engineer who supplied Glasgow with water from Loch Katrine, died June 10th, aged seventy-nine years.

Heinrich Gustav Reichenbach, Professor of Botany and Director of the Botanic Garden at Hamburg, died there, May 6th, in the sixty-seventh year of his age. He was born in Leipsic, the son of a botanist and professor at Dresden, and co-operated with his father in the preparation of the later volumes of the "Icones Floræ Germanicæ et Helveticæ." He devoted more than forty years of his life chiefly to the study of orchids, in knowledge of which he was the first.

Charles Harvey Bollman, museum assistant in the University of Indiana, a young naturalist of great promise, died July 13th, at Waycross, Georgia. He was in charge of the explorations of the United States Fish Commission in Georgia.



CAROLUS LINNÆUS.

THE

POPULAR SCIENCE MONTHLY.

OCTOBER, 1889.

PENSIONS FOR ALL.

By General M. M. TRUMBULL.

IN the wondrous literature of the time there is hardly anything so glaring and sensational as the report of the Commissioner of Pensions explaining the work of his department for the year ending June 30, 1888. In that report he says: "The total amount expended for all purposes by the Bureau of Pensions was $82,038,386.59. The total expenditures of the Government for the fiscal year 1888 were $267,924,801.13. Thus it will be seen that the amount expended for and on account of pensions was nearly thirty-one per cent of the entire outlay of the Government."

In round numbers, one third of the public payments goes for pensions, and it is gravely proposed that the pensioners have the other two thirds also. A few days ago the Governor of Illinois, speaking to the Illinois department of the Grand Army, said, "If the Government paid $1,000,000 daily for pensions, the nation as a nation would be just as rich at the end of the year as it was before, as the money would still be in the hands of our own people."

To take a million dollars a day from industry and bestow it upon idleness is a patriotic form of dragoonade much recommended by politicians like the Governor of Illinois. The "nation as a nation" is not injured by it; the money is still in the hands of our own people. It is merely taken out of the hands that earned it and put into other hands to spend it.

In Whittier's delightful poetry we are cheered by the information that

> ". . . Barbara Frietchie's work is o'er,
> And the rebel rides on his raids no more."

True, the rebel raiders have dismounted, but the "boys in blue" have sprung into the vacant saddles and the raids go on.

The point of attack is the national treasury. The cry is, "On to Washington!" The new foray is not the sudden dash of a scouting party; it is literally the charge of an army. The brazen throats of the bugles and the buglers ring out the inspiring slogan, "Pensions for all!"

Is there no moral resistance in the people? Must the guardians of the public money throw up their hands, while the foragers carry off the national cash-box? Or must they buy off the raiders as once upon a time the Romans bribed the Gauls?

A comprehensive pension system corrodes the heart of government and beguiles a people into servitude. A caste composed of pensioners is always the defender of existing wrongs. It believes that all reforms are assaults upon its own privileges and that public honesty is dangerous. It can always be depended on to support the pensioning power. The history of England shows how worthless ministries have retained office for years by a judicious distribution of pensions. National alms-giving weakens public spirit as it conquers private virtue.

In the United States we have converted civil offices into gifts called patronage, and pensions will share the same fate. Where public offices are legal tender in payment for party services, pensions will become so too. To a dangerous extent they are used as political currency now. By a skillful use of pensions the party in power can bribe one portion of the people with the money of the other.

With the warnings of all history before us, we submit to the corruption of our politics by a pension system heavier than was ever laid upon any other people since governments began. No monarchy, no hierarchy, no oligarchy ever had the daring to put so many idlers under public pay as we have placed there by our pension laws. Some of us think that consequences do not follow causes in republics as in the "effete monarchies," and that we can dignify our people by an alms-tribute that would debase the people of those benighted lands across the sea. With much vehemence we exclaim: "Pensions are not a king's prerogative here; they are the free gifts of a free people. Pensions can not corrupt us. The Asiatic cholera is harmless here, because it is not an American disease."

It has never been suspected that the warriors who subdued the great rebellion, who marched and counter-marched over half a continent and fought a thousand battles, were a puny, sickly race of men. Yet this is the inference we must draw from the official testimony of the Commissioner of Pensions. In his report for 1888 he says, "It thus appears that in the aggregate 1,166,926 pension claims have been filed since 1861, and in the same period 737,200 claims have been allowed."

This includes, of course, the claims of widows and dependent relatives. Although many have been dropped from the rolls by reason of death and other causes, the actual number of old soldiers on the pension-list is 323,020, while there are thousands of claims on file not yet adjusted by the Pension Bureau.

It is pretended that, although the soldiers were sound and hearty when they went into the army, they were enfeebled by hardship and disease when they came out of it. Some of them were, but not many in proportion to the whole number in the ranks. The great parade at Washington in 1865 is a sufficient refutation of that claim. The athletic and boisterous armies which marched in review before the President of the United States at the close of the war were not composed of sickly and vitiated men. They were fairly rollicking with health, they were full of "lusty life." Yet we are told they carried millions of mortal microbes in their knapsacks and all manner of diseases latent in their blood—diseases which needed only pension laws to develop them into activity.

Colossal as are the figures presented by the Commissioner of Pensions, they are to be multiplied six times when Congress finally capitulates to the Grand Army. Even in their present rudimentary form they make the English pension-list cheap and tawdry by comparison. Last year the English pension-roll contained the names of 156,492 persons altogether, who drew from the treasury £7,815,575, of which amount the army pensioners (97,004) drew £3,789,282, and the navy pensioners (38,366) drew £2,040,659. The Financial Reform Association of England, commenting on this exhibit, says: "John Bull will do well to notice that in these last five years of bad trade he has had to pay an army list of over 100,000 pensioners (military, naval, and civil) for doing nothing; and that their drawings, amounting to nearly eight millions, swallowed up the whole of the income-tax laid on the national profits for last year."

The complaint is valuable as a caution to "Brother Jonathan." He has had to pay three or four army corps, each as large as the one criticised by the Financial Reform Association of England, and it is proposed that they shall be recruited to their full capacity by adding to their numbers twice six hundred thousand more.

The pension-roll of England is very much larger than it was a hundred years ago when John Philpot Curran poured upon it the following sarcasm: "This polyglot of wealth, this museum of curiosities, the pension-list, embraces every link in the human chain from the exalted excellence of a Hawke or a Rodney to the debased situation of the lady who humbleth herself that she may be exalted; but the lesson it inculcates forms its greatest perfection.

It teaches that sloth and vice may eat the bread which virtue and honesty may starve for after they have earned it; it teaches the idle and the dissolute to look up for that support which they are too proud to stoop and earn; it directs the minds of men to an entire reliance on the ruling powers of the state."

This condemnation will apply in general terms to every pension system. It is impossible to limit pensions to rewards for sacrifice and service. Favoritism and fraud will crowd the pension ranks with pretenders. Every crippled soldier who has really been disabled by battle-wounds must share his earned reward with men who never did a dollar's worth of service. He must drag along with him to the pension-office a dozen "comrades" who never saw a battle and who never received the slightest injury to body, health, or limb.

"Veteran diseases" are those miraculous ailments which rage unsuspected in the bodies of old soldiers until seductive pension laws bring them to the notice of the sufferers. The Arrears of Pensions Bill is responsible for over a hundred thousand veteran diseases. This law was in existence about two years, and expired by limitation July 1, 1880. In 1878, the year before the law went into operation, the pension applications numbered 18,812. In 1879, under the stimulus of the act, they rose to 36,835. In 1880 they reached the shameful dimensions of 110,673. In 1881, the law having expired, the number of applications fell to 18,455. The Arrears of Pensions law invited the Grand Army to loot the treasury, and 110,673 veterans accepted the invitation. The number of applications filed the year before the law and the year after it, prove that the 110,673 extra diseases were made not by the war, but by the Arrears of Pensions Bill. The bribe offered by Congress put a hundred and ten thousand additional names on the sick report for 1879 and 1880.

The crippled and wounded soldiers, whose battle-scars were vouchers to their honesty and sacrifice, did not receive any benefit from the Arrears of Pensions law. They were already on the pension-rolls. All the booty was divided among the men who suddenly discovered that they were suffering from diseases of which they had been ignorant for fifteen years. The moral enormity of this proceeding is revealed in the fact that every one of those claims was attested by the solemn oath of the claimant.

The law of compensation pervades all things, and it applies here. If pension laws are potent in the making of diseases, pensions themselves have the opposite effect—they cure them. There is nothing that promotes longevity like a pension. It is now seventy-seven years since the War of 1812 began and seventy-four years since it ended. Yet there are nearly a thousand men on the pension-rolls who claim that they were soldiers in that war.

There is a delightful contrast between the rugged and healthy state of the old veteran after his pension has been allowed and his decrepit condition before the allowance. I know a man who was simply a harbor of refuge for diseases until he obtained his pension, and then they disappeared. Having drawn his "arrears," he prudently took out a life-insurance policy. The affidavit on which he obtained his insurance curiously contradicted the affidavit on which he got his pension, proving that the pension had restored him to health and made him a "good risk" for the insurance company. The department was greatly shocked on learning the facts, and revoked the pension; but, on discovering that the delinquent was a good caucus warrior and a hustler at the polls, the department became shocked at its own imprudence and restored him to the "nation's roll of honor."

It is not irony or sarcasm to say that the insurance companies can afford to give lower rates to old pensioners than to other people, because the pensioners' chances of long life are greater than the chances of other men. The commissioner's figures prove this. He reports that the number of the pensioners of 1861 to 1865 who died in 1888 was only two per cent of the three hundred thousand pensioners on the rolls, most of whom must be between forty-five and sixty-five years of age, and all of whom are legally and officially suffering from wounds and diseases contracted in the army. Three hundred thousand healthy citizens of the like age will show a larger mortality than those diseased pensioners can show. This proves that a large proportion of those "veteran diseases" are fictitious.

Still more miraculous is the power of pension laws to bring dead men back to life. Year after year the "Mexican War Pension Bill" was rejected by Congress. At last the claim agents proved by the tables of mortality that the Mexican War soldiers were nearly all dead. That war, they said, was an insignificant affair; our army in Mexico was small, and the surviving members of it could not be numerous after the lapse of forty years. Besides, it was invidious to be generous to the soldiers of the late war and niggardly to the soldiers of Mexico. This plea carried the bill through. It was passed on the 29th of January, 1887, and before the 1st of March, 1889, 21,296 surviving soldiers of Mexico, and 7,742 widows, had filed their claims for pensions under the law. On the very face of the returns it is evident that most of those claims are without any of that merit or grace whereby pensions are justified, namely, service in battle, or at least on the genuine theatre of war during the time of active hostilities.

How happens it that so many Mexican War veterans spring up out of the ground, like Roderick Dhu's freebooters, at the clarion call "to pensions"? Not one tenth of those claimants ever saw a

battle. Here is the explanation of the miracle. Taylor's last fight was at Buena Vista, where he had less than five thousand men. Many of these had also fought at Palo Alto, Resaca de la Palma, and Monterey. It is liberal to say that all the battle-soldiers of Taylor did not exceed ten thousand. Scott's last fight was at the city of Mexico, where he had about eleven thousand men. Many of these were the same soldiers who had fought at Cerro Gordo, Contreras, Churubusco, Chapultepec, and Molino del Rey. Scott's real battle-soldiers could all be included within a total of twenty thousand men. Allowing for losses of all kinds, it is not likely that more than twenty thousand battle-soldiers of the American army in Mexico were alive at the close of the war in 1848. It is not likely that two thousand of them are living now. Every one of these is compelled to lead nine comrades under the flag of booty to the gory field of pensions. Where does he get the nine? He gets them from the army of redundance, thus:

Although the fighting ended in September, 1847, when Scott captured the city of Mexico, peace was not declared until June, 1848. This nine months' interval was passed in "negotiations." This valuable time was wisely employed by our Government in re-enforcing the American armies in Mexico, so that our invincible numbers might act as a moral pressure upon the Mexicans, convincing them how hopeless was their cause. This policy was successful. The Mexican Government, deeming further resistance useless, ratified the Treaty of Querétaro.

From September, 1847, until June, 1848, new regiments, companies, and detachments were poured into Mexico to re-enforce the divisions already there, so that only a small fraction of the army that marched home did any fighting in the Mexican War. Shiploads of soldiers arrived at Vera Cruz in June, before the ratification of the treaty of peace was known at Washington. They were ordered back without being permitted to disembark, because, peace having been declared while they were on the way, there was no necessity that they should land. It is this overflow army that now swoops down upon the Capitol, augmented by the home troops, who did garrison duty at the various posts in the United States during the war, and now march into the treasury by file left, under the pretense that they also are soldiers of Mexico. They can as truthfully claim to be soldiers of Austerlitz.*

Pensions pauperize the character and abase the souls of men, especially those men who have no scars to show. They poison honest pride and make nobility itself ignoble. They paralyze conscience and weaken self-respect. To obtain and retain pensions men will scruple not at perjury. Men of the highest rank

* The benefits of the act are limited to men over sixty-two years of age, so that the soldiers of Mexico who were under twenty-one at the close of the war are yet to hear from.

will stoop to mendicancy for a pension they do not need. Pope asks:

> "What can ennoble sots or slaves or cowards?
> Alas! not all the blood of all the Howards."

And yet a pension can *un*-noble the chief of all the Howards, and reduce him to ignominious pauperism. The Duke of Norfolk, with an income of two millions of dollars a year, is on the pension-list of England for sixty pounds a year. This pension was granted to his ancestor by the gentle Richard III. Nobody knows why. It may have been for smothering the princes in the Tower. It could not have been for anything very good, because Richard was not in the habit of rewarding virtue; yet for more than four hundred years the Dukes of Norfolk, chiefs of all the Howards, have asked for and received this degrading outdoor relief. We, too, can fall to the same base level by the same process of gravitation, as the following testimony shows:

When the Mexican War Pensions Bill passed, the "honor" of being the first man to claim his dole and get it was given to a prominent and wealthy citizen of Kentucky, who did not need the alms any more than the Duke of Norfolk needed the charity of sixty pounds a year. Yet he took it, and was applauded for his promptness by the press as if he had done a patriotic deed. Such demoralizing power has a pension.

It is true that we have no hereditary pensions yet extending beyond the third and fourth generation, but we have made a fair beginning, and may hope to enjoy that high-caste luxury in gorgeous blossom after it shall be withered and dead in England. The "royal prerogative" is now exercised by Congress, with a profuse liberality exceeding that of kings. Our senators and representatives are creating a pensioned aristocracy out of the consanguineous relics of naval and military officers, official dignitaries, and successful politicians, many of whom had no claim to recognition except that their public lives were laboriously spent in the private service of themselves.

The "retired system" is a high-toned pension scheme, available only to those who have taken the superior degrees in the order. This is borrowed from the "half-pay" and "retiring" system of England, where it had a logical and consistent reason for existence, under the social law which decreed that no man should earn an honest living by his own exertions after he had once held the "king's commission." No such law prevails in this country, and the practice founded on it is an exotic ill adapted to the climate of a republic. We have now on the "retired list" of the army one general, four major-generals, twenty-six brigadier-generals, eighty-five colonels, and three hundred and fifty-nine officers of lower grade. The navy can make a like showing, and the civil

service is rapidly growing to the same proportions. Many of those "retired" officers have been placed on the list by the arbitrary favoritism of Congress, and some of them never held the rank in the army which they hold on the retired list. In fact, one of the chief abuses of political power is the reckless and irresponsible usurpation by which members of Congress confederate and combine to place their friends on the retired list, and their constituents on the pension-roll.

One of the amiabilities of the practice is its freedom from partisan bigotry. It is notorious that on a recent occasion the widow of an eminent Republican politician was rewarded with a pension of two thousand dollars a year, on condition that the widow of an eminent Democratic politician should be included in the bill and rewarded with a pension of the same amount. This having been done, the Republicans voted for the Democratic pension and the Democrats for the Republican pension. In this way the benevolence was lifted up out of the impure air of partisan politics into the ethereal atmosphere of good feeling and high life.

In one of Irwin Russell's negro hymns, the jingle sounds like this:

"Close up—saints in de center;
Fall in—sinnahs on de flanks;
An' all 'll get a pension an' a honorable mention
What stand up stiddy in de ranks."

We extend the principle far beyond those boundaries and give pensions to claimants, whether they stood up steady in the ranks or not. If the pension list could be analyzed it would be found that, after taking out the wounded men, fifty per cent of the others did not stand up steady in the ranks nor do any valuable service. It would be found that their diseases are pension pretexts only, and, where they really exist, that they were not contracted in the army.

In addition to pensions for all, we have supplemented claims for "equalization of bounties," and schemes of that kind. A Congressman from Iowa introduced a bill to give the soldiers the difference between the value of the greenbacks in which they were paid and gold at the time of payment. The statesman who introduced this bill is not at all troubled about where the money is to come from to effect its purpose. He is a descendant of Marryat's old sea-captain, who bequeathed princely sums to his friends, together with gold snuff-boxes and diamond-hilted swords which had been presented to him by various emperors and kings. As he did not own a dollar in the world, and the swords and snuff-boxes had no existence, the good-natured impostor showed his liberality without subjecting his will to the dangers of a contest. The sum of money necessary to pay that difference would be the

measure of a conquest, the ransom of an empire. It would far exceed the fine imposed by Germany on France in 1871.

It is time that the soldiers themselves repudiate the demagogues and vindicate their own patriotism. The glory of the Union army is tarnished by the mercenary clamor for pensions. If the soldier is to be a chronic menace to industry, he will forfeit his claim to honor, and cancel the obligation due him for service in the war. As it stands now, every Union soldier is "a suspect" in the eyes of his countrymen. He is regarded as a pension-grabber, and as a patriot who desires to commute his military glory for a stipulated sum in cash. The suspicion is unjust. There are thousands of Union soldiers who, having served the country in war, refuse to forage on it now.

It may be said, Why do they not protest against the pension scheme? Why do they remain silent while the forays are being organized? The answer is easy. In the first place it is not a pleasant thing for any old soldier to criticise the plans and purposes of his comrades. It is an unthankful duty, even if it is a duty at all. It can only make him unpopular among those whose approbation he would like to have. Secondly, he thinks that a general pension law is the only plan by which the worthy soldiers can be placed on a level of reward with the unworthy claimants who never did any good service, but who have no delicacy and no scruples about getting on the pension-rolls. He says: "There are many brave, needy, and deserving soldiers who will never make application for a pension, therefore let the Government offer it." And, thirdly, whatever his own opinions may be as to the morality or policy of pensions, he does not care to be officious in opposition to the general sentiment on that subject, nor does he wish to stand as an obstacle in the pension path of others.

During the latter part of the war there may have been some Union soldiers who were tempted into the army by large bounties, but they were a very small proportion of the whole. Excepting these, it may be truly said that the men who saved the Union neither knew nor cared when they enlisted what were the rates of pay, or the measure of allowances for service. They were moved by patriotism and not by promises of pay. The charge that they were a "mercenary soldiery" was false in the days of Abraham Lincoln, although it was freely made by the envious and disloyal. Let it not become true now. Let not the "pension temptation" change the character or diminish the fame of the Grand Army.

THE OLD AND THE NEW PHRENOLOGY.

By Prof. M. ALLEN STARR, M. D., Ph. D.

ALMOST every one has at some time wondered whether there is any truth in phrenology. The figures of heads, on which various mental faculties are marked, are to be seen everywhere, and the notion that from the shape of the head the character can be determined has enough of the mysterious in it to prove attractive. The thought that some one may discover our little foibles and more serious deficiencies—for it is these rather than our strong points that we are afraid of having found out—makes the study of bumps disagreeably interesting. And perhaps the desire to find out a little more about our friends than they would wish us to know adds somewhat to its attraction.

It is pretty well agreed among scientists, at present, that the old system of phrenology has no actual basis of fact, and that elevations upon the skull do not indicate masses of brain beneath them. But to this old system of Gall modern science really owes a great deal; for, like every false idea, it had within it a little kernel of truth, and the interest excited by the claims of its supporters awakened a discussion which has led to a discovery of the greatest importance in the saving of human life.

The claims of Gall that each part of the brain presided over some mental faculty stimulated Flourens, the leading French physiologist of forty years ago, to a series of experiments which seemed to show the falsity of Gall's hypothesis. These experiments in turn were disputed and led to others, and thus interest in the brain and its action was stimulated, until in 1870 the subject was taken up in Germany, and facts were discovered which form the basis of our present knowledge of brain action.

For in Germany a method of testing the action of the brain was invented by Fritsch and Hitzig in 1870. These men noticed that when they applied an electric shock to the brain of an anæsthetized dog, the result was a movement of the limbs. To cause this movement a certain part of the brain had to be irritated by the electricity, other parts being irresponsive; and it was even possible to distinguish the part which moved the fore-leg from that which moved the hind-leg, while, queerly enough, the irritation of one side of the brain always caused movements in the other side of the body. This was an important discovery, for it showed that one part of the brain governed motions while the other parts had nothing to do with motion.

The German investigators went a step further. They said, "If this part of the brain really governs motion, then when it is

removed the dog will lose the power of movement," and this reasoning was found in fact to be correct; for when this part, which they named "the motor area," was taken away, the animal was found to be paralyzed, while removal of other parts had no such effect. These experiments, since that time repeated in every laboratory of Europe and America, and tried upon various animals, have established the fact that there is in the brain a certain part which directs voluntary movements.

The second step toward the new phrenology was taken in England in 1873 by David Ferrier. Reasoning from the fact that our movements are usually the result of some preceding sensation, he concluded that sensation as well as motion must be governed by the brain. If motion is governed by one part, sensation may be received in another part. This reasoning led him to undertake a series of experiments to settle the question. He soon succeeded in showing that sensations, which are received by the various sense organs of our bodies—by the eye, ear, nose, mouth, or by the skin—are all sent inward to the brain, and that each of these organs sends its impressions to a distinct region of the brain; sensations of light going in one direction, those of sound in another, and so forth.

The work of Munk, of Berlin, in 1881, confirmed and added to the discoveries of Ferrier, and finally established the conclusion that sensations as well as motion can be located. So that to-day it is possible to lay out a sort of map on the brain of animals, and to say that each of the regions put down on the map has a particular sense with which it is related. On such a map there are here and there empty spaces, such as there are on our geographical maps of Africa—for no one knows what is there. But that, of course, does not invalidate our knowledge of regions which are known, and only shows that further discovery is possible. When we come to see the practical results of these discoveries, the arguments of those who oppose vivisection will cease to interest or move us.

These physiological experiments, however, are only of importance to us in our study of our own mental action, provided they have a bearing upon the working of the brain in man. And this is a question which has only been settled within the past fifteen years. It was admitted, indeed, that in the structure and appearance of his brain man resembled quite closely the higher types of gorilla and ape, and yet the apparently impassable barrier between men and animals as regards mental activity prevented any hasty conclusion that these facts could be applied to men. The question whether sensation and motion could be assigned to parts of the brain in the human race was still (ten years ago) an open one. Of course, it is impossible to experiment upon the human brain. But on a little consideration it soon became evident that Nature

was really furnishing the observer with a series of natural experiments on man in the form of disease. The physiologist removed a piece of the brain and watched the loss of sight or hearing, or the loss of motion which ensued. The physician, on the other hand, watches the same kind of loss of sight and hearing, or of motion, in his patient, and may perhaps conclude that here too a loss of brain-tissue is the cause. And this conclusion was confirmed by further observation. Perhaps this may be made a little clearer if we add a fact or two regarding the way in which these experiments of nature are conducted. The blood which is sent to the brain at every throb of the heart goes up in a set of tubes, which give off side branches, like the system of water-pipes which connect your basins with the reservoir. Each tube gets smaller as its branches are given off, until at the end, instead of one large pipe, there is an innumerable series of little end pipes, each throw-out its little stream.

Let us picture to ourselves the water-pipe system of a town set up on a frame aboveground, with the great main, the street mains, the house pipes, and the little pipes all over the houses, all in view, and we will have a sort of conception of the brain's vessels and its blood-supply. Now, it is easy to see that, if a stick or a mass of leaves start out from the reservoir into a main, they will go on and on till they reach a pipe too small to allow them to pass, and there they will lodge. If the stick gets into one's house pipe, one's entire house will be cut off from the water-supply; if the mass of leaves breaks up, a few particles may come in and plug up a pipe to one only of the basins. But in either case the basin will be as useless for washing purposes as if there were no reservoir at all. Now, something very similar to this occurs in disease. Little plugs sometimes come up to the brain from the heart in the blood, and lodge in the little vessels which conduct the blood to various parts of the brain; and when the part of the brain is thus cut off from its supply of nutrition, it gradually withers up and ceases to act.

But when it ceases to act, a loss of some one sense results, just as in the dog when a part of the brain was cut out a loss of some sense occurred. When these facts were studied in this way, it soon became evident that in some persons it was the sight, in others the hearing, in others some other sense, in others still the power of movement which was lost; and further study showed that the varying effect depended upon which part of the brain was deprived of nutrition and was withered, just as in the dogs the location of the part removed determined which sensation was destroyed; so that a striking parallel between the results of experiment and the results of disease can be drawn; and thus the conclusion is arrived at that what is true of animals *is* true of man, that in man as well as in

animals certain regions of the brain can be mapped out and can be assigned to the different senses. It has thus been proved that in their *action* as well as in their *structure* the brains of man and of animals are alike.

If in structure and in function all brains are somewhat similar, it may be interesting to obtain a little notion of what a brain is really like. The figure will demonstrate this very well.

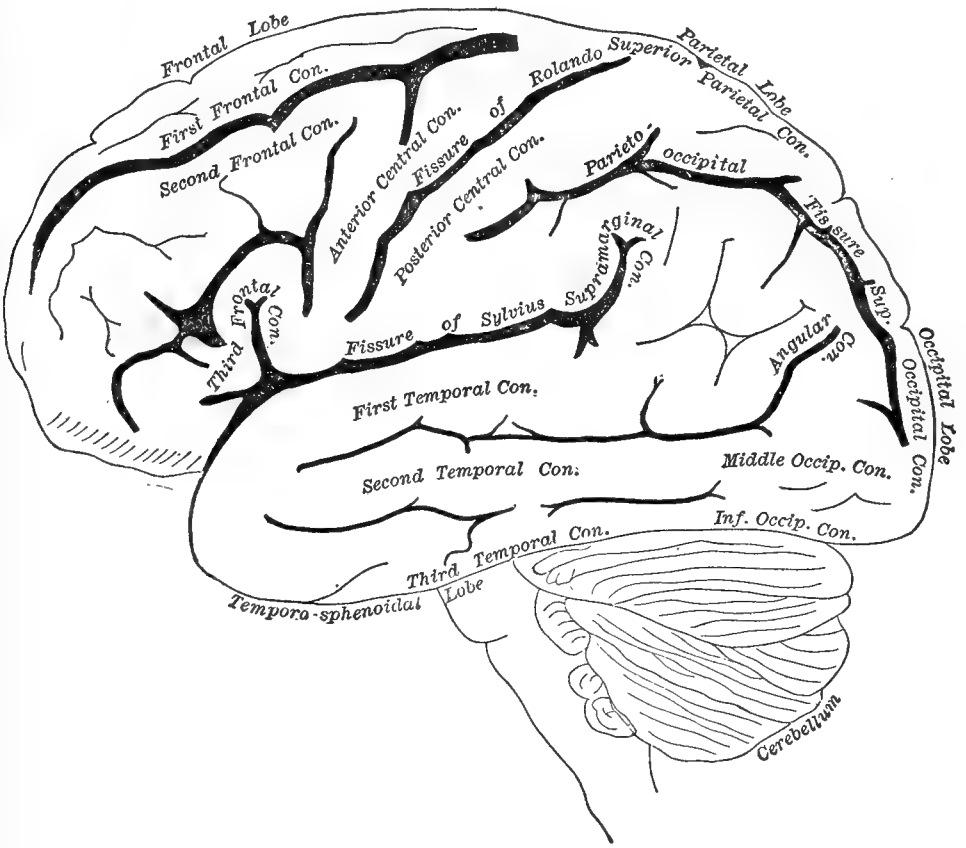


FIG. 1.—DIAGRAM OF THE EXTERNAL SURFACE OF THE LEFT CEREBRAL HEMISPHERE (modified from Ecker).

It shows that the brain is an egg-shaped organ with an irregular surface of a yellowish-gray color. The irregularities are formed by a folding of the surface layer so as to accommodate itself to the small space in the head. To illustrate this, when a handkerchief is spread out over the hands it takes up a great space, and a box in order to hold it would have to be of large size; but by gathering the handkerchief up in the hands it is thrown into folds, and, although its actual surface is not decreased, the space it occupies is much diminished, and it could now be put in a very small box and yet all be there, but then its surface would be irregular and show many creases. Now, what was done to the handkerchief Nature has done to the brain as it has developed. In the lower animals and in an early stage of life the folds are few and simple, but in man when full grown they are many and complex. This only means that the actual surface of

the brain if spread out would be much greater in man than in the lower animals, and far too great to be laid out flat within the head. There are many interesting facts which make one believe that the greater the extent of brain surface in a man, or, to put it a little differently, the more the folds and deeper the creases between them, the greater are the man's mental powers; and just here it becomes apparent that to judge of the extent of the entire brain surface by the size of the head, or by the extent of the superficial irregular surface which is covered by the skull without any regard to the number of folds or their depth, is to fall into an absurd error, and here we begin to see how baseless the old phrenology really is.

For a little brain with many deep folds may really when spread out have a larger surface than a large brain with few shallow folds, and a so-called bump or elevation on the apparent surface of the organ, even if it produces a corresponding elevation on the head, which it frequently fails to do, will indicate nothing regarding the number of the folds or the depth of the creases which lie about it, so that it may be stated without hesitation that from the size or shape of the head no conclusion whatever can be made as to the extent of surface of the brain, and consequently no conclusion can be reached regarding the mental capacity.

But what lies underneath the brain surface? The inner structure of the brain is interesting. Everywhere coming off from the under surface are white threads which gather into bands and pass downward and inward, and finally come out below in the form of nerves. These are the lines of communication by which messages from various parts of the body reach the brain, and along which the impulses are sent out from the brain to the body which result in speech and action. Imagine for a moment that from every part of your hand little threads pass up the arm and find their way to the brain, and there go to a special part of its surface and end. It can be seen at once that you would have a little map of the hand laid out on the brain surface, projected there, to use the terms of the geographer; and in fact such a map of the entire body could really be drawn on the brain surface if we could follow all the little threads to their ends. A sensation which has been sent in from your little finger has always gone to a definite place in your brain, and whenever a message passes along that thread and goes to the brain you feel a sensation in the little finger. The thread goes along your funny-bone at the elbow, and if you happen to strike it there you send a message along it to the brain; but as all such messages have usually come from the little finger, the brain supposes that this one has also come from there, and that is the reason that, although you strike your funny-bone, you feel it in the finger. That also is the reason why peo-

ple whose fingers have been cut off often say that they have pain in the missing finger, and when you are seated on a hard or uncomfortable chair your foot "goes to sleep."

Now, just as the fingers are joined to the brain we must believe that the other organs are joined to it. Thus the eye sends in its thousands of little threads to one part of the brain surface, the ear to another, the nose and tongue to another. So that each of

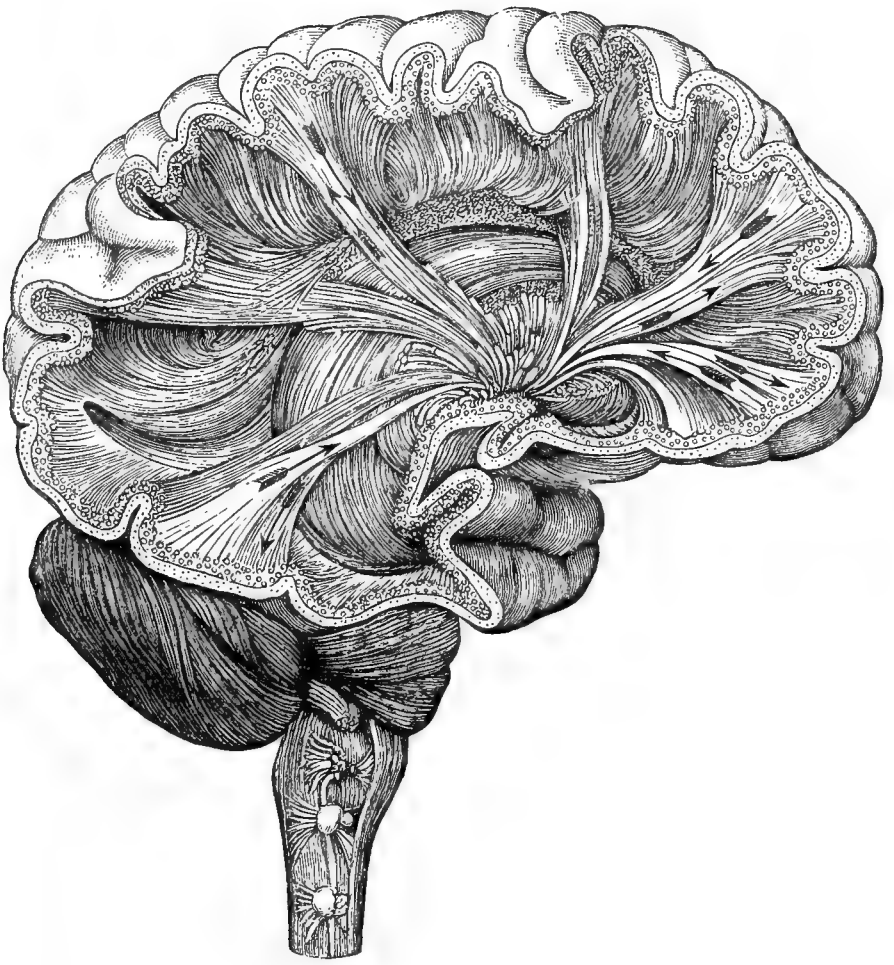


FIG. 2.—DIAGRAMMATIC REPRESENTATION OF THE DIRECTION OF SOME OF THE FIBERS IN THE CEREBRUM (Le Bon). The foldings of the surface; the association fibers joining different regions of the surface with each other; and the fibers passing down to the organs of sense are shown.

the organs of sense is related to a special region of the brain. And each of these regions receives messages from its own particular organ and from no other. That is what is meant by the term localization of brain functions; namely, that each power of sensation can be assigned to a location of its own. This idea aids very materially our conception of the senses. The sense of sight, for example, can not be thought of as dependent upon the eye alone, but upon the eye and the visual part of the brain surface with their connecting threads. And, after all, we must admit that we do not really see with our eyes or hear with our ears. Why does your friend want to hurry through an art gallery, while you wish

to look carefully at the paintings? You both see them with your eyes alike. Is it not because behind the eye there is something that is mental which enhances your enjoyment, and the lack of which prevents him from appreciating the beauties of art?

Go to a concert, and, as you come away, listen to the comments of people about you. One says that he was occupied chiefly in watching the gyrations of the man who plays the kettle-drums. Another is indulging in raptures over the intricate counterpoint displayed in the orchestration of the symphony. You have enjoyed the music without perhaps having noticed the counterpoint at all. And yet you and the other two have heard equally well, so far as the actual hearing goes. But how differently you have really heard! It has been the reception of the sounds in the brain, rather than in the ear, the appreciation of their meaning, the ideas awakened by the sensations there, which has determined this difference. You see and hear with the brain, and not with the eye or ear.

Or take another function of the brain, that of voluntary movement. You may be fairly skillful and graceful; you may have learned to write a good hand, or to play on the piano; you may even have succeeded in acquiring the power to pronounce foreign languages with the ease and fluency of your own. But this is not the limit to the knowledge of movement. There are many new motions which you might acquire; for example, the steps of new dances, the peculiar fingering of the violin or cornet or other musical instruments, or some one of the innumerable fine adjustments of motion which you see made with such rapidity by any one of fifty different operatives in every factory in the land. All these are movements of adaptation and adjustment, first studied by the aid of sight and then imitated by the aid of muscular sense, or the sense of movement, and finally acquired by practice till they can be executed with dexterity. It is not the fingers or the muscles which have learned the movements. It is the brain which, in its motor area, has received the sensation of movement, has retained a memory, and then combined the memories into new forms of motion so as to direct and guide the hand which carries them out. And so, though we all have hands and arms, there are some who use them deftly and are skillful, and there are others who will always be hopelessly clumsy and awkward. And the difference lies in the brain in the part called the motor area.

Where are the various areas? They can be shown by the aid of diagrams representing the brain surface (Figs. 3 and 4). In the middle lies the motor area (Fig. 3, 1), and it is interesting to know that on the left half of the brain, which guides the right hand, it is larger in extent than on the other side which controls the left hand; because the majority of fine movements are performed by

the right hand, and have to be learned by the left brain. The reverse is true of left-handed people.

At the extreme back is the visual area which receives impressions from the eye (Fig. 3, 2; Fig. 4, 2). In the lower part of the side the auditory area is situated, where impressions from the ear are received (Fig. 3, 3). On the under surface and in front of the auditory, the senses of taste and smell are located (Figs. 3 and 4, 4). Touch, which includes the senses of location and of movement, as well as those of temperature and pain, is assigned to the same area as that of motion, but extends a little farther back (Figs. 3 and 4, 5), and this overlapping of the two is not strange when we consider that our motions are guided by touch; think how differently you lift a heavy lamp or a fine bit of cotton-wool, and you will see how your grasp is guided by touch. These are the areas which are thus far discovered, but our knowledge of the brain is by no means complete, for there are large regions, on this African map, of undiscovered country. Fortunately, several Stanleys are on the way.

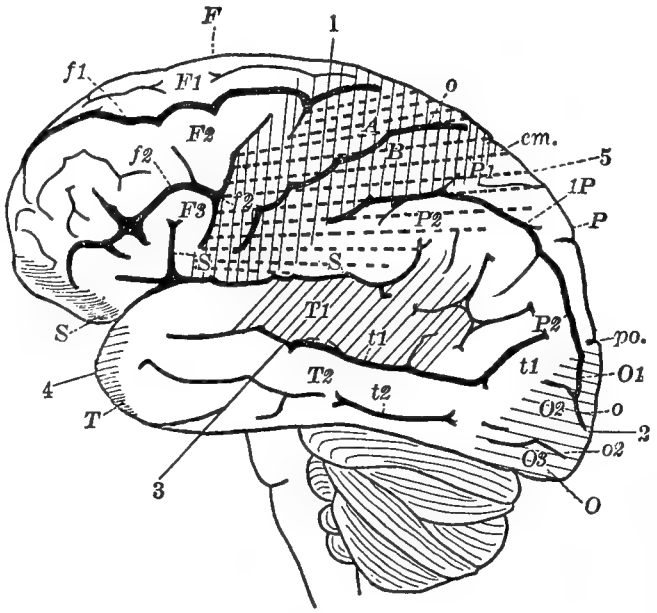


FIG. 3.—THE FUNCTIONAL AREAS ON THE BRAIN SURFACE. The parallel lines show the situation of different areas: 1, area of motion; 2, area of sight; 3, area of hearing; 4, area of smell and taste; 5, area of touch.

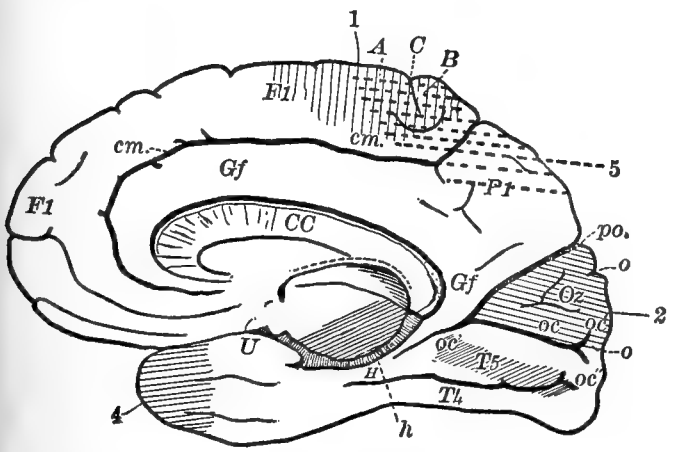


FIG. 4.—THE MEDIAN SURFACE OF THE RIGHT HALF OF THE BRAIN, SHOWING FUNCTIONAL AREAS.

Let us now, accepting this theory of the localization of functions in the brain, go on to see how much it reveals to us regarding the process of thinking.

Although a part of our thinking is done by the aid of language, the greater part of it is carried on without the consciousness of actual words. Mental images are constantly passing

through the mind, one crowding upon another; and it is only when we need to tell some one else about them that we use language. Call up to your mind for a moment the place in which you passed last summer, and already there has appeared a series of mental images of place and people, of scenes and events, each following the other with amazing rapidity but in silent succession. Max Müller would have us believe that thought without words is impossible, and he even attempts to trace the development of thought by studying the growth of language.* But many authorities, scientific and philosophical, teach the contrary, and rather than accept his position one is tempted to undermine it by advancing the opinion that few men think as the student of words does.

If we think, then, by means of mental images largely, it may be worth while to study the structure of a mental image.

When you examine a flower you perceive its graceful shape and form, its exquisite color, its delicate fragrance, and its soft, velvety feel. You say it is called a rose, but—

> "What's in a name? That which we call a rose,
> By any other name would smell as sweet."

So that without its name you have a mental image of it, which is made up of several distinct sensations. These are the sensations of the rose as it appears to the eye—*the visual image;* the sensation as it reaches the nose—*the olfactory image;* and the sensation of its touch, its shape, and softness—*the tactile image.* These impressions on the different senses have been sent to distinct and separate regions of the brain surface. There, having been received, they are stored up, so that the image once formed can be recognized when repeated and can be revived in memory.

Every sensation leaves behind it a trace upon the brain, which trace is the physical basis of our memory of the sensation. Perhaps no modern conception of the physical basis of memory is more graphic than that which we find in Plato. In the "Theætetus" he puts the following words into the mouth of Socrates:

"I would have you imagine, then, that there exists in the mind of man a block of wax, which is of different sizes in different men, harder, moister, and having more or less purity in one than in another. Let us say that this tablet is a gift of Memory, the mother of the Muses, and that when we wish to remember anything which we have seen or heard or thought in our own minds, we hold the wax to the perceptions and thoughts, and in that receive the impressions of them as from the seal of a ring; and that we remember and know what is imprinted as long as the image lasts; but when the image is effaced or can not be taken then we forget and do not know." †

* "Science of Thought."

† "Theætetus," Jowett's translation.

Plato carries out the same figure to explain different degrees of memory. When the wax is deep, abundant, smooth, and of the right quality, the impressions are lasting. Such minds learn easily, retain easily, and are not liable to confusion. But, on the other hand, when the wax is very soft, one learns easily but forgets as easily; if the wax is hard, one learns with difficulty, but what is learned is retained.*

In some way or other, we do not know exactly how, the sensations leave behind them impressions or memory pictures.

And these separate memory pictures are associated together, as they have all come from the same object; so that, the association being once made, any one will bring to mind the others, and hence if you perceive the fragrance you remember the appearance of the flower from which it comes—its color or its feel. This association of separate memory-pictures is secured by means of fine nerve-threads, which pass between the various areas of the brain and join the parts of the mental image with each other. This may be represented in the diagram (Fig. 5) by placing a circle for each memory-picture in its appropriate place and joining the circles by lines. The circles represent those little round masses of brain substance called nerve-cells, and the lines the association nerve-fibers uniting the cells (Fig. 6). The diagram shows the physical basis of the mental image of a rose—what has been called by Romanes a "recept," since its elements have been received by the senses.† What is true of the rose is true of every other object which we have ever learned to know, for of every object we have a recept, or a series of mental images in the brain.

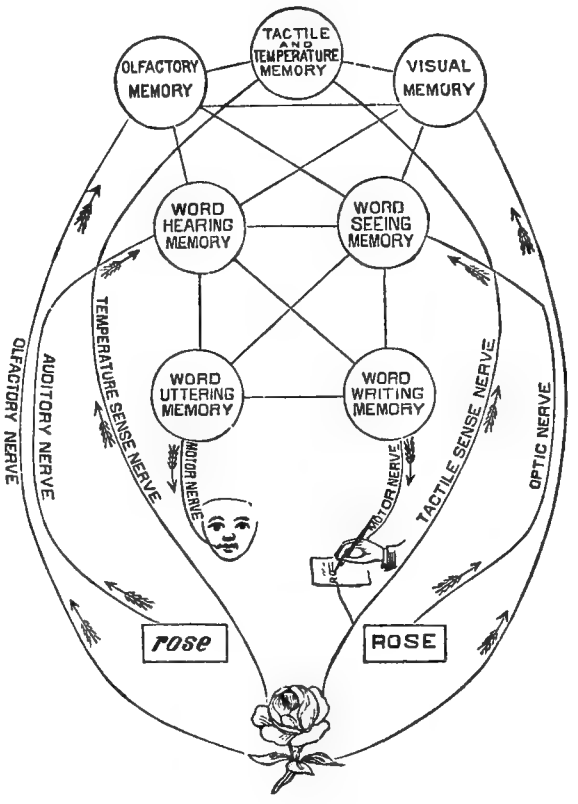


FIG. 5.—DIAGRAM TO ILLUSTRATE THE CONCEPT ROSE.

Each memory is the relic of a past perception, acquired through an organ of sense. These memories are associated, forming together the concept.

The lines from the rose represent the channels of sensation; the lines between the circles the association tracks. The mouth and hand are the motor organs of speech and writing.

* "Memory Historically Considered," Burnham, "American Journal of Psychology," ii, 41.

† Romanes, "Mental Evolution in Man," p. 36, D. Appleton & Co., 1889.

We are constantly increasing our store of mental images, and when one contrasts the small number of such images in the brain of a common uneducated day-laborer with the myriads in the brain of one who has traveled widely, has become familiar with the stores of information in foreign languages as well as in his own, and has cultivated his powers of observation in many different directions —for example, such a great leader of thought as Gladstone — one can not but be amazed at the capacity of work in this little organ, the brain. And if there is a physical basis for each of these mental images, is it not evident that in the brain of a Gladstone large areas must be taken up which in the laboring man are really empty? We have seen that on our brain-map there are some empty spaces. There is every reason to believe that these grow smaller as our information widens; and, if so, then, like the undiscovered country of Africa, they should really be a stimulus to efforts of further conquest.

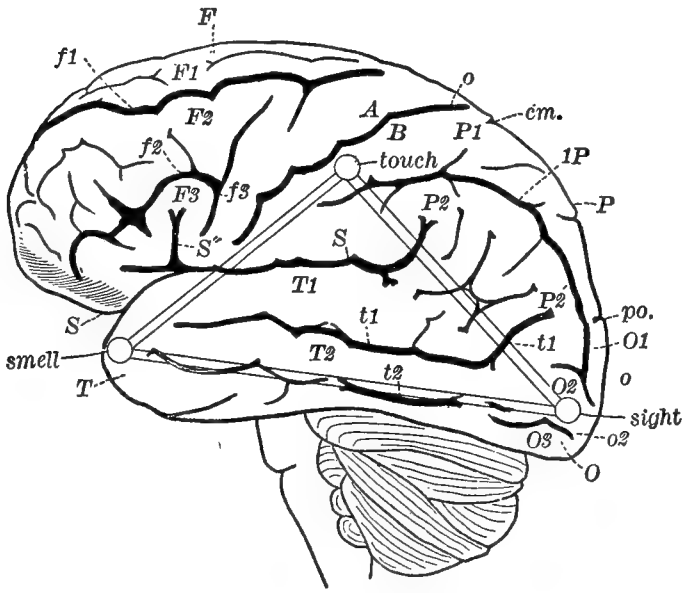


FIG. 6.—THE LOCATION OF THE MEMORY-PICTURES IN THE MENTAL IMAGE OF A ROSE ON THE BRAIN SURFACE. The different memory-pictures are joined by association fibers.

But this mental image of the rose, as represented in the figure, is not really a complete image until it is associated with a name. And the mental image of the name is not as simple as might at first be supposed; for you have not only learned to recognize the word "rose" when you hear it, or when you see it printed, but you have also learned to say the word and to write it, so that you really have a *word-image "rose"* made up of two sensory images, auditory and visual, and of two motor images, or the memory of the effort necessary to use the word in speech and in script. It is necessary to add then four more circles to the diagram to show the physical basis of the word "rose," and each of these must be placed in its own special region, which has been determined by a long series of investigations. These circles, too, must be joined together, since all the parts of the word are connected in the mind; and, finally, the word-image and the mental image, in all their parts, must also be associated (Fig. 7). Thus the complete mental image of such a simple object as a rose is made up of numerous distinct mental pictures, each joined to all the others, and each located in

its own particular domicile. Now, such a mental image is termed a *concept*, and concepts are the material of thought. Thought is the play of consciousness among these concepts—a play which always, in our waking hours, is within definite boundaries and along lines of association. The oddity of our dreams arises from the disregard of these lines and boundaries in a semi-conscious state. Many of the concepts are related to one another. Thus the rose is only one of many flowers which you know, and the term "flower" really brings to a focus all the images of the different roses, chrysanthemums, pansies, and pinks and varied objects which the most complete horticultural exhibition can display. The term "flower"—which we may call an abstract term, because it stands, not for a single object, but for a class of different objects with common features—enables us to handle these many mental images easily and communicate the pictures before our minds to others. It is a convenience, then, to use the word; but, nevertheless, it is the mental images, rather than the words, which play the greater part in our thinking.

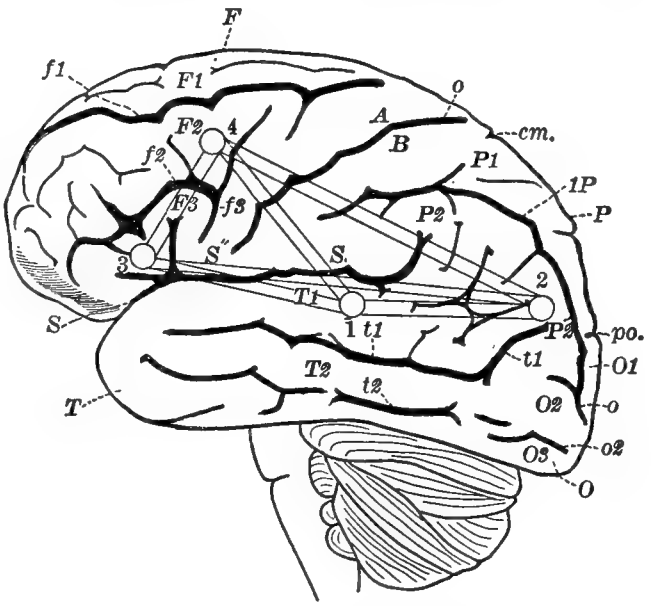


FIG. 7.—THE LOCATION OF THE MEMORY-PICTURES OF THE WORD-IMAGE ROSE. 1, word-hearing; 2, word-seeing; 3, word-uttering; 4, word-writing memory-picture.

This has been most ably expressed by the Duke of Argyll, who says: "Images are repetitions of sensation, endowed with all its mental wealth, and consciously reproduced from the stores of memory. Without images we can do nothing in the fields of thought, while with images we can mentally do all things which it is given us to do. The very highest and most abstract concepts are seen and handled by our intellects in the form of voiceless imagery. How many are the concepts roused in us by the forms and by the remembered images of the human countenance! Love and goodness, purity and truth, benevolence and devotion, firmness and justice, authority and command—these are a few, and a few only, of the abstract ideas which may be presented and represented to us in every degree and in every combination by the remembered image of some silent face. What a wealth of concepts is set before us, for example, in the images raised by this single line:

'Her eyes are homes of silent prayer'!

"Introspection will convince us—perhaps to our own astonishment—how large a part of our thinking operations are conducted through the raising and recalling of remembered images." *

But it may be objected that one can not spend one's time in day-dreams, or in the mere pleasures of memory and imagination. You say that reason and action are the real things of life. Have these, too, such a physical as well as a mental basis? Let us follow one or two simple acts of reasoning for a moment. When you see a rose, although it is at a distance from you, you will admit that you believe it to have a fragrance. You conclude that it has, because in your former experience with roses you remember that, when you have held one near, you have always perceived its perfume. The association of the sight of the rose and the fragrance has become fixed in your mind, and when you see it your thought is led along to its fragrance, and you draw the conclusion that the rose is fragrant. That is an act of reasoning. Supposing some one says that the rose sounds sweetly. You have no association between such things as roses and sounds in nature, and your thought refuses to run along where there is no track. You reply that he is talking nonsense—that is, the unreasonable.

Or take another example. Your dog sees you go into the hall and take up your hat and cane; he at once jumps up and runs about, showing by his action that he has come to the conclusion that you are off for a walk, and that he wants to go with you. What is the basis of this process of reasoning? He has a mental image of this act of yours, associated with another mental image of a run on the lawn, and the first calls up to his mind the second. In his experience one act has usually followed the other, and he draws the conclusion that you are going out where he can run. You say at once that the dog has reasoned correctly. It may even be true that the dog has learned to understand language. Many dogs know the word "out," and it calls up to them as distinct a mental image as your act of putting on your hat. Sir John Lubbock has even taught his dog to read; † for, by showing him a large card on which the word "water" was printed, every time he gave him a drink, an association was established in the dog's mind between the card and the act; and, finally, when the dog wanted a drink, he would bring the card in his mouth to his master. Ten such different words were taught him, and he rarely made a mistake. So that the understanding of speech and of writing and the act of reasoning, so far as simple conclusions go, from the recollection of mental images, may be granted to animals as well as to man. And these acts of reasoning, like those

* Argyll, "The Identity of Thought and Language," "Contemporary Review," December, 1888, p. 814.

† "Intelligence of Animals," D. Appleton & Co.

of memory, have as a basis the association of ideas. It may be admitted at once that many high processes of thought involve the following of association along many lines at once, or in such a complex way that to picture them clearly to the mind would be an almost impossible task. But there appears to be no essential difference in kind between the simple conclusions which have been used as illustrations and the more complex ones involved in abstract reasoning. The logician will reduce all your acts of reasoning to certain syllogisms which it is now quite customary to express in algebraic formulæ. For each of these formulæ it is possible to picture a physical basis of nerve-cells, joined together by nerve-fibers, so that it seems probable that the mechanism of thought will some day be understood. Our thoughts are usually so rapid and so many that we do not stop to analyze them, but, when we do, we find them always the result of a gradual accretion of ideas and not a new creation. The inventor will tell you that his mostbrilliant discovery did not spring suddenly into his mind in all its perfection, but was gradually led up to, step by step, with many halts and puzzling alternatives. Finally, old mechanisms and principles, formerly familiar, were successfully associated together with new adaptations into a new unit, and the ingenious mechanism was complete. The evolution of the locomotive, of the telegraph, and of the telephone teaches us the process in the inventor's mind as clearly as it shows his genius for construction. There are many other mental processes which might be followed out which display equally well how closely reasoning depends on the association of ideas—i. e., upon the play of consciousness along lines of communication between different regions of the brain. But we must pass on to some illustrations of action.

Watch a game of tennis and notice the difference between players, and you can tell a great deal about their mental processes. One is quick to see the ball, to note its direction, and to calculate its speed and the position it will reach in a moment, and yet from a lack of quickness in movement or from clumsiness he is unable to return it well. Another is particularly agile and graceful, plays all over the field, and seems to be everywhere at the right time; and you think him the better player. But as you watch you find that he judges the ball badly, and is not accurate in his calculation as to where it is going or when it will fall. The champion player is the one who combines accuracy and quickness with precision and agility. The sight of the direction of the ball leads him at once to a correct judgment of how far he has to run or reach for it, and his movement is quick enough and directed with just sufficient force to make the return. Now, this matter of precision of movement is dependent upon a process of perception,

association, and effort, and is to a great extent a matter of inborn capacity. The physicists express this by saying that each of us has his personal equation. Perhaps this will be more easily understood if we follow the manner in which it was discovered. One of the interesting astronomical events is the eclipse of Jupiter's moons as they pass behind the planet and disappear from the astronomer's view. Maskelyne, British astronomer royal, and his assistant in the Greenwich Observatory, in 1795, sitting side by side and looking through two telescopes, were attempting to record very accurately the moment at which the eclipse was complete. It was found that their records differed from one another by some fractions of a second. And the differences were about the same when other observations with a similar object were made. The explanation of these differences has been found, after many years of investigation, to be due to a difference in the rapidity with which each man observed and recorded his observation, and those differences can now be measured. This was not appreciated at first, for we find that the result of this discovery of a difference between the records of the two observers was very unfortunate to one of them; for in his annual report Maskelyne writes:

"I think it necessary to mention that my assistant, Mr. David Kinnebrook, who had observed the transits of stars and planets very well in agreement with me all the year 1794, and for the great part of the present year, began from the beginning of August last to set them down half a second of time later than he should do according to my observations; and in January of the succeeding year, 1796, he increased his error to eight tenths of a second. As he had unfortunately continued a considerable time in this error before I noticed it, and did not seem to me likely ever to get over it and return to the right method of observing, therefore, though with reluctance, as he was a diligent and useful assistant to me in other respects, I parted with him."

Thus Mr. David Kinnebrook fell a victim to the earliest discovery of the difference of power of observation.

How these differences were measured it would take too long to relate. The results only can be stated, and for details reference made to an article by Prof. Cattell in a recent number of "The Popular Science Monthly" on "The Time it takes to Think," and to one by Prof. Sandford, in the "American Journal of Psychology," on the "Personal Equation." *

Any act which depends upon sensation, such as returning a tennis-ball or replying to a question, takes time. This act can be separated into certain parts. There is the perception of the sensation, the decision to respond to it, and the act of motion. You

* Vol. ii, No. 1.

hear the question, you think of the answer, and you say it. Each of them has been separately measured, and takes from one tenth to one sixth of a second, so that the entire process requires from three tenths to one half of a second to complete it. People differ widely from one another in this rapidity of action, and the same person differs much at different times, and the explanation of this difference is found in the inherent power of activity in the brain. The effect of wine is to make these acts slower. The action as a whole calls into activity several parts of the brain, the nerve from the organ of sense to the brain, the part receiving the sensation, the tract from it to the motor area, and the part of that area which initiates the impulse and guides the movement and the nerve thence to the muscles. It is not surprising, therefore, that it should take some time; the astonishing thing is really the rapidity with which the brain acts, for modern measurements extend to thousandths of a second, and some mental processes in rapid brains take only a few hundredths of a second to be completed. Familiarity with a certain act lessens the time it requires. A lady was heard to say the other day, in alluding to the acting of the French comedians who have recently been seen here, that it was surprising how much faster French people talked than Americans. She would have thought it an act lacking in courtesy had it been insisted upon that it was not because they really talked faster, but because her English-speaking brain refused to think as rapidly in French, that had led her to the conclusion. Yet such was the fact.

There is one more process of mental activity to which allusion must be made, as it has thrown much light upon the theory of localization, and has now been fully explained by that theory—viz., the power of speech. There is perhaps no mental process which brings us more closely to the point of meeting of the physical and mental elements of the mind.

Language is so complex, as we survey it and as we constantly use it, that it seems at first impossible to unravel all its mysteries. But, if we watch its growth, we can get at some facts of not a little interest. Let us trace the way in which a baby learns its first word.* As the baby looks about him he begins after a time to distinguish faces, and one face, his mother's, being constantly near, soon becomes most familiar. Mothers are constantly talking to their babies, and always speak of themselves as "mamma" or "mother," never using "I" or "me." After a time the baby begins to notice this sound "mamma" and to recognize it, and then the fact that a certain face and a certain sound usually come together finally establishes a fixed association between the sight-picture and the sound-picture, so that the one when brought to mind brings up the other. Then, if you ask the baby, "Where

* Preyer, "The Mind of the Child," D. Appleton & Co., 1888.

is mamma ?" he will look about the room until he finds the familiar face. He has now taken his first step in acquiring speech, he has learned the meaning of a word. The second step follows after a time. From time immemorial in the baby's experience he has been able to cry, and he knows it; in other words, he is aware of the fact that it is one of his native powers to make a noise. By and by it begins to occur to him that this sound, "mamma," is also a noise, and some day, probably by accident, as he is being cruelly shaken up by being trotted on some one's knee, he emits a sound like "mamma." If he is a bright baby—and whose baby is not ?—he notices the similarity between the sound he has made and the sound he has already learned. Such attempts at saying "mamma" usually meet with considerable active encouragement of an agreeable kind, and he naturally repeats the attempt. After many failures it is a success, and he has at last acquired a memory of the exact effort in certain muscles of lips and tongue needed to produce the sound, and has also associated that memory of effort with the memory of the sound which in time is joined to the memory of the mother's face. And now the second process is complete, and the baby knows how to say the word intelligently; for intelligent speech is speech based upon an association of ideas. Of course, as the child grows, he subsequently adds a visual picture of the word "mamma" to the auditory picture when he learns to read; and a manual-effort memory to the speech-effort memory when he learns to write. When all these four memories are acquired and associated, he has acquired the use of language.

Now, what is true of this simple word has been true of every other word which we make use of; and, though we can not recall this process which we have been through, we can see it going on about us. If you wish to study it carefully, study children, by the aid of Preyer's interesting book, "The Mind of the Child."* Or if you wish to observe the process more directly, recall the manner in which you have acquired a foreign language, for that is done in the same way, if the natural method is followed. Suppose that you are told that in German the brain is called Gehirn—that it is pronounced gayheern, and spelled g-e-h-i-r-n. If you are not familiar with German, you have now a new word-image connected with the mental image of the brain much more easily acquired than was the word "mamma" when you learned it, but nevertheless acquired in the same way.

Whether we think, then, in mental images or in language, the process is the same; it is consciousness playing along certain lines of association to and fro between definite memory-pictures. These memory-pictures have been acquired through the senses,

* The practical application of this knowledge is made by Dr. Mary Putnam Jacobi, in an article on "Language in Education," "American Journal of Psychology," vol. ii, No. 1.

each through its own particular channel of sensation, and are stored up in the brain, each in its particular part of the brain.

Memory is the revival in consciousness of these various memory-pictures.

Imagination is the combination of old pictures into a new image.

Reasoning is the passage of thought from one picture to another, along established lines.

Action is the carrying out of the impulse to whose memory reason has led up.

These are some of the mental faculties, and it is at once evident that they are not distinct entities, like the mental image, but rather powers of the mind to deal with these images; and, therefore, the faculties can not be said to have any particular seat, and can never be located in an area of the brain. Imagination and reasoning power are therefore not to be assigned to bumps on the head, as the old phrenology taught. And even when we speak of memory we distinguish it broadly from the memory-pictures, which do have a location, but one that is wholly different from that taught by Gall. Here, again, we see how far removed from the old phrenology the new phrenology is, and how much more exact in its knowledge. If proofs of these facts are demanded, they are to be found in the study of diseases of memory, as described in Ribot's entertaining little volume. But one or two statements may be made, very briefly, in closing, which must carry conviction to the most skeptical mind.

The reason why it is now accepted that each sense with its memory-pictures has a definite location in the brain distinct from all others, is that it is possible for one sense or one set of memory-pictures to be lost without affecting the others. There are men in apparently perfect health who have suddenly lost all their sight-memory, so that they no longer recognize people or things formerly familiar. One such man did not even know his wife until she spoke to him, when he at once knew her voice. There are men who have in the course of a few moments been deprived of their memory of language, and who, although they could talk and even write, were as incapable of understanding what was said to them or of understanding what they saw on a printed page as one would be of spoken or written Chinese. There are others still who have lost their artistic or musical powers, but in other respects are perfectly sound, so that instead of being able to sketch from memory as formerly they are unable to call up to mind a single memory-picture; and instead of being able to follow or recollect a melody or appreciate the harmonies of music, they are totally deprived of this pleasure, and this without any blindness or deafness excepting of the mind.

Others, again, lose the power of speech or of writing without having their understanding of language interfered with or without any paralysis of the muscles—the effort-memory of speech is lost.

Such effects find their only possible explanation in the fact that each set of memory-pictures may be destroyed simply, and this is only possible provided they are situated in separate regions of the brain.

And there is a great practical application of all this theory of localization, which has only been reached within the past three years.

If it is possible to locate a set of memories, and in the progress of disease those memories are lost, it is evident that the location of the disease has been determined. Sometimes that disease is of a kind which can be removed—for example, a brain tumor. From a study of such facts as those presented here it has been possible to determine the location of tumors in the brain, and, although externally there was no sign of disease, it has been possible for surgeons to go through the skull to find the tumor and to remove it. Up to the present time about seventy such operations have been done in this country and in Europe, and of these fifty have been successful, and what was formerly considered a necessarily fatal disease has thus been cured.

The practical demonstration of the truth of the new phrenology is therefore complete.

The old phrenology, as we have seen, was wrong in its theory, wrong in its facts, wrong in its interpretation of mental processes, and never led to the slightest practical result. The new phrenology is scientific in its methods, in its observations, and in its analysis, and is convincing in its conclusions. And who can now set a limit to the benefit it has brought to mankind by its practical application to the saving of human lives?

LIFE AT THE CAMEROONS.

By ROBERT MÜLLER, M. D.

THE Cameroons youth has the inclination to independence from the day of his birth, and it is taken advantage of by his mother. Before he can walk, she sets him out near the house, where he looks about him all the day at will. As soon as he is large enough she gives him the day's catch of fish of his father or elder brother, to spread and turn for drying and putting away. As soon as he can use his legs, he is taken by his brothers or a friendly youth in the canoe, and is gradually taught the management of the vessel. When he has become stronger, he is allowed

to go alone and disport himself in the water to his heart's content. At the same time he begins to fish, using four lines at once —two attached to his big toes as his feet hang over the side of the boat, and two held in his hands. It is a curious spectacle indeed to see him pulling in first one foot and then the other, as a fish has been caught upon it, and at the same time gesticulating with his arms to keep the boat in position and manage the lines in his hand. As he fishes the boat is allowed to drift down the stream; but the pulling back absorbs his entire attention. Crab-fishing comes in about every two years, when the crustaceans occupy the water so thickly that they can be caught as fast as they can be taken out with the hands.

For the chief dish at his breakfast or dinner he receives a hash of various vegetables, baked or packed sausage-fashion in leaves. Rice, bought from the factories, and pilot-bread from the ships, are becoming common, and are regarded as delicacies. A favorite dish is made of chicken and yams, cooked, with pepper-pods, in palm oil. The youth eats his meal in company with his mother and brothers and sisters, and is allowed only in exceptional cases to share his father's usually solitary repast. By "brothers and sisters" are understood only children of the same mother; the others are the sons and daughters of his father. I learned this when I asked my little companion Akuelle, a son of King Bell, who was the other youth with us. "He is a son of King Bell," was the reply. "Then he is your brother?" "No, doctor, he has another mother." When the child is nine years old he is shorn and counted among the men. If his father is rich, a wife is bought for him, but the couple are not expected to live together for some years yet. During his earlier years the negro of this part of Guinea is conspicuously intelligent and a most pleasing companion. But his good qualities disappear with the passing away of his youth, and he becomes the false, idle, quarrelsome African of the factories.

The breech-clout constitutes the usual clothing of the men. A small apron is also worn, so that if the former piece becomes oppressive it can be taken off without the man being wholly naked. Articles of European clothing are often worn, but only on the upper part of the body; trousers have not yet been admitted to the Cameroons wardrobe. King Bell wears also a stove-pipe hat, which he manages to keep always looking new.

The birth of a girl is received with great joy, as a costless acquisition of wealth, for she is sure when she becomes marriageable to bring a goodly sum. The purchaser may come from the same village or from another, but is more welcome in the latter case, for then he will have to pay more. The child grows up under the eyes of her mother, and is taught by her to cook, work

in the field, take care of the other children, and smoke. All this must be done early, for it will not be many years before a purchaser will come for her; and at ten or twelve years of age she will probably be called upon to follow a stranger. Notwithstanding the early marriages, the number of children seldom exceeds three, and the woman is a matron at twenty. When she has passed her bloom she is relegated to the capacity of a servant, and her husband gets another, younger wife. Thus men of means often take one or two new women every year. The women and their children live in separate houses, which are not shared by the husband. He lives, too, in a house of his own, in the midst of the women's houses, which are sometimes quite numerous. King Bell has a hundred and twenty wives. The intercourse between mother and child is very different from what it is with us, and the Cameroons mother is more sparing in her caresses than her white sisters. Kissing has no place among them, but they have their own peculiar ways of fondling and petting, which perhaps represent as much affection as the more demonstrative proceedings of Europeans.

So long as they are young and handsome the Cameroons women pay great attention to their toilet. The petticoat, which reaches down from the hips to the ankles, must be thoroughly smooth and clean, and the apron, which is worn under it, is as spotless as the under-clothing of a European lady. Their hair is woven by professional hair-dressers into braids of various shapes, without grease and usually without ornaments, although a woman is occasionally found who wears a string of beads around her head. The dressing usually lasts for a week, and is bound up at night in a cloth for protection. It is also a part of the hair-dresser's business, which is carried on in the street, to pull out the lady's eyelashes. A string of pearls or some other ornament of European origin is worn around the neck. The shoulders, breast, and belly are covered with ornamental tattooing in red and blue, apparently centering at the navel. Elaborate ruffles of ivory or metallic rings are worn upon the wrists and ankles.

The principal musical instrument is the drum, or *climbi*, which is made from a hollowed log. It has a slot along the direction of its length, which is unevenly divided by a bridge left across it, on which the drumstick is beat to produce different tones. The music is at first monotonous enough to the ear, and it is hard to realize that the instrument is available as a telegraph. Yet this is its principal use. The Cameroons man drums out every event that appears worth communicating. The next man takes it up and drums it on, and in this way news is spread speedily from one village to another. A regular drum-language has been worked out, which the Cameroons man can imitate with his mouth or beat

silently on his breast, and thus converse at his convenience with his countrymen, even in the presence of white men who understand the spoken language. The drum-telegraph does not cease during the whole night, for the Cameroons man is communicative and has much time. The drum is also available as an instrument to dance by. The dances are quite different from those of the civilized world. The sexes being separated, there are no waltzes or contra-dances; there are no pauses for conversation; but the dancing lasts all day, and, when any one gets tired of it, he simply goes away and rests. The performance presents a curious scene, with two fellows beating on their drums as if wild, yet in regular measure, and a company of male or female dancers in action in front of them. These have disposed themselves in a circle, and beginning with short, shuffling steps to the right and left, gradually wax more lively in their motions till the muscles of the legs, arms, and shoulders are all engaged, and the whole body at last gets into a condition of shaking and twisting that no European can imitate. There is, however, no jumping, but a kind of singing, in which a favorite theme is taken up by one of the musicians and joined in by the chorus, which from time to time rises into a regular bellowing. This goes on to the climax, then subsides into a calmer *tempo*, while the performers are gathering strength for a new outburst. The Cameroons music would be tame without the drum. It is therefore taken into the boat, where the song is performed in the same fashion as at the dance. The subjects of the songs are various: sometimes they celebrate the beauty of the canoe; sometimes the good trade which the singers have made; sometimes scorn of their enemies or praise of their friends; and sometimes they are of love. The other musical instruments are of inferior importance as compared with the drum, and include stringed instruments of various construction, in which the resonance is sometimes strengthened by using a hollow gourd shell; and, in King Bell's royal canoe, a bell and an ivory horn.

The Cameroons man is a most passionate trader. Circumstances compel the recognition of a credit system between Europeans and the Duallas. The black comes to the white man and asks for an advance upon the products which he engages to bring. When he brings them he wants another advance, and, keeping this up for several years, he is liable to get considerably behind in the white man's books. The Europeans accordingly find it convenient to "stop the trade" from time to time, and compel the natives to "wash out their accounts" before they will permit any further advances. This they do by agreement among themselves, whereby the native is debarred the opportunity of skipping from one dealer to another. Trade is almost wholly by barter, in which the blacks receive rice, tobacco, spirits, cloth, guns, ammunition,

salt, and knickknacks in exchange for their palm-oil, nuts, and ivory. The Europeans, of course, do not fail to make the bargains profitable to themselves. The unit of values is the "kru," and represents the quantity of goods which the man will receive for a definite quantity of his products. It is a very indefinite standard; for a kru of salt is not worth as much as a kru of cloth, and thus it varies according to the kind of goods in question. It may be rated at about twenty marks German. There are also the "kek," or the quarter-kru, and the "bar," or twentieth of a kru; whence apparently the kru may in the beginning have represented the English pound.

The exchange of his products keeps the Cameroons man very busy. He usually spends the day at the factory in bargaining. For the goods which he has actually brought for the satisfaction of his immediate wants, he usually receives a ticket or "book"; and this little paper is the one thing in the world for which he has a real respect, and by which he will swear. He can not read it, but he has learned that on presenting it he will receive what has been promised him. The mystery of this process seems to him a real enchantment, and he regards it accordingly; and the awe with which it inspires him is extended to all writing.

The objects offered in the factories are not produced by the Cameroons man. He is too idle for that, and prefers to be a middle-man. He buys the goods in "the bush," on such terms as to give him a tremendous profit in the whole transaction. In fact, he cheats the bushman, and because of it conceives a great contempt for him, which he expresses by calling every one whom he regards as dull a bushman.

From time to time the Cameroons man leaves his home, provisions his canoe, and, taking some of his wives with him, is rowed by his slaves into the bush, where he has his appointed trading posts and purveyors. When his boat or boats are filled, he returns to the Cameroons in grand style, and celebrates the end of his expedition with a feast.

The Cameroons man is also a sportsman on the water. The canoe is an exceedingly unstable craft when an inexperienced man is trying to manage it, but the blacks handle it with great skill, and, whether it be a large boat carrying many persons (some of them have capacity for sixty), or built for himself alone, he propels it swiftly, safely, and accurately. A canoe skimming over the water in the panoply of war offers an attractive sight. The boats are handsomely painted in gay colors, and have artistic figure-heads, chiefly representing birds or men, or creatures of fancy. The crew sit on the sides and propel it by dexterous manipulations of the paddles, which they hold with one hand at the end of the handle, and the other close down by the blade; and

they pride themselves on the figures and tricks they can execute with it. The boatmen in these war-vessels delight in arraying themselves with warlike emblems—helmets of goat-skin, guns of all kinds except good ones, swords, and bush-knives. While the war vessels are highly adorned, the trading vessels and those in common use are plain.

On account of their lack of industry, the Cameroons people make very few articles beyond what are necessary for their own use; and it is therefore hard to obtain a satisfactory collection of their products. If they could be taught to apply themselves to anything, they would make most excellent wood-carvers. The figure-heads and models of their canoes, and their chairs, are very fine. They make handsome mats and bags of bast. Their fishing nets and lines do them credit. Carved canes of ebony and calabashes are harder to procure. An ivory-cutter drives a good business in making walking-sticks for persons of means. The gardens, in which banana-trees and yams are the most important plants, are taken care of by the women, who also look after the eggs, committing the sale of them to the young people. The youthful salesmen drive their trade at the factories and the ships. The buyer very carefully tests all the eggs, selecting the good ones, which are usually not in very large proportion to the whole number, and the seller takes his pay and goes with the rejected eggs to the next customer. He takes the best he can find out of the lot, and the seller goes on till he generally manages to dispose of most of his stock. Sometimes a chicken pecks through the egg-shell while the bargain is going on. This vexes the European, but is very enjoyable to the native; for are we not fond of teasing those we love? The egg-merchant uses his mouth for a porte-monnaie, and puts coin after coin into it; when he has to make change, he spits his fund into his hand, and picks out the needed six- and three-penny pieces.

The people also keep goats, which they eat and Europeans do not; swine, whose flesh Europeans reject; in the interior, very small cows, which furnish good meat; dogs; and in the way of pets, parrots, monkeys, chameleons, and crabs.—*Translated for the Popular Science Monthly from Das Ausland.*

THE report of the British Royal Education Commission assumes that if the object of elementary education be the fitting of pupils in general for those duties which they will most probably be called on to perform, instruction in science is only second in importance to instruction in reading, writing, and arithmetic. The soundness of this view is illustrated by the fact, also declared in the report, that the preponderance of opinion among the teachers examined is that no subject is better calculated to awaken the interest and intelligence of the pupils than science.

EVOLUTION AS TAUGHT IN A THEOLOGICAL SEMINARY.

By ROLLO OGDEN.

AT the time of the last hearing of the case of Prof. Woodrow before the General Assembly of the Southern Presbyterian Church, at Baltimore, many of the Johns Hopkins students embraced the opportunity of a lifetime to listen to the expositions of the doctrine of evolution made by so many of the divines of that gathering. It is said that inextinguishable laughter was excited among these young men by their learning how greatly their incompetent professors had misled them as to what evolution really was and meant. It is not often that a theologian can stop to afford such enlightenment to the inquirer in science; and, when he does, it is an obvious duty for one finding such priceless light hidden under a bushel to discover it to the world.

The bushel, in the case in hand, is the two volumes of "Dogmatic Theology," recently published by Prof. Shedd, of Union Theological Seminary, embodying the lectures which he gives in that institution; and the little candle which would surely cast its beams far in this naughty world if really given a chance to shine, is the exposition and annihilation of the doctrine of evolution as given in the chapter on "Creation," vol. i, pp. 499–515. The professor opens the discussion by admitting that there is a "true evolution." This whets curiosity, until it is explained to be the individual development of an organism from its embryo. This being the only "true" evolution, all other kinds are, of course, false, and accordingly are labeled forthwith "pseudo-evolution," under the burden of which eminently calm and philosophical epithet they have to stagger all through the subsequent pages. A better name, however, could not be devised to fit that caricature of the theory which Dr. Shedd sets himself to explain before refuting. It is probably unwitting caricature; the professor is an unconscious humorist. It is, at any rate, charitable to suppose that he jumbles up several different theories into one through ignorance. It would be hard to excuse, on any other ground, his identifying the views of Darwin with those of Spencer and Haeckel. Chauncey Wright long ago pointed out the great differences between these writers. Whatever may be thought of the general theorizings of the last two, it is clear that their method is not the patiently inductive one of Darwin. They are wide-ranging philosophers and rigid systematizers. Darwin was the most matter-of-fact and plodding naturalist, who dreaded of all things getting his feet off the earth. He felt himself lost once out of

sight of facts. His books furnish the best examples of careful induction the world has seen, and it is, of course, for that reason that they have had such immense influence, and that he gave an indestructible life to that cautious working theory of evolution which is to-day the presupposition of all the best work in natural science.

But Prof. Shedd leaves all this out of the account, and knows of no evolution which does not mean the change of a mineral into a vegetable, and of a vegetable into an animal. "Evolution," he says, "is not a mere change of form but of matter." It is true he recurs frequently to Darwin and his specific views, but you can never be sure that he will not fly off to his favorite Haeckel even when apparently farthest from him. This process of mixing up distinct things makes it easy for a disputant, when persecuted in one city, to flee into another, but does not much help one who is after the facts.

This confusion can be forgiven, however, for the sake of the doctor's great lucidity when he comes to state the objections to evolution. Here you always know what he means. We can not follow him all through his enumeration of the difficulties which the theory has to encounter, but will allude to those which are the most novel. The first gun he fires off is formidable enough: "The first objection to the theory of pseudo-evolution is that it is contradicted by the whole course of scientific observation and experiment. It is a theory in the face of facts." That is certainly a serious objection, and one wonders that it had never occurred to any of the scientists who have looked into this matter. It is but another instance of the value of a new point of view. In fact, the thing appears to be mostly intuitive with Prof. Shedd (and, of course, for that reason all the more certain; he stands by the intuitive philosophy), for he advances slight evidence for the statement we have quoted; the gist of what he says being that he never heard of a pigeon being developed out of a cabbage or a piece of quartz, nor of its developing, on the other hand, into a horse. It would be a brazen theory that could hold up its head after such an objection, but the professor seems to fear that evolution needs to be slain at least twice, and so he fires a second fatal shot: "This objection is proved to be true by the failure of the theory to obtain general currency." He means Darwinism now, for all the testimony which he cites bears on that theory. Agassiz is his main tower of strength. The views of a man who died sixteen years ago may be thought to have little to do with what is now "general currency," but that is nothing beside the witness of Haeckel himself. Out of its own mouth Dr. Shedd will judge evolution. He cites a passage from "Creation" in which the German rails at the French for not accepting Darwinism, and

says that even among his own countrymen are to be found many doubters. It is scarcely worth mentioning that this book was written twenty-one years ago, only nine years after the appearance of the "Origin of Species," for it is one of Prof. Shedd's first principles that a proof-text is a proof-text, no matter where you find it. Besides, it is exposition, not comment, that we are at just now.

"If the doctrine be true, it should be supported like that of gravitation by a multitude of undisputed facts and phenomena." The implication is that it is not so supported, and that is pretty tough on the libraries full of books like Müller's "Facts for Darwin." Prof. Shedd takes it very unkindly of Darwin that he never exactly defined a species. Considering that that is one of the things that Darwin said he was perfectly unable to do, and that this very fact led him to believe that there was something mighty queer about species anyhow, it does seem rather hard to bring it up against him now. "Evolution," adds the professor, "conflicts with the certainty of natural science." If it is true, it is the introduction of chance into nature. Anything may happen from anything. This is clear, for the evolutionists themselves say that "variations are accidental." Poor Darwin! after all his pains and endless iteration, there it goes—"accidental." One of the most tiresome things in his books is his constant crying out, "Now, mind you, when I say accidental, I mean according to laws that are not yet discovered." But, after all, here is an order of mind for which he ought to have said it twice as many times.

The embryological argument for evolution attains the high honor of being admitted to be "plausible"; but it is immediately and severely added that this is just the place to apply the maxim, "Judge not by the outward appearance." Naturally, Prof. Shedd is strong on design: "The abundant proof of design in nature overthrows the theory of evolution. This design is executed even in an extreme manner. The mammæ on man's breast and the web-feet of the upland goose show that the plan of structure is carried out with persistence even when in particular circumstances there is no use for the organ itself." If that is hyperborean science, it is dangerously near Hibernian logic, and ought to be called the argument from the usefulness of useless things.

But it is really impossible to keep up the pretense of taking Prof. Shedd's arguments against evolution seriously. Even one who has read in the subject as little as the writer has can not but see that this theologian, in attempting to refute the arguments of the evolutionists, does not know what those arguments are. Take one sentence of his: "If evolution be true, man may evolve into ape as well as ape into man." It would not be possible to construct a single sentence containing a more complete misapprehen-

sion of evolutionary doctrine. Evolution does not assert, it denies that ape evolves into man. Evolution undertakes to show why it is perfectly impossible that man should ever evolve into ape. Prof. Shedd ought to know this, or, if he does not, he ought to refrain from attacking what he does not understand. There is a misprint in one of his pages which is highly significant. He speaks of Darwin's work on "insectivorous animals"! A misprint, of course, yet how characteristically a sign that the author was moving about in a world not realized when he wrote those pages! A scientist reading proof, with a spark of vitality left in him, could no more have passed over that blunder than Prof. Shedd could have passed over a careless expression which might have implied that he believed the mercy of God was of equal rank with his justice. In one case as in the other the thing would have seemed so horrible a mistake that instinct without intellect would have prevented its finally getting printed.

The worst of it is that there is no reason whatever to suspect Dr. Shedd's perfect honesty in all this. When he says that evolution has failed to obtain general currency, he undoubtedly believes it. Evidence to the contrary he either has not read or has not weighed. If he were to see what Romanes says in his latest book, and says wholly in passing, wholly as a matter of course, that there is not living a naturalist of note who is not an evolutionist, he would probably be greatly surprised. If he were to read the evidence gathered a few years ago by the "Independent," and recently by the "Christian Union," going to show that evolution underlies the scientific teaching of all our leading colleges, he would probably be greatly alarmed. I repeat that Prof. Shedd is undoubtedly entirely honest in his ignorance; and I say that that is the worst of it, because it lends the influence of his high character and great learning and unusual ability to the spread of erroneous and disastrous beliefs.

Narrowly considered, it is in reality a conspicuous and crowning testimony to the place which evolution has taken in the thought of the world, that Prof. Shedd should have, at last, taken up the cudgels against it. It is like exerting influence back into the seventeenth century. It is a doctrine of the nineteenth century, making such a din, cutting up so much of the inherited theology by the roots, that Turretin looks out uneasily from his grave to see what the row is all about. Such a remark is in the line of what the professor considers the highest compliment. He prefers to be known as scholastic. A student who listened to a year's lectures from him, a decade ago, reported that but two books written in this century were referred to—and, as one of these was Hodge's "Theology," that, as the student admitted, reduced the number to one. The writer heard the late President

Sturtevant, of Illinois College, narrate an experience of his own with Prof. Shedd, which, as the story was told in general company, may be referred to without any violation of confidence. It was many years ago that he and Prof. Shedd went in company from Andover to Boston, each intending to preach in a Boston pulpit on the following Sunday. They returned on the same train, Monday morning.

"I don't know how it was with you, professor," said President Sturtevant, "but, for myself, I certainly felt like laying unusual stress on evangelical doctrine yesterday, preaching in Boston where so many loose theories are afloat." And Prof. Shedd replied: "I really don't know anything about that. I never read books of that class. All these infidel arguments were so much better put by the writers of the seventeenth century." To have pierced through such an armor is a great achievement, and the counter-attack of the professor is in reality, as has been said, a supreme proof of the immense influence now gained by evolutionary doctrine—a sort of rueful cry, "Thou hast conquered, O Evolution!"

Such complete failure to understand the great contribution to knowledge and speculation made by the theory of evolution can not but have a most deplorable influence when found in one occupying so prominent a chair of instruction in so prominent an institution. A fair proportion of Prof. Shedd's students come from colleges where they have been taught to regard evolution as one of the settled things. They must come out from their lectures in Union Seminary either dazed or indignant. Others, of course, who have either taken a short cut to the ministry, or have had their only education in some ecclesiastically controlled school where they have met no competent teacher of natural science, take in all that they are told on this, as on other subjects, and go out to swell the number of ministers who know nothing of the revolution wrought in human thought in the past thirty years. They are the men who do all they can (of course unwittingly) to make Christian belief an impossibility to a large class of intelligent and educated young men. One of that class came to his pastor, not long ago, and said: "I was at the meeting of the Benighted Presbytery last week, and they were talking about evolution as a very dangerous thing, and finally passed a resolution condemning it. I thought that everybody accepted evolution." That young Presbyterian was a graduate of Harvard, and learned of Prof. Gray (who, by the way, is a Balaam whom Prof. Shedd in delightful innocence summons to curse evolution) to reconcile evolution with theistic and even Christian belief, and was not unnaturally surprised at running up against a chunk of the last century.

It would be wholly unfair to give the impression that such

treatment of evolution as Prof. Shedd's is the regular thing in our theological seminaries. In a few of them there is a frank acceptance of the main positions of evolutionary teaching; in many of them there is a growing care not to antagonize evolution as flatly as was once customary, and to lay down theological propositions which would not be entirely swept away if it should turn out that evolution should finally have to be admitted to be established. Archbishop Whately used to say that the attitude of the clergy to new scientific doctrines was marked by three definite stages: "At first they say, 'It is ridiculous'; then they affirm, 'It is contradicted by the Bible'; at last they declare, 'We always believed it.'" All these stages are represented in the teaching of the seminaries—to which one Union should be assigned may be inferred from what has gone before. It will certainly not be Prof. Shedd's fault if the institution which he serves does not prove to be the one to come to mind as the best illustration of Horace Bushnell's remark: "Some theological seminaries are not only behind the age, but behind all ages."

THE ART OF PROLONGING LIFE.

By Dr. ROBSON ROOSE.

THE doctrine that a short life is a sign of divine favor has never been accepted by the majority of mankind. Philosophers have vied with each other in depicting the evils and miseries incidental to existence, and the truth of their descriptions has often been sorrowfully admitted, but they have failed to dislodge, or even seriously diminish, that desire for long life which has been deeply implanted within the hearts of men. The question whether life be worth living has been decided by a majority far too great to admit of any doubt upon the subject, and the voices of those who would fain reply in the negative are drowned amid the chorus of assent. Longevity, indeed, has come to be regarded as one of the grand prizes of human existence, and reason has again and again suggested the inquiry whether care or skill can increase the chances of acquiring it, and can make old age, when granted, as comfortable and happy as any other stage of our existence.

From very early times the art of prolonging life, and the subject of longevity, have engaged the attention of thinkers and essayists; and some may perhaps contend that these topics, admittedly full of interest, have been thoroughly exhausted. It is true that the art in question has long been recognized and practiced, but the science upon which it really depends is of quite mod-

ern origin. New facts connected with longevity have, moreover, been collected within the last few years, and some of these I propose to examine, and further to inquire whether they teach us any fresh means whereby life may be maintained and prolonged.

But, before entering upon the immediate subject, there are several preliminary questions which demand a brief examination, and the first that suggests itself is, What is the natural duration of human life? This oft-repeated question has received many different answers; and inquiry has been stimulated by skepticism as to their truth. The late Sir George Cornewall Lewis expressed the opinion that one hundred years must be regarded as a limit which very few, if indeed any, human beings succeed in reaching, and he supported this view by several cogent reasons. He pointed out that almost all the alleged instances of abnormal longevity occurred among the humbler classes, and that it was difficult, if not impossible, to obtain any exact information as to the date of birth and to identify the individuals with any written statements that might be forthcoming. He laid particular stress upon the fact that similar instances were altogether absent among the higher classes, with regard to whom trustworthy documentary evidence was almost always obtainable. He thought that the higher the rank the more favorable would the conditions be for the attainment of a long life. In this latter supposition, however, Sir George Lewis was probably mistaken: the comforts and luxuries appertaining to wealth and high social rank are too often counterbalanced by cares and anxieties, and by modes of living inconsistent with the maintenance of health, and therefore with the prolongation of life. In the introduction to his work on "Human Longevity," Easton says, "It is not the rich or great . . . that become old, but such as use much exercise, are exposed to the fresh air, and whose food is plain and moderate—as farmers, gardeners, fishermen, laborers, soldiers, and such men as perhaps never employed their thoughts on the means used to promote longevity."

The French naturalist, Buffon, believed that, if accidental causes could be excluded, the normal duration of human life would be between ninety and one hundred years, and he suggested that it might be measured (in animals as well as in man) by the period of growth, to which it stood in a certain proportion. He imagined that every animal might live for six or seven times as many years as were requisite for the completion of its growth. But this calculation is not in harmony with facts, so far, at least, as man is concerned. His period of growth can not be estimated at less than twenty years; and if we take the lower of the two multipliers, we get a number which, in the light of modern evidence, can not be accepted as attainable. If the period of growth

be multiplied by five, the result will in all probability not be far from the truth.

If we seek historical evidence, and from it attempt to discover the extreme limit of human life, we are puzzled at the differences in the ages said to have been attained. The longevity of the antediluvian patriarchs when contrasted with our modern experience seems incredible. When we look at an individual, say ninety years of age, taking even the most favorable specimen, a prolongation of life to ten times that number of years would appear too absurd even to dream about. There is certainly no physiological reason why the ages assigned to the patriarchs should not have been attained, and it is useless to discuss the subject, for we know very little of the conditions under which they lived. It is interesting to notice that after the Flood there was a gradual decrease in the duration of life. Abraham is recorded to have died at one hundred and seventy-five; Joshua, some five hundred years later, "waxed old and stricken in age" shortly before his death at one hundred and ten years; and his predecessor, Moses, to whom one hundred and twenty years are assigned, is believed to have estimated the life of man at threescore years and ten—a measure nowadays pretty generally accepted.

There is no reason for believing that the extreme limit of human life in the time of the Greeks and Romans differed materially from that which agrees with modern experience. Stories of the attainment of such ages as one hundred and twenty years and upward may be placed in the same category as the reputed longevity of Henry Jenkins, Thomas Parr, Lady Desmond, and a host of others. With regard to later times, such as the middle ages, there are no precise data upon which any statements can be based, but there is every reason to believe that the *average* duration of life was decidedly less than it is at present. The extreme limit, indeed, three or four centuries ago, would appear to have been much lower than it is in the nineteenth century. At the request of Mr. Thoms, Sir J. Duffus Hardy investigated the subject of the longevity of man in the thirteenth, fourteenth, fifteenth, and sixteenth centuries, and his researches led him to believe that persons seldom reached the age of eighty. He never met with a trustworthy record of a person who exceeded that age.

To bring the investigation down to quite recent times, I can not do better than utilize the researches of Dr. Humphry, Professor of Surgery at Cambridge. In 1886 he obtained particulars relating to fifty-two individuals then living and said to be one hundred years old and upward. The oldest among them claimed to be one hundred and eight, the next one hundred and six, while the average amounted to a little more than one hundred and two years. Many interesting facts connected with the habits and

mode of life of these individuals were obtained by Dr. Humphry, and will be referred to in subsequent paragraphs.

A short account of the experience of a few life-assurance companies will conclude this part of my subject. Mr. Thoms tells us that down to 1872 the records of the companies showed that one death among the assured had occurred at one hundred and three, one in the one hundredth, and three in the ninety-ninth year. The experience of the National Debt Office, according to the same authority, gave two cases in which the evidence could be regarded as perfect; one of these died in the one hundred and second year, and the other had just completed that number. In the tables published by the Institute of Actuaries, and giving the mortality experience down to 1863 of twenty life-assurance companies, the highest age at death is recorded as ninety-nine; and I am informed by the secretary of the Edinburgh Life Office that from 1863 onward that age had not been exceeded in his experience. In the valuation schedules, which show the highest ages of existing lives in various offices, the ages range from ninety-two to ninety-five. It is true that one office which has a large business among the industrial classes reports lives at one hundred and three, and in one instance at one hundred and seven; but it must be remembered that among those classes the ages are not nearly so well authenticated as among those who assure for substantial sums. There is, moreover, another source of error connected with the valuation schedules. When a given life is not considered to be equal to the average, a certain number of years is added to the age, and the premium is charged at the age which results from this addition. It follows, therefore, that in some cases the ages given in the schedules are greater by some years than they really are.

Taking into consideration the facts thus rapidly passed under review, it must, I think, be admitted that the natural limit of human existence is that assigned to it in the book of Ecclesiasticus, "The number of a man's days at the most are an hundred years" (chapter xviii. 9). In a very small number of cases this limit is exceeded, but only by a very few years. Mr. Thoms's investigations conclusively show that trustworthy evidence of one hundred and ten years having been reached is altogether absent. Future generations will be able to verify or reject statements in all alleged cases of longevity. It must be remembered that previous to the year 1836 there was no registration of births, but only of baptisms, and that the registers were kept in the churches, and contained only the names of those therein baptized.

Whatever number of years may be taken as representing the natural term of human life, whether threescore and ten or a century be regarded as such, we are confronted by the fact that only

one fourth of our population attains the former age, and that only about fifteen in one hundred thousand become centenarians. It is beyond the scope of this article to discuss the causes of premature mortality, but the conditions favorable to longevity, and the causes to which length of days has been assigned, are closely connected with its subject.

A capability of attaining old age is very often handed down from one generation to another, and heredity is probably the most powerful factor in connection with longevity. A necessary condition of reaching advanced age is the possession of sound bodily organs, and such an endowment is eminently capable of transmission. Instances of longevity characterizing several generations are frequently brought to notice. A recent and most interesting example of transmitted longevity is that of the veteran guardian of the public health, Sir Edwin Chadwick, who was entertained at a public dinner a few weeks ago on the occasion of his reaching his ninetieth year. He informed his entertainers that his father died at the age of eighty-four, his grandfather at ninety-five, and that two more remote ancestors were centenarians.

It is difficult to estimate the influence of other contingencies which affect longevity. With regard to sex, Hufeland's opinion was that women were more likely than men to become old, but that instances of extreme longevity were more frequent among men. This opinion is to some extent borne out by Dr. Humphry's statistics: of his fifty-two centenarians, thirty-six were women. Marriage would appear to be conducive to longevity. A well-known French *savant,* Dr. Bertillon, states that a bachelor of twenty-five is not a better life than a married man of forty-five, and he attributes the difference in favor of married people to the fact that they take more care of themselves, and lead more regular lives than those who have no such tie. It must, however, be remembered that the mere fact of marrying indicates superior vitality and vigor, and the ranks of the unmarried are largely filled by the physically unfit.

In considering occupations as they are likely to affect longevity, those which obviously tend to shorten life need not be considered. With respect to the learned professions, it would appear that among the clergy the average of life is beyond that of any similar class. It is improbable that this average will be maintained for the future; the duties and anxieties imposed upon the clergy of the present generation place them in a very different position from that of their predecessors. Among lawyers there have been several eminent judges who attained a great age, and the rank and file of the profession are also characterized by a decided tendency to longevity. The medical profession supplies but few instances of extreme old age, and the average duration

of life among its members is decidedly low, a fact which can be easily accounted for. Broken rest, hard work, anxieties, exposure to weather and to the risks of infection can not fail to exert an injurious influence upon health. No definite conclusions can be arrived at with regard to the average longevity of literary and scientific men, but it might be supposed that those among them who are not harassed by anxieties and enjoy fair health would probably reach old age. As a general rule, the duration of life is not shortened by literary pursuits. A man may worry himself to death over his books, or, when tired of them, may seek recreation in pursuits destructive to health; but application to literary work tends to produce cheerfulness, and to prolong rather than shorten the life even of an infirm man. In Prof. Humphry's "Report on Aged Persons," containing an account of eight hundred and twenty-four individuals of both sexes, and between the ages of eighty and one hundred, it is stated that forty-eight per cent were poor, forty-two per cent were in comfortable circumstances, and only ten per cent were described as being in affluent circumstances. Dr. Humphry points out that these ratios "must not be regarded as representing the relations of poverty and affluence to longevity, because, in the first place, the poor at all ages and in all districts bear a large proportion to the affluent; and, secondly, the returns are largely made from the lower and middle classes, and in many instances from the inmates of union workhouses, where a good number of aged people are found." It must also be noticed that the "past life-history" of these individuals showed that the greater proportion (fifty-five per cent) "had lived in comfortable circumstances," and that only thirty-five per cent had been poor.

Merely to enumerate the causes to which longevity has been attributed in attempting to account for individual cases would be a task of some magnitude; it will be sufficient to mention a few somewhat probable theories. Moderation in eating and drinking is often declared to be a cause of longevity, and the assertion is fully corroborated by Dr. Humphry's inquiries. Of his fifty-two centenarians, twelve were recorded as total abstainers from alcoholic drinks throughout life, or for long periods; twenty had taken very little alcohol; eight were reported as moderate in their use of it; and only three habitually indulged in it. It is quite true that a few persons who must be classified as drunkards live to be very old; but these are exceptions to the general rule, and such cases appear to be more frequent than they really are, because they are often brought to notice by those who find encouragement from such examples. The habit of temperance in food, good powers of digestion, and soundness of sleep are other main characteristics of most of those who attain advanced years, and may

be regarded as causes of longevity. Not a few old persons are found on inquiry to take credit to themselves for their own condition, and to attribute it to some remarkable peculiarity in their habits or mode of life. It is said that Lord Mansfield, who reached the age of eighty-nine, was wont to inquire into the habits of life of all aged witnesses who appeared before him, and that only in one habit, namely, that of early rising, was there any general concurrence. Health is doubtless often promoted by early rising, but the habit is not necessarily conducive to longevity. It is, as Sir H. Holland points out, more probable that the vigor of the individuals maintains the habit than that the latter alone maintains the vitality.

If we pass from probable to improbable causes of longevity we are confronted by many extravagant assumptions. Thus, to take only a few examples, the immoderate use of sugar has been regarded not only as a panacea, but as decidedly conducive to length of days. Dr. Slare, a physician of the last century, has recorded the case of a centenarian who used to mix sugar with all his food, and the doctor himself was so convinced of the "balsamic virtue" of this substance that he adopted the practice, and boasted of his health and strength in his old age. Another member of the same profession used to take daily doses of tannin (the substance employed to harden and preserve leather), under the impression that the tissues of the body would be thereby protected from decay. His life was protracted beyond the ordinary span, but it is questionable whether the tannin acted in the desired direction. Lord Combermere thought that his good health and advanced years were due, in part at least, to the fact that he always wore a tight belt round his waist. His lordship's appetite was doubtless thereby kept within bounds; we are further told that he was very moderate in the use of all fluids as drink. Cleanliness might be supposed to aid in prolonging life, yet a Mrs. Lewson, who died in the early part of this century, aged one hundred and six, must have been a singularly dirty person. We are told that instead of washing she smeared her face with lard, and asserted that "people who washed always caught cold." This lady, no doubt, was fully persuaded that she had discovered the universal medicine.

Many of the alchemists attributed the power of prolonging life to certain preparations of gold, probably under the idea that the permanence of the metal might be imparted to the human system. Descartes is said to have favored such opinions: he told Sir Kenelm Digby that, although he would not venture to promise immortality, he was certain that his life might be lengthened to the period of that enjoyed by the patriarchs. His plan, however, seems to have been the very rational and simple one of checking all excesses and enjoining punctual and frugal meals.

Having thus endeavored to show the extent to which human life may be prolonged, and having examined some of the causes or antecedents of longevity, the last subject for inquiry is the means by which it may be attained. Certain preliminary conditions are obviously requisite; in the first place there must be a sound constitution derived from healthy ancestors, and in the second there must be a freedom from organic disease of important organs. Given an individual who has reached the grand climacteric, or threescore and ten, and in whom these two conditions are fulfilled, the means best adapted to maintain and prolong his life constitute the question to be solved. It has been said that "he who would long to be an old man must begin early to be one," but very few persons designedly take measures in early life in order that they may live longer than their fellows.

The whole term of life may be divided into the three main periods of growth and development, of maturity, and of decline. No hard and fast line can be drawn between these two latter phases of existence: the one should pass gradually into the other until the entire picture is changed. Diminished conservative power and the consequent triumph of disintegrating forces are the prominent features of the third period, which begins at different times in different individuals, its advent being mainly controlled by the general course of the preceding years. The "turning period," also known as the "climacteric" or "middle age," lies between forty-five and sixty; the period beyond may be considered as belonging to advanced life or old age. The majority of the changes characteristic of these last stages are easily recognizable. It is hardly necessary to mention the wrinkled skin, the furrowed face, the "crow's feet" beneath the eyes, the stooping gait, and the wasting of the frame. The senses, notably vision and hearing, become less acute; the power of digestion is lessened; the force of the heart is diminished; the lungs are less permeable; many of the air-cells lose their elasticity and merge into each other, so that there is less breathing surface as well as less power. Simultaneously with these changes the mind may present signs of enfeeblement; but in many instances its powers long remain in marked contrast with those of the body. One fact connected with advanced life is too often neglected. It should never be forgotten that while the "forces in use" at that period are easily exhausted, the "forces in reserve" are often so slight as to be unable to meet the smallest demand. In youth, the *vires in posse* are superabundant; in advanced life, they are reduced to a minimum, and in some instances are practically non-existent. The recognition of this difference is an all-important guide in laying down rules for conduct in old age.

In order to prolong life and at the same time to enjoy it, occu-

pation of some kind is absolutely necessary; it is a great mistake to suppose that idleness is conducive to longevity. It is at all times better to wear out than to rust out, and the latter process is apt to be speedily accomplished. Every one must have met with individuals who, while fully occupied till sixty or even seventy years of age, remained hale and strong, but aged with marvelous rapidity after relinquishing work, a change in their mental condition becoming especially prominent. There is an obvious lesson to be learned from such instances, but certain qualifications are necessary in order to apply it properly. With regard to mental activity, there is abundant evidence that the more the intellectual faculties are exercised the greater the probability of their lasting. They often become stronger after the vital force has passed its culminating point; and this retention of mental power is the true compensation for the decline in bodily strength. Did space permit, many illustrations could be adduced to show that the power of the mind can be preserved almost unimpaired to the most advanced age. Even memory, the failure of which is sometimes regarded as a necessary concomitant of old age, is not infrequently preserved almost up to the end of life. All persons of middle age should take special pains to keep the faculties and energies of the mind in a vigorous condition; they should not simply drift on in a hap-hazard fashion, but should seek and find pleasure in the attainment of definite objects. Even if the mind has not been especially cultivated, or received any decided bent, there is at the present day no lack of subjects on which it can be agreeably and profitably exercised. Many sciences which, twenty or thirty years ago, were accessible only to the few, and wore at best a somewhat uninviting garb, have been rendered not merely intelligible but even attractive to the many; and in the domain of general literature the difficulty of making a choice among the host of allurements is the only ground for complaint. To increase the taste for these and kindred subjects is worth a considerable effort, if such be necessary; but the appetite will generally come with the eating. The possession of some reasonable hobby which can be cultivated indoors is a great advantage in old age, and there are many pursuits of this character besides those connected with literature and science. Talleyrand laid great stress on a knowledge of whist as indispensable to a happy old age, and doubtless to many old people that particular game affords not only recreation but a pleasant exercise to the mind. It is, however, an unworthy substitute for higher objects, and should be regarded only as an amusement and not as an occupation.

Whatever be the sphere of mental activity, no kind of strain must be put upon the mind by a person who has reached sixty-five or seventy years. The feeling that mental power is less than

it once was not infrequently stimulates a man to increased exertions which may provoke structural changes in the brain, and will certainly accelerate the progress of any that may exist in that organ. When a man finds that a great effort is required to accomplish any mental task that was once easy, he should desist from the attempt, and regulate his work according to his power. With this limitation, it may be taken for granted that the mental faculties will be far better preserved by their exercise than by their disuse.

Somewhat different advice must be given with regard to bodily exercises in their reference to longevity. Exercise is essential to the preservation of health; inactivity is a potent cause of wasting and degeneration. The vigor and equality of the circulation, the functions of the skin, and the aëration of the blood, are all promoted by muscular activity, which thus keeps up a proper balance and relation between the important organs of the body. In youth, the vigor of the system is often so great that if one organ be sluggish another part will make amends for the deficiency by acting vicariously, and without any consequent damage to itself. In old age, the tasks can not be thus shifted from one organ to another; the work allotted to each sufficiently taxes its strength, and vicarious action can not be performed without mischief. Hence the importance of maintaining, as far as possible, the equable action of all the bodily organs, so that the share of the vital processes assigned to each shall be properly accomplished. For this reason exercise is an important part of the conduct of life in old age; but discretion is absolutely necessary. An old man should discover by experience how much exercise he can take without exhausting his powers, and should be careful never to exceed the limit. Old persons are apt to forget that their staying powers are much less than they once were, and that, while a walk of two or three miles may prove easy and pleasurable, the addition of a return journey of similar length will seriously overtax the strength. Above all things, sudden and rapid exertion should be scrupulously avoided by persons of advanced age. The machine which might go on working for years at a gentle pace often breaks down altogether when its movements are suddenly accelerated. These cautions may appear superfluous, but instances in which their disregard is followed by very serious consequences are by no means infrequent.

No fixed rule can be laid down as to the kind of exercise most suitable for advanced age. Much must depend upon individual circumstances and peculiarities; but walking in the open air should always be kept up and practiced daily, except in unfavorable weather. Walking is a natural form of exercise and subserves many important purposes: not a few old people owe the maintenance of their health and vigor to their daily "constitu-

tional." Riding is an excellent form of exercise, but available only by a few; the habit, if acquired in early life, should be kept up as long as possible, subject to the caution already given as to violent exercise. Old persons of both sexes fond of gardening, and so situated that they may gratify their tastes, are much to be envied. "Fortunati nimium, sua si bona nôrint!"* Body and mind are alike exercised by what Lord Bacon justly termed "the purest of human pleasures." Dr. Parkes goes so far as to say that light garden or agricultural work is a very good exercise for men past seventy: "It calls into play the muscles of the abdomen and back, which in old men are often but little used, and the work is so varied that no muscle is kept long in action." A few remarks must be made, in conclusion, with regard to a new form of exercise sometimes indulged in even by elderly men. I allude to so-called "tricycling." Exhilarating and pleasant as it may be to glide over the ground with comparatively little effort, the exercise is fraught with danger for men who have passed the grand climacteric. The temptation to make a spurt must be often irresistible; hills must be encountered, some perhaps so smooth and gradual as to require no special exertion, none, at least, that is noticed in the triumph of surmounting them. Now, if the heart and lungs be perfectly sound, such exercises may be practiced for some time with *apparent* impunity; but if (as is very likely to be the case) these organs be not quite structurally perfect, even the slightest changes will, under such excitement, rapidly progress and lead to very serious results. Exercise unsuited to the state of the system will assuredly not tend to the prolongation of life.

With regard to food, we find from Dr. Humphry's report that ninety per cent of the aged persons were either "moderate" or "small" eaters, and such moderation is quite in accord with the teachings of physiology. In old age the changes in the bodily tissues gradually become less and less active, and less food is required to make up for the daily waste. The appetite and the power of digestion are correspondingly diminished, and although for the attainment of a great age a considerable amount of digestive power is absolutely necessary, its perfection, when exercised upon proper articles of diet, is the most important characteristic. Indulgence in the pleasures of the table is one of the common errors of advanced life, and is not infrequent in persons who, up to that period, were moderate or even small eaters. Luxuries in the way of food are apt to be regarded as rewards that have been fully earned by a life of labor, and may, therefore, be lawfully enjoyed. Hence arise many of the evils and troubles of old age, and notably indigestion and gouty symptoms in various forms, besides mental discomfort. No hard and fast rules can be laid down, but

* [Fortunate beyond measure if they know their own advantages.]

strict moderation should be the guiding maxim. The diet suitable for most aged persons is that which contains much nutritive material in a small bulk, and its quantity should be in proportion to the appetite and power of digestion. Animal food, well cooked, should be taken sparingly and not more often than twice a day, except under special circumstances. Dr. Parkes advocates rice as a partial substitute for meat when the latter is found to disagree with old persons. "Its starch-grains are very digestible, and it supplies nitrogen in moderate amount, well fitted to the worn and slowly repaired tissues of the aged." Its bulk, however, is sometimes a disadvantage; in small quantities it is a valuable addition to milk and to stewed fruits.

The amount of food taken should be divided between three or four meals at fairly regular intervals. A sense of fullness or oppression after eating ought not to be disregarded. It indicates that the food taken has been either too abundant or of improper quality. For many elderly people the most suitable time for the principal meal is between 1 and 2 P. M. As the day advances the digestive powers become less, and even a moderately substantial meal taken in the evening may seriously overtask them. Undigested food is a potent cause of disturbed sleep, an evil often very troublesome to old people, and one which ought to be carefully guarded against.

It is an easier task to lay down rules with regard to the use of alcoholic liquors by elderly people. The Collective Investigation Committee of the British Medical Association has lately issued a "Report on the Connection of Disease with Habits of Intemperance," and two at least of the conclusions arrived at are worth quoting: "Habitual indulgence in alcoholic liquors, beyond the most moderate amount, has a distinct tendency to shorten life, the average shortening being roughly proportional to the degree of indulgence. Total abstinence and habitual temperance augment considerably the chance of death from old age or natural decay, without special pathological lesion." Subject, however, to a few exceptions, it is not advisable that a man sixty-five or seventy years of age, who has taken alcohol in moderation all his life, should suddenly become an abstainer. Old age can not readily accommodate itself to changes of any kind, and to many old people a little good wine with their meals is a source of great comfort. To quote again from Ecclesiasticus, "Wine is as good as life to a man, if it be drunk moderately, for it was made to make men glad." Elderly persons, particularly at the close of the day, often find that their nervous energy is exhausted, and require a little stimulant to induce them to take a necessary supply of proper nourishment, and perhaps to aid the digestive powers to convert their food to a useful purpose. In the debility of old

age, and especially when sleeplessness is accompanied by slow and imperfect digestion, a small quantity of a generous and potent wine, containing much ether, often does good service. Even a little beer improves digestion in some old people; others find that spirits, largely diluted, fulfill the same purpose. Individual peculiarities must be allowed for; the only general rule is that which prescribes strict moderation.

It is not to be inferred from the hints given in the preceding paragraphs that the preservation of health should be the predominant thought in the minds of elderly persons who desire that their lives should be prolonged. To be always guarding against disease, and to live in a state of constant fear and watchfulness, would make existence miserable and hasten the progress of decay. Selfish and undue solicitude with regard to health not only fails to attain its object, but is apt to induce that diseased condition of mind known as hypochondriasis, the victims of which are always a burden and a nuisance, if not to themselves, at least to all connected with them. Addison, in the "Spectator," after describing the valetudinarian who constantly weighed himself and his food, and yet became sick and languishing, aptly remarks, "A continual anxiety for life vitiates all the relishes of it, and casts a gloom over the whole face of nature, as it is impossible that we should take delight in anything that we are every moment afraid of losing."

Sleep is closely connected with the question of diet; "good sleeping" was a noticeable feature in the large majority of Dr. Humphry's cases. Sound, refreshing sleep is of the utmost consequence to the health of the body, and no substitute can be found for it as a restorer of vital energy. Sleeplessness is, however, often a source of great trouble to elderly people, and one which is not easily relieved. Narcotic remedies are generally mischievous; their first effects may be pleasant, but the habit of depending upon them rapidly grows until they become indispensable. When this stage has been reached, the sufferer is in a far worse plight than before. In all cases the endeavor should be made to discover whether the sleeplessness be due to any removable cause—such as indigestion, cold, want of exercise, and the like. In regard to sleeping in the daytime, there is something to be said both for and against that practice. A nap of "forty winks" in the afternoon enables many aged people to get through the rest of the day in comfort, whereas they feel tired and weak when deprived of this refreshment. If they rest well at night there can be no objection to the afternoon nap; but if sleeplessness be complained of, the latter should be discontinued for a time. Most old people find that a reclining posture, with the feet and legs raised, is better than the horizontal position for the afternoon nap. Digestion proceeds with more ease than when the body is recumbent.

Warmth is very important for the aged; exposure to chills should be scrupulously avoided. Bronchitis is the malady most to be feared, and its attacks are very easily provoked. Many old people suffer from more or less cough during the winter months, and this symptom may recur year after year, and be almost unheeded. At last, perhaps a few minutes' exposure to a cold wind increases the irritation in the lungs, the cough becomes worse, and the difficulty of breathing increases until suffocation terminates in death. To obviate such risk the skin should be carefully protected by warm flannel clothes, the outdoor thermometer should be noticed, and winter garments should always be at hand. In cold weather the lungs should be protected by breathing through the nose as much as possible, and by wearing a light woolen or silken muffler over the mouth. The temperature of the sitting- and bed-rooms is another point which requires attention. Some old people pride themselves on never requiring a fire in their bedrooms. It is, however, a risky practice to exchange a temperature of 65° or 70° for one fifteen or twenty degrees lower. As a general rule, for persons sixty-five years of age and upward, the temperature of the bed-room should not be below 60°, and when there are any symptoms of bronchitis it should be raised from five to ten degrees higher.

Careful cleansing of the skin is the last point which needs to be mentioned in an article like the present. Attention to cleanliness is decidedly conducive to longevity, and we may congratulate ourselves on the general improvement in our habits in this respect. Frequent washing with warm water is very advantageous for old people, in whom the skin is only too apt to become hard and dry; and the benefit will be increased if the ablutions be succeeded by friction with coarse flannel or linen gloves, or with a flesh-brush. Every part of the skin should be thus washed and rubbed daily. The friction removes worn-out particles of the skin, and the exercise promotes warmth and excites perspiration. Too much attention can hardly be paid to the state of the skin; the comfort of the aged is greatly dependent upon the proper discharge of its functions.

Such, then, are the principal measures by which life may be prolonged and health maintained down to the closing scene. It remains to be seen whether, as a result of progress of knowledge and civilization, life will ever be protracted beyond the limit assigned to it in a preceding paragraph. There is no doubt that the *average duration* of human life is capable of very great extension, and that the same causes which serve to prolong life materially contribute toward the happiness of mankind. The experience of the last few decades abundantly testifies to the marked improvement which has taken place in the public health. Statistics show

that at the end of the septennial period, 1881–'87, 400,000 persons were alive in England and Wales whose death would have taken place had the mortality been in the same proportion as during the previous decade. It may be reasonably expected that as time goes on there will be an increase in the proportion of centenarians to the population as a whole.

The question whether long life is, after all, desirable does not admit of any general answer. Much depends upon the previous history of the individual, and his bodily and mental condition. The last stages of a well-spent life may be the happiest, and while sources of enjoyment exist, and pain is absent, the shuffling-off of the mortal coil, though calmly expected, need not be wished for. The picture afforded by cheerful and mellow old age is a lesson to younger generations. Elderly people may, if they choose, become centers of improving and refining influence. On the other hand, old age can not be regarded as a blessing when it is accompanied by profound decrepitude and disorder of mind and body. Senile dementia, or second childishness, is, of all conditions, perhaps the most miserable, though not so painful to the sufferer as to those who surround him. Its advent may be accelerated by ignorance and neglect, and almost assuredly retarded or prevented by such simple measures as have been suggested. No one who has had opportunities of studying old people can shut his eyes to the fact that many of the incapabilities of age may be prevented by attention to a few simple rules, the observance of which will not only prolong life and make it happier and more comfortable, but will reduce to a minimum the period of decrepitude. Old age may be an incurable disease, admitting of but one termination, but the manner of that end, and the condition which precedes it, are, though not altogether, certainly to a very great extent, within our own power.—*Fortnightly Review.*

NOTE.—Since the above was sent to press, the civilized world has lost its most noted centenarian in the person of M. Chevreul, the famous French chemist, who died on the 9th of April, aged one hundred and two years and seven months. Only a few days before his death he went in his carriage to see the Eiffel Tower, in which he took a lively interest. Throughout his long life he had worked hard, sparing neither mind nor body, and it would seem that his faculties were preserved with but slight impairment up to the time of his death.

IT is observed by Mr. Stanley, in one of his recent letters from Central Africa, that Nejambi Rapids, about two hundred and fifty miles above the junction of the Aruwimi and Congo Rivers, marks the division between two different kinds of architecture and language. Below, the cone-huts are to be found; above the rapids we have villages, long and straight, of detached square huts surrounded by tall logs, which form separate courts, and add materially to the strength of the village.

EDUCATION IN ANCIENT EGYPT.

By F. C. H. WENDEL, A. M., Ph. D.

THE first state to recognize the necessity of education was ancient Egypt. The period referred to here is from 4000 B. C. to the time of Christ; but it is only of about fifteen hundred years of this period—2530–1000 B. C.—that we know the educational conditions. But education here was not popular education. The ancient Egyptians had no care of the populace; they educated only their officials. The government consisted of the departments of state, treasury, and justice. Each of these departments had its own schools, in which young men were trained for the work of the department; but it is only of the treasury schools that we know anything, and of these we do not know any details. Besides these department schools of the general government, there was a number of department schools in the various nomes into which Egypt was divided.* These schools did not purpose to give their pupils a liberal education, but merely to train up competent officials, and in this they succeeded admirably. The efficiency of the various departments is traceable, to a great extent, to the excellent training their officials received in these schools.

It is a significant fact that all boys, rich or poor, of lofty or humble birth, were received into these schools. In the earliest times, boys born on the same day with the prince royal were educated together with him; but in later times this custom was stopped, possibly because the prince royal attended the same department schools as those of humbler parentage. No distinction of castes existed, and no discrimination was made, either by the teachers or the government, between scribes (i. e., students or officials) of lofty birth and those of humbler antecedents. It is true that in ancient Egypt, as everywhere else, influence went a great way after a young man had entered the actual service of the government; but it is equally true that specially efficient officials of lowly birth advanced step by step to the highest offices in the gift of the government. All, the rich as well as the poor, advanced step by step from the lower offices to the higher, the prince royal being compelled to go through the same course of training and to advance through the same offices as the laborer's son, though, of course, his progress was more rapid, and in the end he

* Egypt was not always what it appears in historic times, a political whole; on the contrary, we have abundant proof that it was for a long while divided into two nations, the north and south countries, which were by Mena, about 4000 B. C., united under one scepter, much as Sweden and Norway are to-day. Each of these two countries, again, was a composite product, the resultant of the union of various small districts which we are accustomed to call *nomes*. These nomes retained all through antiquity a certain autonomy, having their own governments modeled after the general government, and their hereditary rulers.

attained to higher offices than his humbler companions, there being certain offices open to him alone. But, with this single exception, the poor man's son could by efficiency accomplish the same results as the rich man's and the prince's son. The only test was efficiency, and this test was applied most rigidly and in a thoroughly democratic manner, giving all an equal chance.

It was, furthermore, left entirely to the option of a young man or his parents what occupation he should fit himself for. If the father was a treasury official, a priest, or an officer, it did not necessarily follow that the son should also be a treasury official, a priest, or an officer; nor yet, if the father was a merchant, mechanic, or farmer, did it necessarily follow that the son should also be a merchant, mechanic, or farmer. In some families we find several members in the government service; while others, having no titles, were private citizens engaged in civic pursuits. As a further confirmation of this fact, we have a didactic poem, written by a certain Daauf, in which he advises his son Pepy to become a scribe—i. e., a government official. In this exceedingly interesting poem he sketches the misery of all that are not in the service. His sketches are of course prejudiced, as he seeks to influence his son to enter the government service; but, nevertheless, the poem plainly shows that the choice of occupation was left to the young man. The poem closes with a couplet that was often quoted in later writings:

> "Lo, there is no class that is not governed;
> Only the scribe; he is a governor!"

The Egyptians were *stern utilitarians,* and thus they esteemed learning, not for its own sake, but merely for the *practical* advantages it conferred upon its happy possessor. They were not intellectualists and idealists, like the ancient Greeks, nor yet were they seekers after truth, like our modern scholars. They were practical men, and sought to attain learning for practical ends. They devoted themselves to their studies in order to fit themselves for the government service. They argued much in the line of Daauf's old poem. The burden of all they have written on the subject is always the same: The scribe alone is free; he need do no manual labor, but leads a pleasant and agreeable life; the government provides for him. And, then, to think of all the honors he may attain to! The diligent scribe is sure to rise, and may even gain princely rank. But to attain this he must be diligent. "Work, work, study, study, grind, grind," is also a continuous burden of this class of writings.

Boys intended for the government service entered the school at a very early age. The course of instruction was very simple. The first care of the teacher was to initiate the young scribe into the mysteries of the art of writing. After he had mastered the

first difficulties, he was given older texts to copy. These texts were moral treatises, older poems, fairy tales, religious and mythical writings, and letters. It is to this fact that we owe the preservation of the greater part of the literary remains of ancient Egypt. When one of these school-boys died, the copies he had written, that could be of no earthly use to any one else, were buried with him. From these old books that he copied he learned to form his own style; he learned the grammar and syntax of his beautiful language; he became acquainted with its vast stock of moral precepts, religious and mythical traditions, and with the unnumbered poems and tales that undoubtedly abounded, and of which the merest fragments have come down to us. Two classes of writings were preferred for this purpose, moral precepts and letters. It was considered absolutely indispensable to inculcate on the minds of the pupils vast numbers of moral precepts. Letter-writing was considered a high and difficult art, and the pupils needed very special preparation in it. Often these copies took the form of correspondence between master and pupil, the letters being sometimes copied from older ones, sometimes invented for the purpose by the teacher. The pupil wrote three pages a day, and the teacher examined his copy with great care, often writing for him the correct form of the letters on the margin, and sometimes expressing his approbation by writing under the copy the word "*nôfer*"—good. The boys wrote only on one side of the papyrus, often using the other side for rough notes, for first draughts of letters, for practicing more difficult forms of writing; or they drew all sorts of pictures on it, as their fancy dictated.

School was out at noon, but the boy was not then free. He had to assist in the department work all the afternoon, thus learning his duties practically, and being of real use to the government while still a school-boy. The teachers were older officials of the same department, under whose care and instruction the boys were placed, and the same teacher conducted the entire education of a young man, teaching him the first rudiments of writing, initiating him into the practical work of the department, and, even after the young man had become an official himself, remaining his counselor and friend.

Discipline was very strictly maintained. The pupils, who seem to have been entirely under the care of the department, were not allowed to sleep long. Corporal punishment stood in great renown, and the fundamental principle of Egyptian pedagogics was, "The boy has a back; if you beat him on this he will hear." But whipping was not the severest punishment. Specially refractory pupils were bound to the block, and we hear of a youth who suffered this punishment for three months until he was subdued. This strictness is based on a rather curious theory. The argu-

ment is: All animals—horses, lions, dogs, hawks—can be tamed, and a certain animal from Ethiopia can be taught to speak and sing; why can not a young scribe be tamed in like manner? But since men and animals are not exactly one and the same thing, the teachers also used "moral suasion," as we would say. The pupil is constantly pursued with moral precepts and good advice. He is continually admonished to be diligent and obedient, lest he be beaten, for "a boy's ears are situated on his back."

Another principle of Egyptian pedagogics was that the pupils should be but scantily fed. Three rolls and two mugs of beer must suffice for a day, and these the boy's mother brings him every day, and she certainly never forgot to add some slight gift for the teacher. When in the times of the new empire (1530 to 1000 B. C.) Egypt became a military nation, she needed trained officers to lead her troops. These officers were looked upon as officials, as scribes, and their official title was "army-scribes." They were educated in a special school attached to one of the departments, which one we do not know, nor do we know what special course of training they went through.

These schools were maintained by the government for its own purposes; but there was also a large number of theological schools connected with the various temples, and each temple trained up its priests in its own peculiar doctrines. These temple schools seem to have held in ancient Egypt much the same position that the various theological seminaries hold here. There are cases on record showing that young men first graduated from one of the department schools before entering the temple school, and this may have been the regular course.

The ancient Egyptians were acquainted with the sciences of medicine, astronomy, and mathematics, and were good practical engineers and miners. Medicine was, of course, in a very crude and primitive state, though the "Papyrus Ebers" shows some knowledge of anatomy and pathology. Astronomy had been somewhat further advanced. The ancient Egyptians had discovered the zodiac, grouped the stars in constellations, and had devised a means, although crude, of determining the position of the various stars in the heavens; but they seem not to have distinguished the stars from the planets. Their mathematical knowledge was extremely crude and primitive. They could add and subtract, but multiplication and division were very cumbersome, owing to the fact that they could multiply only by 2, and that division resolved itself into the problem of finding by what number the divisor must be multiplied in order to produce the dividend. Of fractions they only knew those whose numerator is 1, except the fraction $\frac{2}{3}$. Geometry and mensuration were also practiced. In their surveys they based their operations on the right-angled triangle.

Of these sciences, medicine and astronomy were probably taught in the temple schools—certainly the former, for all physicians were priests. Engineering and mining were, in all probability, taught practically. Where or how mathematics was taught we do not know. It is, however, a curious fact that while we possess no other Egyptian text-books, we do possess text-books of medicine and mathematics. The great medical "Papyrus Ebers" is a collection of diagnoses and prescriptions calculated to assist the general practitioner as well as to instruct the student. A mathematical text-book has been published by Eisenlohr.

Such is as complete a sketch as can be given of Egyptian education. It is to be borne in mind that it was under control of the government, that it was thoroughly democratic, and that its fundamental principle was utility and its purpose to train scribes, priests, physicians, and officers for the state service, not to form scholars. It is significant in this connection that no mention is made of the education of girls. In the times of the new empire (1530 B. C. and after) we meet with workingmen who are able to read and write, and no doubt the merchants, mechanics, and farmers that composed the wealthy middle class were educated. It may be supposed that the government taught its master workmen to read and write, two accomplishments they needed to properly fulfill their functions; but where and how the merchants, mechanics, and farmers, if they were educated, got their education, we can not even conjecture. The state certainly did not educate them, since it could in its estimate derive no benefit from them, and the idea of popular education never occurred to the state.

THE BRONZE AGE IN SWEDEN.

By W. H. LARRABEE.

BY the Bronze age, Dr. Oscar Montelius * understands that period in the earliest civilization of the Northern races when they made their weapons, tools, etc., of bronze. Besides that composition, they knew only of one metal, gold. The word bronze includes all combinations of copper with tin or zinc, but the usual composition of the articles of this age was ninety parts of copper to ten of tin.

It would be a mistake, however, to refer all antiquities of bronze to the Bronze age. Vessels, rings, buckles, needles, and the like, were still made of bronze after the end of this period, just as they are even in our own day, but generally of a somewhat

* "The Civilization of Sweden in Heathen Times," by Oscar Montelius, Ph. D., with maps and 205 illustrations (New York and London: Macmillan & Co.), whence the materials for this article are derived.

different composition from that which prevailed then. "To this age belong only weapons and edge-tools made of bronze, and such vessels and ornaments as are usually found with them."

Different opinions have been put forward as to the manner in which the Bronze age began in the North. "Some have supposed that it was due to the immigration of a Celtic race, others to a Teutonic immigration. Prof. Nilsson has endeavored to show that the North is indebted to Phœnician colonists for the earliest knowledge of metals; while Herr Wiberg, in Gefle, regarded the Bronze age as having begun in the North through the influence of the Etruscans." Prof. Lindenschmit, of Mainz, who has views of his own respecting the reality of a Northern Bronze age, regards most of the bronze works in question as Etruscan. Dr. Montelius's view is that the beginning of the Bronze age in Scandinavia was not connected with any great immigration of a new race, but that the people of the North learned the art of working in bronze by intercourse with other nations. The "Bronze culture," he thinks, gradually spread itself over the continent of Europe in a northerly and northwesterly direction, until at last it reached the coasts of the Baltic. The end of the Bronze age proper in Scandinavia, when it gave way to the "Iron age," is fixed in the fifth century before the Christian era, when it had lasted about a thousand years. It has been divided into six successive periods. Dr. Montelius does not attempt to distinguish between and describe all of these, but simply makes two general divisions—the earlier and the later Bronze ages.

FIG. 1.—MASSIVE BRONZE AXE, WITH HAFT-HOLE.

The works of the earlier age are decorated with fine spiral ornaments and zigzag lines, some of which are seen in the axe (Fig. 1), and are associated with the remains of unburned bodies They are distinguished by artistic forms, and point to a highly developed taste, in which they generally surpass the relics of the Bronze age found in other European countries. The works of the later age, of which an illustration is given in the knife (Fig. 2), are characterized by a very different taste and style of ornamentation. Instead of spirals engraved or stamped in the body of the implement, we find the ends of the articles often rolled up in spiral volutes. During this period the dead were always burned. The relative antiquity of burned and

unburned bodies is determined by their relative positions in barrows in which both occur. The burned bodies are always above the unburned ones, showing later deposition.

The large majority of the antiquities belonging to the Swedish Bronze age were of native production. Nearly all the articles of bronze are cast; and traces of the use of the hammer do not appear till near the close of the period. Local styles are observable, so that it is often possible to distinguish with considerable cer-

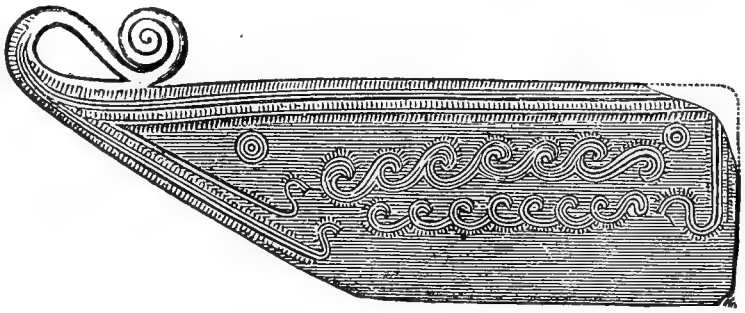


FIG. 2.—BRONZE KNIFE.

tainty in what part of the North the article was made. Interesting evidences of the home production of these things are often found in the shape of the molds, of stone, in which they were cast, that are occasionally found. A mold of this kind, for casting four saws, is represented in Fig. 3. The presence of unfinished castings, defective specimens, and broken molds, affords sure evidence that the bronze-founding work was done in the country. But "as there are no tin mines in Scandinavia, and the copper mines were probably not worked till more than a thousand years after the end of the Bronze age, we must conclude that the bronze used during this period was imported from foreign countries. Probably it was already mixed, either in the form of works or in bars, because copper and tin in a pure state very seldom occur in the North in finds of this age." Instances of the high perfection which the art of bronze casting had reached are seen in certain large thin bronze vessels cast over a clay core, and a pair of bronze axes with wide-spreading blades consisting of plates of bronze hardly more than the third part of a line in thickness, with the clay core over which they were cast still existing. These axes

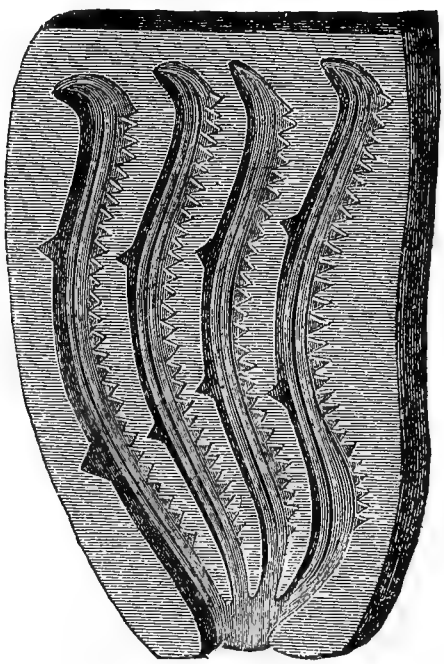


FIG. 3.—STONE MOLD FOR CASTING FOUR BRONZE SAWS.

could not have been used as battle-axes, and were too frail to stand the shaking of being carried ceremonially in processions. It is therefore suggested that they were fixed somewhere as standing ornaments. The art of soldering being unknown, joining or repairing was done by pinning the pieces together or by casting bronze over the joint, often in a very clumsy way. Inlaying was practiced, with amber, or with a dark-brown material like resin, which must have produced an effective contrast with the yellow bronze. The art of gilding was not known, but objects were sometimes overlaid with thin plates of gold.

No traces remain of Bronze-age houses, and no representations of them occur among the rock-carvings. The tools were substantially the same as those known to the Stone age, but were more usually—not always—made of bronze. The most common tool was a kind of axe or chisel, known as a "celt." The celts were originally copies of the stone axes, and were "socketed" and not socketed. The socketed celts had a handle inserted into a socket, and were bound to it by a little loop that was provided in the casting. The non-socketed celts were fixed, like the flint axes, into one end of a cloven haft. "Of sewing implements there have been found especially needles, awls, tweezers, and knives. They are almost always of bronze; but a few tweezers and one awl of gold have been found in Sweden and Denmark." The awls were fixed in a haft, of which specimens made of bronze, bone, and amber are preserved. The needles were used in making woolen clothes, and the other implements for sewing leather or skins. Narrow strips or threads of skin were cut out with the knife, holes were bored with the awl, and the leather thread was drawn through the holes with the tweezers. "These implements are much more frequent than the needles, which partially indicates that clothes of skin were far more generally worn than those of wool during this period." Scissors were unknown.

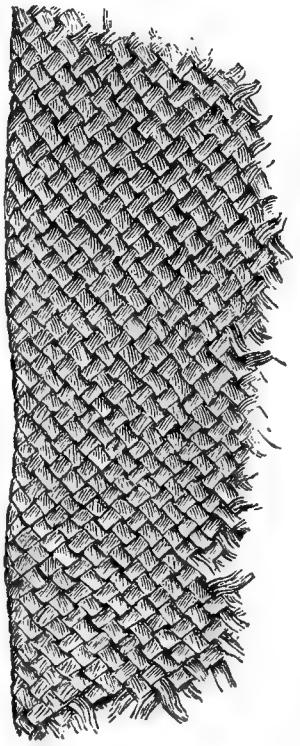


FIG. 4. — PIECE OF WOOLEN STUFF OF THE BRONZE AGE.

The specimen of woolen cloth represented in Fig. 4 is part of a piece, five feet long and two feet wide, which was found in a barrow at Dömmestorp, in Holland, in 1869, and of which the larger pieces are preserved in the National Museum. It is now brown, and had a yellow border at the narrow ends. A coffin made of a cloven and hollowed trunk of oak, found in the "Treenhoi" barrow at Havdrup, in Denmark, in 1861, contained the

body of a warrior with his clothes well preserved. They consisted of a high cap, a wide, roundly cut mantle, and a sort of tunic, all of woven wool, and two small pieces of wool which are supposed to have covered the legs. At the feet were seen some small remains of leather, which possibly were once shoes. The outside of the cap was covered with projecting pieces of worsted, all ending in a knot, and the inside of the mantle with pendent worsted threads. The tunic was kept together with a long woolen belt, which went twice round in the middle, was knotted in front, and had two long ends hanging down and decorated with fringes. There were also found in the grave a second woolen cap, and a woolen shawl decorated with tassels.

FIG. 5.—WOMAN'S DRESS FROM BORUM-ESHÖI, JUTLAND.

A complete woman's dress (Fig. 5) was found in another Danish barrow, Borum-Eshöi, near Arhus, in Jutland, in 1871. The body had been wrapped in a large mantle, woven with a mixture of wool and cow-hair. The very long hair had probably been fastened up by a horn comb, which was found in the grave. Upon the head was a well-knotted worsted net; and remains of a second similar net were found. The dress consisted of jacket and sleeves, and a long robe, both of woolen stuff, woven in precisely the same way as the clothes found in the graves already described. The jacket was sewed together under the arms and upon the back, and was open in front. The coarse seam on the back showed that it used to be covered by the mantle. The robe was cinctured by two woolen bands, one of coarser and the other of finer work. The latter band, a belt, was of wool and cow-hair mixed, and woven in three rows, of which the middle one seems to have been

of different color from those on the sides. It ended in thick ornamental tassels. A fibula, which may have fastened the jacket or the mantle in front, a spiral finger-ring, two bracelets, a torque, and three round decorated plates with points projecting in the middle, ornaments of the belt, were found in the coffin, and a dagger, the occurrence of which with a woman's body gives the archæologists something to speculate upon. These graves were of the early Bronze age, and are therefore nearly three thousand years old. Both this body and the one in the Treenhoi barrow were inclosed in coffins made of the cloven and hollowed trunk of an oak, and were wrapped in untanned hides.

The ornaments of this age were far more beautiful and varied than those of the Stone age. They were made chiefly of gold and bronze. Amber was more rare than in the Stone age; and silver ornaments and glass do not seem to have yet been known. They included ornaments for the neck and breast, belt ornaments, bracelets, finger-rings, bronze buttons, combs, pendants, and pins. The weapons consisted of daggers, axes, spears, bows and arrows, probably clubs and slings, swords, helmets, and shields. The last were usually of wood or leather, but some of them are very elaborate works of bronze. Representations of helmets appear in the rock-carvings, but an actual specimen—a chin-piece, beautifully decorated and overlaid with gold—of only one has been found. The swords, of which, with daggers of bronze, large numbers have been found in Sweden, were made for thrusting and not for cutting, were short-hilted, and had two-edged and very pointed blades; their sheaths are sometimes unearthed in a more or less complete state of preservation. One is made of wood overlaid with well-tanned leather, and lined with fine skin; others are all wooden, without leather, but sometimes decorated with carved ornaments. Not all of their weapons and tools were of bronze. Flints still continued to be used for the cheaper sorts, and for those most liable to be lost; and bronze seems to have been the mark of a choicer tool, a more favorite weapon, and perhaps of more wealth in the owner.

FIG. 6.—BRONZE SICKLE.

Suggestions of agricultural and pastoral occupations appear in the rock-carvings. One of these sculptures, at Tenegby, in Bohuslän, represents two animals harnessed to a plow and driven by a workman who is walking behind. Another, on one of the re-

markable carved stones of a grave at Kivik, shows a two-wheeled chariot, with two horses, and a driver standing upon it. Bits and bridles of nearly the same kind as those used now have been

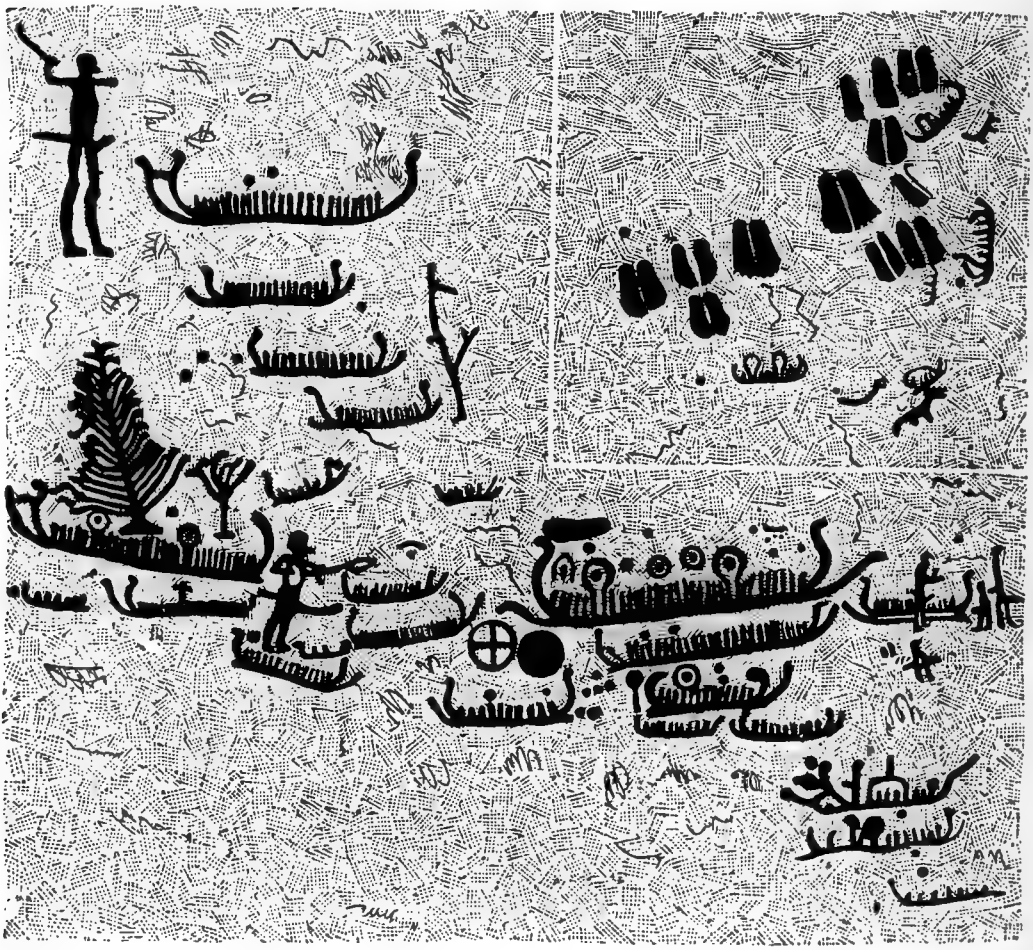


FIG. 7.—ROCK-CARVING IN LÖKEBURG IN BOHUSLÄN.

found; and the bones of domestic animals and hides—both tanned and untanned—of oxen and cows, are common.

Shapely bronze sickles (Fig. 6) and hand-mills attest to a sys-

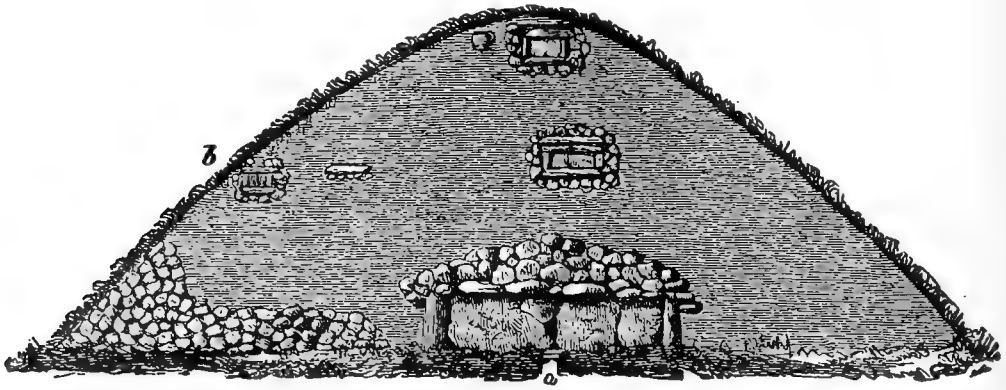


FIG. 8.—SECTION OF A BARROW AT DÖMMESTORP IN SOUTH HOLLAND.

tematic cultivation of grain. "Tillage," Prof. Montelius adds "necessarily presupposes fixed dwelling-places; that these existed

is further made probable by the fact that the barrows of the period so often lie thick together."

While writing was unknown during the Bronze age, a sort of picture-writing existed which is preserved in the rock-carvings found quite often in different parts of the country. There can hardly be a question of the age of these works, for the representations of swords and other known objects correspond closely with the objects themselves that remain; and the absence of Runic or other inscriptions in connection with them forbids the presumption of their belonging to a later age than that of bronze. The pictures do not indicate much artistic power in the carvers, but they furnish useful clews to the kind of life the people led and the trend of their thoughts. Thus, besides illustrating the use of horses and oxen, they tell us of the appearance and size of the boats (Fig. 7), of which no actual specimens that can be certainly assigned to the Bronze age have yet been found. These vessels seem to have been usually, but not always, alike at the two ends. "We often see the high and narrow stem terminating in an animal's head; sometimes the stern also is similarly decorated. As no indisputable traces of masts and sails have been found on the rock-carvings, the boats of the Bronze age would seem to have been exclusively designed for rowing. The same is also the case . . . with the remarkable boat found in the bog at Nydam, in Denmark, which belongs to an early part of the Iron age. We often find sea-fights described on the rock-carvings. We have also proofs of peaceful intercourse by sea with other peoples in the many things imported from foreign lands which occur in the finds from the Bronze age. Chief among imported goods we must reckon all the bronze used in Sweden at this time regarded as raw material. Probably also most of the gold used there during the Bronze age was brought from other countries. Besides these, we ought also to set down as imports certain bronze works which are undoubtedly of foreign origin, because they are very rare in Scandinavia but common in other countries."

The dead were buried unburned in the earlier and burned in the later part of the Bronze age. The unburned bodies were usually laid in cists composed of flat stones placed edgewise, and covered with similar stones. Coffins made of oak trunks split and hollowed out are not uncommon. The stone cists, which contain several skeletons, and are often very large, appear to be the oldest; others are smaller, and contain a single extended skeleton. Sometimes the bones do not lie immediately in the small stone cists, but in an earthenware vessel, which may be closely surrounded by the stones of the cist, or may be without a cist. Sometimes, again, graves of the Bronze age are made up entirely of collections of burned bones lying buried in the ground and only covered by a flat

stone, as in Fig. 8.* The burial-places "thus form a gradual transition from the great grave chambers, and the stone cists with their many skeletons, of the Stone age on the one side, to the insignificant grave with burned bones at the end of the Bronze age on the other." The graves were usually covered with a barrow, and this often contained several stones. The barrows are generally situated upon some height which commands an unimpeded view over the sea or some large lake. Weapons, ornaments, and vessels of earthenware or wood are often found by the remains of the dead.

The author believes, from the evidence of the finds lately made in that land, that the condition of Greece during its Bronze age was in many ways like that of the North during the same stage of its civilization; and that probably Homer's description of the heroic age of Greece would in more than one respect apply to the south of Scandinavia three thousand years ago—"at least if we do not allow our eyes to be dazzled by the poetic shimmer which hangs around the heroes of the Trojan war." But the Bronze age both began and ended in Greece earlier than in the North. There are also other countries in which the Bronze age ended later than in Scandinavia. Of these was Mexico, when the Spaniards entered upon the conquest of it. And yet in many respects, the author remarks, the civilization of the Aztecs was "as high as that of which Europe could boast in the middle ages." He expresses no inference from this remark, but presumably expects us to draw one that the Scandinavians of the Bronze age were possibly not so barbarous as we assume that they were.

ANTHROPOLOGY AT WASHINGTON.

By Prof. J. HOWARD GORE.

THE early voyagers to America, coming from the civilized countries of Europe, were perhaps more surprised at the native inhabitants whom they found than at the broad rivers, boundless forests, or vast plains. The Indians, with their curious customs and various costumes, produced dissimilar impressions upon their different beholders. But all found that the most interesting portions of the reports which they sent back to their homes were the descriptions of the strange people whom they had seen; the report being in some cases accompanied with specimens

* In the middle of the bottom of this barrow was a stone cist nearly seven feet long (*a*), containing an unburned body and a bronze pin. Higher up were found three small stone cists containing burned bones and antiquities of bronze. Close by the little cist at the top of the barrow stood a vessel filled with burned bones, and near the cist, marked *b*, lay a heap of burned bones, covered only by a flat stone.

of their handiwork, and in a few cases by living captives. The stimulated curiosity regarding America, and the feeling that there could be nothing too unusual to come from this almost fabulous land, prompted men to weave a large amount of fiction into their statements concerning the people of the New World, and by skillful alterations to make the work of these savages appear more startling or ingenious. Hence, many early books describing the aborigines of America are of no value, and the illustrations of industrial arts are unreliable. The meeting with new customs did not cease with the thorough acquaintance with the first tribe who greeted the foreigners, nor was all of interest known at the time when an independent government was established for the infant colonies. Almost each day's journey westward brought the explorer, if not into the center of a new tribe, at least into a new community, whose customs differed from those of the people who had surrounded him the day before. Should the wanderer be permitted to return to the seat of his government, his tales of strange scenes and adventures would be listened to with as much interest as the Spanish or English reader had given to the written stories a century previous. Thus, during the most advantageous period for careful observation of the unaffected customs of the Indians, the visitors were hunters or traders who used their opportunities in collecting miraculous stories for the ears of those who awaited their return, and the number of such stories required of each new one, as the price of its acceptance, that it be more exciting than its predecessors.

When an intelligent foresight suggested the systematic exploration of new territories, the first step was taken in the establishment of institutions which are now the pride of America. Though it was the desire to know more of the mineral and agricultural resources of the undiscovered portions of our country that started the first expeditions westward, still the intelligent men who were in charge brought back much of interest and value to the ethnologist. These expeditions increased in number and usefulness, and their reports are still sources of interesting information. The objects which were brought back to serve as models for the illustrations soon formed a nucleus for collections which are now studied by anthropologists of all countries.

The wisdom of investigating the customs of the Indians of North America, and of preserving specimens of their work, has made itself so apparent that we have in the United States three institutions doing more toward collecting information about its native people than is or has been done by any other country of the world. These are, the Smithsonian Institution and the allied National Museum, the Bureau of Ethnology, and the Army Medical Museum.

THE SMITHSONIAN INSTITUTION AND THE NATIONAL MUSEUM.—The will of Smithson in founding this institution contained but one proviso regarding its organization, that it was to be "for the increase and diffusion of knowledge." The museum feature was purely incidental: specimens were sent, accompanying questions that were addressed to the institution; they were preserved, and with the collection of birds brought by Baird from the Pacific Railroad expedition formed the beginning of a museum. These objects, growing rapidly in number at the return of each expedition, were taken care of in the Smithsonian building, until the large gifts received from many foreign governments and private exhibitors at the Centennial Exposition in 1876 made it necessary to erect a separate building, which is now known as the National Museum.

Prof. Goode, who was wisely placed in charge of the collection, secured at once the assistance of volunteer curators to supplement the museum staff, and with their co-operation elaborated and perfected a scheme which may be called, in its fruition, an Anthropological Kindergarten. Prof. Goode considers as the central point Man, and aims to illustrate as far as possible the development of everything that contributes to his welfare, comfort, or amusement, that is hurtful or beneficial to him, or that affects his moral or æsthetic nature. No monstrosity finds a place, nor does any object of sentimental association receive a welcome.

The first successful attempt to embrace the whole science of anthropology under one systematic classification was made by Prof. O. T. Mason. Its adoption as the basis for the Smithsonian exhibit at the Centennial gave to it the importance it deserves. It is, with such modifications as its practical application have suggested, now followed in the National Museum, where Prof. Mason has charge of the department of anthropology, and has given to the Anthropological Society of Washington its principal divisions.

The science of anthropology is now divided between the National Museum and the Army Medical Museum, in contiguous buildings, as follows: All specimens belonging to the biological side of the science, collected by the National Museum, are placed in the Army Medical Museum. This includes anatomy, physiology, embryology, anthropometry, and kindred topics.

On the other hand, all specimens illustrative of languages, arts, sociology, customs, beliefs, etc., of man, gathered by the army, are deposited in the National Museum. In this way, the two institutions work in harmony, and do not duplicate each other's work.

The division of anthropology in the National Museum is organized into departments of the ARTS AND INDUSTRIES OF MANKIND, in which are included, in their several sections, medicinal

plants; foods and textiles; fisheries (showing methods of taking and utilizing marine animals); naval architecture (starting with the bark boat, the skin boat, the raft, and the dug-out, and tracing the evolution of naval architecture to the ocean steamer); graphic arts; history and numismatics; and land transportation (beginning with the simplest device for locomotion and transportation, and ending with the railroad);—ETHNOLOGY, in which is included the fullest collection of American pottery in the world;—and PREHISTORIC ARCHÆOLOGY, in a magnificent collection, occupying the entire upper story of the Smithsonian building. The American portion was classified by the late Dr. Charles Rau. The European collection, founded by Mr. Thomas Wilson, is arranged according to the chart of De Mortillet.

As avenues of publication the Museum has the "Reports," "Miscellaneous Collections," and "Contributions" of the Smithsonian Institution, and its own "Proceedings," "Bulletin," and "Transactions."

For obtaining collections, it relies upon gifts and deposits, which are often very liberal; the material collected by officers of the army and navy, Hydrographic Bureau, Coast Survey, Geological Survey, Bureau of Ethnology, consular service, etc., which are given to it by law; gifts turned over by public expositions and fairs at their close; and international exchanges. The material thus accruing is received as fast as the staff of the Museum can attend to it.

THE BUREAU OF ETHNOLOGY.—The bureau, as at present constituted, was organized in 1879, when an appropriation of twenty-five thousand dollars was made by Congress for "the prosecution of ethnologic researches among the North American Indians." During each of the succeeding years an equal or larger appropriation has been made, the amount up to the present time aggregating three hundred thousand dollars. This amount has been expended for field and office work. The force officially connected with the bureau, and constituting its staff of workers, consists of specialists trained in the several lines of research, each working independently in his own field, but each giving assistance, and receiving assistance from every other, as the lines of investigation touch and overlap each other. The whole is under the direction of Major J. W. Powell. Results of great value are derived by stimulating and guiding research on the part of collaborators in different parts of the country who are not officially connected with the bureau.

Of the researches at present conducted by the bureau, the most important are probably those in linguistics. Owing to the breaking up of the tribal system and the consolidation of the smaller with the larger tribes, to the adoption by the Indians of

civilized manners and pursuits, and to the extinction in some portions of the country of the language with the Indians who spoke them, the Indian languages are fast disappearing from the face of the earth. Accordingly, a large share of the time and labor of the bureau force has been, and will continue to be, devoted to the record and preservation of aboriginal languages. Each year one or more trained linguistic scholars are dispatched to remote parts of the country, charged, as their prime duty, with the task of collecting as much as possible of the speech of obscure tribes. To facilitate their work, and to aid and encourage linguistic students in all portions of the country, a special work has been prepared by the director, entitled "Introduction to the Study of Indian Languages."

Comparatively little time can be devoted at present to the analysis and study of the languages collected. The pressing need of the moment is their preservation for the use and study of future scholars. Nevertheless, the study is by no means wholly neglected, as will be apparent from the fact that monographs are now being prepared upon the Dakota languages, by J. Owen Dorsey; upon the Klamath language, by A. S. Gatschett; upon the Tuscarora language, by J. N. B. Hewitt; and upon Cherokee, by James Mooney.

Much has been accomplished in the direction of a comparison of vocabularies and the classification of the tribes by language. A book embodying the final results of this study, by Major Powell, which has been many years in progress, will soon appear. The number of distinct linguistic families occupying the territory north of Mexico at the time of the discovery was, so far as known, sixty, while the languages included in these probably numbered not less than three hundred. A colored map has been completed, and is now ready for publication, setting forth the areas occupied by the linguistic families.

Another important work, now far advanced toward completion, is a "Dictionary of Tribal Names," in charge of Mr. H. W. Henshaw. In this will be assembled, under each of the linguistic families, all the tribes composing it. Short, succinct historical and descriptive accounts will appear under the head of each family and tribe, while cross-references will refer to the proper names of each tribe the vast body of synonyms which have crept into literature since the earliest published accounts. It is calculated that the above material will fill a volume of about one thousand pages.

MOUNDS.—The important work of the exploration of the mounds east of the Mississippi Valley is under the charge of Cyrus Thomas, whose investigations cover a period of six years. The first of the three volumes which will contain his final report is now ready for the press. A very large number of mounds in several States

have been surveyed, photographed, and explored, with a view to ascertain their nature, purposes, and contents, and a considerable body of facts pertaining thereto has been gathered.

RUINS.—Aboriginal remains of this class are chiefly confined to the Territories of Arizona and New Mexico. Their examination is in charge of Victor Mindeleff, who is now preparing an extensively illustrated work upon them. Each visit to these regions results in the discovery of hitherto unknown groups of these interesting ruins. A large number have been photographed and surveyed so carefully that models of many of them have been made to a scale, and are now on exhibition in the National Museum. Careful examination of the methods of architecture of the ruins connects them closely with the existing *pueblos*, among the present inhabitants of which indeed have been found exact traditions of the former occupancy of these ruins by their ancestors, while the causes that led to their abandonment are often known.

SIGN-LANGUAGE AND PICTOGRAPHY.—The collection and study of the material for a monograph on these subjects is in charge of Colonel Garrick Mallery. Nowhere, perhaps—at least in modern times—has the sign-language been so extensively used as in America. The collection of the gestures employed in different parts of the country, and their comparison with those used in other parts of the world, have involved great labor, but are now nearly completed. The study of pictographs is a natural correlative to that of gesture-language, the latter being an earlier form of the preceding. Various portions of the United States have been visited, and a large number of pictographs have been photographed or sketched. These occur in the form of petroglyphs or rock-carvings, of paintings on the hides of animals, and etchings on birch-bark. Colonel Mallery's final report upon the above subject may be looked for at no distant day.

MYTHOLOGY.—The number of myths current among any one Indian tribe is surprising; and, as they differ to a greater or less degree even among tribes of the same locality and are quite distinct in different regions, their total number in the country at large is enormous. As ideas of a religious or superstitious character are known to be very enduring, it has been thought by some that myths may prove an important adjunct in the work of classifying tribes. They are also important as constituting the philosophy of savagery and barbarism, and by their study we arrive more closely than in any other way at primitive ideas of the nature of things, of the forces of nature, and of primitive methods of reasoning. No opportunity has been lost by the bureau assistants to collect Indian myths in their purity, and a vast body of them are now awaiting study.

PHOTOGRAPHY.—The director of the bureau has been fully

alive to the importance of recording the physical appearance, features, and methods of dress of the Indian in his primitive condition, and to this end full use has been made of the camera. The collection of photographs of Indians from all parts of the country, taken either in their homes or upon the occasion of their periodical visits to Washington, is now very large, and constitutes a body of ethnologic material, the value of which it would be difficult to overestimate.

ARTS AND CUSTOMS.—Although the rapid settlement of the country, and the introduction of habits and implements of civilization, have effected great change in the arts and customs of the Indians, yet among many tribes the old ways of life have been by no means abandoned, and primitive habits and modes of thought still flourish. Investigators sent out by the bureau are required to note the details of the every-day life of the Indians, and to describe such of their primitive arts as still survive as well as those that are borrowed from civilization and modified in accordance with the Indian ideas. Especial attention has been paid to their mechanical operations and appliances, particularly to the making of pottery and textile fabrics, to the ideas and methods of medicinal practice, etc. Here, again, photography has done good work in retaining, uninfluenced by a writer's subsequent imagination, the exact method of using the different implements and materials. Very large collections of pottery, clothing, and implements of various sorts have been made and are deposited in the National Museum.

Of the publications of the bureau the annual reports consist of an account of the current year's operations by the director, together with papers upon a variety of topics by the bureau assistants and by collaborators. These reports are usually liberally illustrated, and are intended to include subjects of a popular character, or those which from their nature are likely to interest a large class of readers. Up to the present time four volumes of the reports have appeared, and the matter for Vol. V is ready.

The contributions to North American ethnology are quarto volumes appearing at irregular intervals, and are in the nature of monographs upon special subjects, to which many of the papers in the annual reports are preliminary. They constitute the most important series published by the bureau, and contain the ripened studies of the scholars by whom they were written. Of these, three volumes have appeared, and two are ready for the press. A third class of publications embraces the bulletins which are intended to be the vehicle of publication of short articles upon various subjects, the speedy appearance of which is desired. So far five such bulletins have been published.

During the progress of investigations, which are ultimately to

be published in the form of monographs, it is the custom to issue, as widely as occasion requires, circulars intended to call attention to special subjects being investigated, and to invite correspondence and to elicit information from specialists and investigators in all parts of the world. Occasionally the importance of the subject has warranted the issuance of such documents in the form designed for the finished work, with the view of setting forth the facts gathered and the progress made in the study. The latter publications, however, are looked upon only in the nature of proof-sheets, being intended for the temporary use of collaborators, and are to be recalled and destroyed when the final reports are published.

THE ARMY MEDICAL MUSEUM.—The anthropological investigations which are fostered by this institution are on the biological side. The large collections of skeletons, and especially of crania, make it possible to secure valuable data in anthropometry. Drs. Billings and Matthews have been alive to the richness of the material at their disposal, and their studies in skull measurements and composite photography of crania will be among the most valuable contributions of the United States Government to anthropology.

It is not surprising that with the large number of anthropologists, together with such other students as the public and private institutions at Washington contain, a prosperous Anthropological Society should be in operation. This society, organized in 1879, now has an active membership of sixteen hundred. Of the two hundred and more papers that have been presented, more than half were by persons who were in the institutions already described. Four volumes of "Transactions" have been published, and the society is now issuing a quarterly of ninety-six pages.

The following are the titles of the principal papers in the publications of the Bureau of Ethnology:

ANNUAL REPORTS.

Vol. I, Washington, 1881:

1. "On the Evolution of Language," by J. W. Powell.
2. "Sketch of the Mythology of the North American Indians," by J. W. Powell.
3. "Contribution to the Study of the Mortuary Customs of the North American Indians," by Dr. H. C. Yarrow.
4. "Studies in Central American Picture-Writing," by E. S. Holden.
5. "Cessions of Land by Indian Tribes to the United States," by C. C. Royce.
6. "Sign-Language among North American Indians compared with that among other Peoples and Deaf-Mutes," by Garrick Mallery.

Vol. II, 1883:

1. "Zuñi Fetiches," by F. H. Cushing.
2. "Myths of the Iroquois," by E. A. Smith.

3. "Animal Carvings from Mounds of the Mississippi Valley," by H. W. Henshaw.

4. "Navajo Silversmiths," by Dr. W. Matthews.

5. "Art in Shell of the Ancient Americans," by W. H. Holmes.

Vol. III, 1888:

1. "Notes on Certain Maya and Mexican Manuscripts," by Cyrus Thomas.

2. "Masks, Labrets, and Certain Aboriginal Customs," by W. H. Dall.

3. "Omaha Sociology," by J. O. Dorsey.

4. "Navajo Weavers," by Dr. W. Matthews.

5. "Prehistoric Textile Fabrics of the United States derived from Impressions on Pottery," by W. H. Holmes.

Vol. IV, 1886:

1. "Pictographs of the North American Indians: a Preliminary Paper," by Garrick Mallery.

2. "Pottery of the Ancient Pueblos," by W. H. Holmes.

3. "Ancient Pottery of the Mississippi Valley," by W. H. Holmes.

4. "Origin and Development of Form and Ornament in Ceramic Art," by W. H. Holmes.

5. "A Study of Pueblo Pottery as illustrating Zuñi Culture-Growth," by F. H. Cushing.

Vol. V, 1887:

1. "Burial Mounds of the Northern Section of the United States," by Cyrus Thomas.

2. "The Cherokee Nation of Indians," by C. C. Royce.

3. "The Mountain Chant; a Navajo Ceremony," by Dr. W. Matthews.

4. "The Seminole Indians of Florida," by Clay Maccauley.

5. "The Religious Life of the Zuñi Child," by Mrs. T. E. Stevenson.

CONTRIBUTIONS TO NORTH AMERICAN ETHNOLOGY.

Vol. I, Washington, 1877:

1. "Tribes of the Extreme Northwest," by W. H. Dall.

2. "Tribes of Western Washington Territory and Northwestern Oregon," by George Gibbs.

Vol. II. Not published.

Vol. III, 1877:

"Tribes of California," by Stephen Powers, with an Appendix on Linguistics, by J. W. Powell.

Vol. IV, pp. xi–281, Washington, 1881.

"Houses and House-Life of the American Aborigines," by Lewis Morgan.

Vol. V, 1882:

1. "Observations on Cup-shaped and other Lapidarian Sculpture in the Old World and in America," by C. Rau.

2. "On Prehistoric Trephining and Cranial Amulets," by Robert Fletcher.

3. "A Study of the Manuscript Troano," by Cyrus Thomas.

BULLETINS.

1. "Ancient Inhabitants of Chiriqui, Isthmus of Darien," by W. H. Holmes. Pp. 27, 22 cuts. Washington, 1887.

2. "Work in Mound Exploration of the Bureau of Ethnology," by Cyrus Thomas. Pp. 13. Washington, 1887.

3. "Perforated Stones from California," by H. W. Henshaw. Pp. 34, 16 cuts. Washington, 1887.

4. "Bibliography of the Eskimo Language," by J. C. Pilling. Pp. v–115. Washington, 1887.

5. "Bibliography of the Siouan Language," by J. C. Pilling. Pp. v–87. Washington, 1887.

6. "Indian Textile Fabrics of Ancient Peru," by W. H. Holmes.

7. "Problems of the Ohio Mounds," by Cyrus Thomas.

8. "Bibliography of the Iroquoian Language," by J. C. Pilling.

The three by J. C. Pilling are separate and extended parts of a work which Mr. Pilling first published as proof-sheets of a "Bibliography of the Languages of the North American Indians."

DIGESTION AND RELATED FUNCTIONS.*

By WESLEY MILLS, M. D.,

PROFESSOR OF PHYSIOLOGY IN MCGILL UNIVERSITY.

IT is a matter well recognized by those of much experience in breeding and keeping animals with restricted freedom and under other conditions differing widely from the natural ones—i. e., those under which the animals exist in a wild state—that the nature of the food must vary from that which the untamed ancestors of our domestic animals used. Food may often with advantage be cooked for the tame and confined animal. The digestive and the assimilative powers have varied with other changes in the organism brought about by the new surroundings. So much is this the case, that it is necessary to resort to common experience and to more exact experiments to ascertain the best methods of feeding animals for fattening, for work, or for breeding. Inferences drawn from the feeding habits of wild animals allied to the tame to be valuable must always, before being applied to the latter, be subjected to correction by the results of experience.

To a still greater degree does this apply to man himself. The greater his advances in civilization, the more he departs from primitive habits in other respects, the more must he depart in his feeding. With the progressive development of man's cerebrum, the keener struggle for place and power, the more his nervous energies are diverted from the lower functions of digestion and assimilation of food; hence the greater need that food shall be more carefully selected and more thoroughly and scientifically prepared. Not only so, but, with our increasing refinement, the progress of digestion to successful issues demands that the senses of man be ministered to in order that there be no interferences in the central nervous system, and every encouragement given to

* From advance sheets of a text-book on "Animal Physiology" in press of D. Appleton & Co.

the latter to furnish the necessary nervous impulses to the digestive organs and the tissues in every part of the organism: for it is not enough that food be digested in the ordinary sense; it must also be built up into the tissues, a process depending, as we shall endeavor to show later, on the nervous system.

The "gastronomic art" has, therefore, become of great importance. It is as yet more of an art than a science; the cook has outstripped the physiologist, if not the chemist also, in this direction.

We can not explain fully why food prepared by certain methods and served in courses of a certain established order is so suited to refined man. A part is known, but a great deal remains to be discovered. We may, however, notice a few points of importance in regard to the preparation of food.

It is now well established by experience that animals kept in confinement must have, in order to escape disease and attain the best results on the whole, a diet which not only imitates that of the corresponding wild forms generally, but even in details, it may be, with altered proportions or added constituents, in consequence of the difference in the environment. To illustrate: poultry can not be kept healthy confined in a shed without sand, gravel, old mortar, or some similar preparation; indeed, for the best results they must have green food also, as lettuce, cabbage, chopped green clover, grass, etc. They do not require as much food as if they had the exercise afforded by running hither and thither over a large field. We have chosen this example because it is not commonly recognized that our domesticated birds have been so modified that special study must be made of the environment in all cases if they are not to degenerate. The facts in regard to horned cattle, horses, and dogs are perhaps better known.

But all these instances are simple as compared with man. The lower mammals can live and flourish with comparatively little change of diet; not so man. He demands food not only dissimilar in its actual grosser nature, but differently prepared. In a word, for the efferent nervous impulses, on which the digestive processes depend, to be properly supplied, it has become necessary that a variety of afferent impulses (through eye, ear, nose, palate) reach the nervous centers, attuning them to harmony, so that they shall act, yet not interfere with one another.

Cooking greatly alters the chemical composition, the mechanical condition, and, in consequence, the flavor, the digestibility, and the nutritive value of foods. To illustrate: meat in its raw condition would present mechanical difficulties, the digestive fluids permeating it less completely; an obstacle, however, of far greater magnitude in the case of most vegetable foods. By cooking, certain chemical compounds are replaced by others, while some may be wholly removed. As a rule, boiling is not a good form of pre-

paring meat, because it withdraws not only salts of importance, but proteids and the extractives—nitrogenous and other. Beef-tea is valuable chiefly because of these extractives, though it also contains a little gelatin, albumin, and fats. Salt meat furnishes less nutriment, a large part having been removed by the brine; notwithstanding, all persons at times, and some frequently, find such food highly beneficial, the effect being doubtless not confined to the alimentary tract.

Meat, according to the heat employed, may be so cooked as to retain the greater part of its juices within it or the reverse. With a high temperature (65° to 70° C.) the outside in roasting may be so quickly hardened as to retain the juices.

In feeding dogs it is both physiological and economical to give the animal the broth as well as the meat itself. The poor man may get excellent food cheaply by using not alone the meat of the shank of beef, but the soup (extractives) derived from it. There is much waste not only by the consumption of more food than is necessary, but by the purchase of kinds in which that important class, the proteids, comes at too high a price.

It is remarkable in the highest degree that man's appetite, or the instinctive choice of food, has proved wiser than our science. It would be impossible even yet to match, by calculations based on any data we can obtain, a diet for each man equal upon the whole to what his instincts prompt. With the lower mammals we can prescribe with greater success. At the same time chemical and physiological science can lay down general principles based on actual experience, which may serve to correct some artificialities acquired by perseverance in habits that were not based on the true instincts of a sound body and a healthy mental and moral nature; for the influence of the latter can not be safely ignored even in such discussions as the present. These remarks, however, are meant to be suggestive rather than exhaustive.

We may with advantage inquire into the nature of hunger and thirst. These, as we know, are safe guides usually in eating and drinking.

After a long walk on a warm day one feels thirsty; the mouth is usually dry; at all events, moistening the mouth, especially the back of it (pharynx), will of itself partially relieve thirst. But if we remain quiet for a little time the thirst grows less, even if no fluid be taken. The dryness has been relieved by the natural secretions. If, however, fluid be introduced into the blood either directly or through the alimentary canal, the thirst is also relieved speedily. The fact that we know when to stop drinking water shows of itself that there must be local sensations that guide us, for it is not possible to believe that the whole of the fluid taken can at once have entered the blood.

Again, in the case of hunger, the introduction of innutritious matters, as earth or sawdust, will somewhat relieve the urgent sensations in extreme cases, as will also the use of tobacco by smokers, or much mental occupation, though this is rather illustrative of the lessening of the consciousness of the ingoing impulses by diverting the attention from them. But hunger, like thirst, may be mitigated by injections into the intestines or the blood. It is, therefore, clear that, while in the case of hunger and thirst there is a local expression of a need, a peculiar sensation, more pronounced in certain parts (the fauces in the case of thirst, the stomach in that of hunger), yet these may be appeased from within through the medium of the blood, as well as from without by the introduction of food or water, as the case may be.

Up to the present we have assumed that the changes wrought in the food in the alimentary tract were identical with those produced by the digestive ferments as obtained by extracts of the organs naturally furnishing them. But for many reasons it seems probable that artificial digestion can not be regarded as parallel with the natural processes except in a very general way. When we take into account the absence of muscular movements, regulated according to no rigid principles, but varying with innumerable circumstances in all probability, the absence of the influence of the nervous system determining the variations in the quantity and composition of the outflow of the secretions; the changes in the rate of so-called absorption, which doubtless influences also the act of the secretion of the juices—by these and a host of other considerations we are led to hesitate before we commit ourselves too unreservedly to the belief that the processes of natural digestion can be exactly imitated in the laboratory.

What is it which enables one man to digest habitually what may be almost a poison to another? How is it that each one can dispose readily of a food at one time that at another is quite indigestible? To reply that, in the one case, the digestive fluids are poured out and in the other not, is to go little below the surface, for one asks the reason of this, if it be a fact, as it no doubt is. When we look further into the peculiarities of digestion, etc., we recognize the influence of race as such, and in the race and the individual that obtrusive though ill-understood fact—the force of *habit*, operative here as elsewhere. And there can be little doubt that the habits of a people, as to food eaten and digestive peculiarities established, become organized, fixed, and transmitted to posterity.

It is probably in this way that, in the course of the evolution of the various groups of animals, they have come to vary so much in their choice of food and in their digestive processes, did we but know them thoroughly as they are; for to assume that even the

digestion of mammals can be summed up in the simple way now prevalent seems to us too broad an assumption. The field is very wide, and as yet but little explored.

HUMAN PHYSIOLOGY.—The study of Alexis St. Martin has furnished probably the best example of genuine human physiology to be found, and has yielded a harvest rich in results.

We suggest to the student that self-observation, without interfering with the natural processes, may lead to valuable knowledge; for, though it may lack some of the precision of laboratory experiments, it will prove in many respects more instructive, suggestive, and impressive, and have a bearing on medical practice that will make it telling. Not that we would be understood now or at any time as depreciating laboratory experiments, but we wish to point out from time to time how much may be learned in ways that are simple, inexpensive, and consume but little time.

The law of rhythm is illustrated, both in health and disease, in striking ways in the digestive tract. An individual long accustomed to eat at a certain hour of the day will experience at that time not only hunger, but other sensations, probably referable to secretion of a certain quantity of the digestive juices and to the movements that usually accompany the presence of food in the alimentary tract. Some persons find their digestion disordered by a change in the hours of meals.

It is well known that defecation at periods fixed, even within a few minutes, has become an established habit with hosts of people; and the same is to a degree true of dogs, etc., kept in confinement, taught cleanly habits, and encouraged therein by regular attention to their needs.

Now and then a case of what is very similar to regurgitation of food in ruminants is to be found among human beings. This is traceable to habit, which is bound up with the law of rhythm or periodic increased and diminished activity.

Indeed, every one sufficiently observant may notice in himself instances of the application of this law in the economy of his own digestive organs.

This tendency is important in preserving energy for higher ends, for such is the result of the operation of this law everywhere.

The law of correlation, or mutual dependence, is well illustrated in the series of organs composing the alimentary tract.

The condition of the stomach has its counterpart in the rest of the tract: thus, when St. Martin had a disordered stomach, the epithelium of his tongue showed corresponding changes.

We have already referred to the fact that one part may do extra work to make up for the deficiencies of another.

It is confidently asserted of late that, in the case of persons

long unable to take food by the mouth, nutritive substances given by enemata find their way up to the duodenum by antiperistalsis. Here, then, is an example of an acquired adaptive arrangement under the stress of circumstances.

It can not be too much impressed on the mind that in the complicated body of the mammal the work of any one organ is constantly varying with the changes elsewhere. It is this mutual dependence and adaptation—an old doctrine, too much left out of sight in modern physiology—which makes the attempt to *completely* unravel vital processes well-nigh hopeless, though each accumulating true observation gives a better insight into this kaleidoscopic mechanism.

We have not attempted to make any statements as to the quantity of the various secretions discharged. This is large, doubtless, but much is probably reabsorbed, either altered or unaltered, and used over again. In the case of *fistulæ* the conditions are so unnatural that any conclusions as to the normal quantity from the data they afford must be highly unsatisfactory. Moreover, the quantity must be very variable, according to the law we are now considering. It is well known that dry food provokes a more abundant discharge of saliva, and this is doubtless but one example of many other relations between the character of the food and the quantity of secretion provided.

EVOLUTION.—We have from time to time either distinctly pointed out or hinted at the evolutionary implications of the facts of this department of physiology. The structure of the digestive organs, plainly indicating a rising scale of complexity with greater and greater differentiation of function, is, beyond question, an evidence of evolution.

The law of natural selection and the law of adaptation, giving rise to new forms, have both operated, we may believe, from what can be observed going on around us and in ourselves. The occurrence of transitional forms, as in the epithelium of the digestive tract of the frog, is also in harmony with the conception of a progressive evolution of structure and function. But the limits of space will not permit of the enumeration of details.

SUMMARY.—A very brief *résumé* of the subject of digestion will probably suffice.

Food is either organic or inorganic, and comprises proteids, fats, carbohydrates, salts, and water; and each of these must enter into the diet of all known animals. They must also be in a form that is digestible. Digestion is the reduction of food to a form such that it may be further dealt with by the alimentary tract prior to being introduced into the blood (absorption). This is effected in different parts of the tract, the various constituents of food being differently modified, according to the secretions there

provided, etc. The digestive juices contain essentially ferments which act only under definite conditions of chemical reaction, temperature, etc.

The changes wrought in the food are the following: Starches are converted into sugars, proteids into peptones, and fats into fatty acids, soaps, and emulsion; which alterations are effected by ptyalin and amylopsin, pepsin and trypsin, and bile and pancreatic steapsin, respectively.

Outside the mucous membrane containing the glands are muscular coats, serving to bring about the movements of the food along the digestive tract and to expel the fæces, the circular fibers being the more important. These movements and the processes of secretion and so-called absorption are under the control of the nervous system.

The preparation of the digestive secretions involves a series of changes in the epithelial cells concerned, which can be distinctly traced, and takes place in response to nervous stimulation.

These we regard as inseparably bound up with the healthy life of the cell. To be natural, it must secrete.

The blood-vessels of the stomach and intestine and the villi of the latter receive the digested food for further elaboration (absorption). The undigested remnant of food and the excretions of the intestine make up the fæces, the latter being expelled by a series of co-ordinated muscular movements essentially reflex in origin.

THE CHEMIST AS A CONSTRUCTOR.

By W. BERNHARDT.

ONE of the most attractive branches of modern chemistry comprises the artificial preparation of compounds existing preformed in nature, or, in other words, the imitation of the works of creative power. Synthesis, as this section of chemical investigation is called, although it has already attained a considerable degree of success, is of but recent origin compared with analysis, or those researches by which we become acquainted with the composition of the products of nature, and of what we derive from them by industrial processes. It is an indispensable condition, before learning how to compound a body, to know what are its constituents, what their properties are, and by what agents they are most liable to be brought into combination with each other. Therefore, synthetical processes could only be founded upon the results of analytical investigations. It is chiefly to the thorough knowledge of the properties and affinities of the seventy so-called elements that we owe the innumerable discoveries which

have raised chemistry to its present important position, together with the insight into the manifold changes and metamorphoses which terrestrial matter has undergone in past times, and which it still undergoes, and into the processes active in vegetable and animal organisms.

The events preceding the discovery of the composition of water afford a striking instance of how many difficulties had to be overcome from the very first observations on the chemical nature of this body—ubiquitous on the surface of the earth—to the ascertainment of its composition, and to our ability voluntarily to prepare it. In the middle ages the doctrine of Aristotle was predominant, that all matter consisted of four elements—air, fire, earth, and water—difference in properties being ascribed only to the varying proportions in which these elements were present. Not much more was known of its physical and chemical characters, but that it may be brought into a solid state by cold and volatilized by heat, and that it offers a good solvent for many substances. Paracelsus, a prominent physician and chemist of the sixteenth century, found that, on treating iron with sulphuric acid, a gas is given off. Boyle, in 1672, discovered this gas to be inflammable; thirty years later, its detonating properties in contact with air became known; but not until Cavendish, in 1766, devoted himself to the exact study of this gas was there any conjecture established on the relations existing between it and water. In 1787 Cavendish made the discovery that, by combustion of this gas in air, water is generated; but, prejudiced by the chemical theories then prevailing, he failed to explain the process in the right way. We are indebted to Lavoisier for a correct definition of the changes taking place in the combustion of hydrogen, which name he gave to the gas in question, signifying a body from which water may be generated by uniting it with oxygen. Thus Lavoisier, supported by the discovery of oxygen by Priestley and Scheele in 1774, became the originator of chemical synthesis. It is a trifling experiment nowadays to demonstrate the formation of water by placing an inverted glass over a jet of burning dry hydrogen, when a dew of water will cover the sides of the vessel and gradually gather into drops.

A rapid advance in synthetical knowledge took place during the third and fourth decades of this century, the artificial preparation of a long series of organic compounds becoming known; and it is a surprising fact, although the chemistry of the carbon compounds, or organic chemistry, was in an infantile state at that time, while most mineral bodies were pretty well known as to their composition and character, that the manufacturing of the former with all their physical and chemical properties was successfully performed, while the imitation of minerals in their

peculiar structure and appearance frequently met with unsurpassable difficulties. Even our most modern expedients do not enable us to imitate more than a few well characterized and crystallized minerals regarding shape, luster, and other physical properties. We can build up the carbonates of calcium, iron, and manganese from their elements, but we lack the means to give them the rhombohedral form in which they are naturally found. It was only in the course of the last year that Krontschuff made known the first method of crystallizing silica in the hexagonal form of quartz; and that Fremy and Meunier succeeded in gaining real rubies and spinels by a melting process. It also required long years of incessant experimenting to find out a way of manufacturing the splendid blue coloring matter, ultramarine, as an approximative imitation of lapis lazuli. We should be at a loss, if requested to prepare crystallized manganic binoxide, or calcium triphosphate, or most other crystallized compounds spread throughout the rocky schists of the earth.

Asking for the reason of this insufficiency of our chemical faculties, we find it to be the impossibility of providing, through a sufficient length of time, those conditions of heat, pressure, and other circumstances which prevailed and were of influence when such compounds were separating from molten masses of mineral matter, or from saturated solutions, the composition of which will always remain concealed from us. Organic substances, on the contrary, of the most various kinds, are continually formed and decomposed in the bodies of plants and animals, very readily combining and separating under conditions which exist everywhere, or which may easily be induced. The extraordinary mutability of the compounds of carbon with hydrogen and oxygen is a feature particular to this element, not equaled by those of any other. Their liability to chemical changes enables us voluntarily to build up and to reconstruct carbon compounds occurring in organisms as well as those derived from them.

Alcohol, one of the best-known products of chemical industry, may serve as evidence to what degree of perfection the composition and decomposition of chemical compounds has been brought. As the chief constituent of intoxicating beverages, alcohol, together with carbonic acid, originates by fermentation from sugar; but this is not the only possible way to produce it. The brightness of electric lights, by which public places, roads, stores, etc., of our cities now are illuminated at night, is emitted by an electric current passing between two carbon points. When such a passage of electricity takes place in a glass balloon filled with hydrogen, the electric current causes this gas to unite with carbon, forming acetylene, a gaseous compound, which in contact with more hydrogen readily takes it up, forming a second gaseous compound—

ethylene—which is the chief light-giving constituent of illuminating gas. Ethylene, when brought into contact with sulphuric acid, forms a liquid combination, and this when treated with potassium hydrate is converted into alcohol. Having thus built up from its elements a substance formerly known only as a product of fermentation, we may proceed at once to decompose it again into its elements. We can easily regain the carbon which it contains, by heating alcohol with sulphuric acid, which again converts it into ethylene; and this gas, when mixed with chlorine gas and lighted, burns away, leaving carbon, which as a dense black smoke fills the vessel.

An event very encouraging and helpful to synthetical investigations was the artificial preparation of urea, a product of secretion in animal bodies, resulting from the decay of muscle, and one of the most important substances in animal exchange of matter. When Woehler, in 1828, found out that, by a chemical process, it can be composed with all its physical and chemical properties, this event gave a tremendous shock to the foundations of the doctrine formerly believed, that a "vital power" governed the functions of the organs of living animals, independently of physical as well as of chemical forces. The discovery of artificial urea was followed by others in an uninterrupted series, which, besides the practical interest they were entitled to claim, threw a new and clear light upon many processes in organic life. In glancing at some of them, we confine ourselves to cases of more general interest.

A conspicuous instance of the degree to which synthetical chemistry has enabled us to imitate nature in some of the processes going on in the bodies of plants and animals is represented by the changes which salicin undergoes. It is to this white and crystalline compound—belonging to the chemical group of glucosides—that the leaves of willow and poplar trees owe their bitter taste. Several species of *Spiræa*, while young, also contain salicin, which, during growth, is converted into a volatile oil of reddish color—salicylic aldehyde—an oil which, remarkably enough, is also produced from salicin in the body of the larvæ of *Chrysomela populi*, a beetle feeding on the leaves of poplar-trees. In *Spiræa*, as well as in other plants containing this oil, it is partly transformed into salicylic acid, which in its turn in *Gaultheria procumbens* and *Betula lenta* combines with methyl to form a product known as "wintergreen-oil." Now by synthesis we can artificially reproduce all these changes, though pursuing quite a different way from that which Nature follows. We can convert salicin into salicylic aldehyde; we can transform this into salicylic acid, and we can produce wintergreen-oil by combining this acid with methyl. We can even manage to prepare salicylic acid and wintergreen-oil from coal-tar, a substance which, as everybody may

judge by the way of its production, is not likely to contain any ingredients found in living plants. The preparation of salicylic acid from the products of coal-tar was discovered by Kolbe about twenty years ago, inducing a more thorough study of the properties of this acid, from which it was found to be one of the most valuable remedies for rheumatic complaints and for gout. Thus one discovery often becomes the source of a whole series of new ones, and may prove a blessing to mankind in the most unexpected and various ways.

Few people know what xanthin is. The name, indeed, represents a body of neither commercial nor industrial significance. Scarcely anybody else but chemists and physicians knows that it is a substance which, in a small amount, is found in muscles, in the liver, brain, and certain other organs of the animal body. But little, therefore, does he who enjoys a cup of cocoa, coffee, or tea, fancy that the beneficent, animating effect of these beverages is due to the methyl compounds of xanthin, contained as theobromine in cocoa-beans and as caffeine, in coffee-beans and in the leaves of tea and several other plants. Both theobromine and caffeine can readily be prepared from xanthin, the products having exactly the same physiological effect as the natural compounds.

The line of products of organic life which have been built up artificially from their constituents includes representatives of many groups of compounds, although they are not equally numerous in all of them. A large number of vegetable acids may be synthetically prepared. The volatile oils of bitter almonds and mustard, as well as the coloring matters indigo and alizarin, besides being prepared from plants, are obtained from other sources by chemical processes; but, since their original production depends on fermentative actions, to which the material is subjected, they can not justly be classed among natural products. In some groups of natural organic compounds our efforts to obtain them by synthesis have hitherto almost utterly failed. Our knowledge of alkaloids, many of which, by their great physiological effects, are of prominent therapeutic importance, has advanced so far as to permit us to convert some of them into others—for instance, to transform morphine into codeine; but, with the exception of conine, which Ladenburg claims to have synthetically obtained, and conhydrine, prepared by Hoffmann, both of which are contained in hemlock (*Conium maculatum*), no success of consequence has been registered. Nevertheless, as the knowledge of their chemical structure has been cleared up to a very considerable degree, we may expect that, by continued researches, ways for their artificial manufacture will be found out.

Many chemical discoveries were made by accident; compounds of valuable properties were found by researches under-

taken for other purposes; the knowledge of the making of china and of the separation of phosphorus resulted from experiments intended for producing gold. But the principal successes of modern science in general, and of chemistry in particular, were obtained in a speculative, inductive way, the only one to be considered as actually scientific. With positive surety the astronomer, from the movements of the stars, and from the attracting forces which they thereby manifest, can ascertain the presence of another star which has never been observed before. He may prophesy a solar eclipse to the accuracy of a minute, and many years before predict the return of a comet. In a similar way exact chemical knowledge often enables us to foretell the formation of certain compounds hitherto unknown, and to define the properties they may be expected to have. It was in this way that, the composition and chemical structure or arrangement of atoms in the molecule of conine and conhydrine having been explored, their preparation was likewise effected, the operators being guided by logical inferences. This scientific way of proceeding proved successful in numerous cases, and led to some surprising results in the course of the last year.

Not many years ago what was known regarding the source from which common plants draw their food consisted in the recognized fact that carbonic acid and water, both abundant in air and fertile soil, are taken up by the roots, converted into sugar by an unknown process, the sugar afterward being transformed into cellulose, the matter chiefly constituting the body of the plant, and into starch. It was also known that oxygen was set free in the course of these changes. In 1870 Baeyer promulgated a theory, explaining how assimilation of the mentioned substances might be effected. He demonstrated the possibility of "formaldehyde" being produced from carbonic acid and water, which is only possible, if—as is the case—oxygen is liberated. All plants in daylight exhale oxygen and absorb carbonic acid. Formaldehyde, a gaseous compound, is, as aldehydes in general are, very liable to condense to solid compounds by accumulating a greater number of atoms into one molecule. Baeyer expressed his belief that sugar, the composition of which agrees with that of formaldehyde multiplied by six, is the product of such a condensation.*

The first signs that sugar might result from such a condensation, when conducted in the proper way, were observed by Butlerow, but since he claimed to have prepared a sugar-like compound from formaldehyde, all the experiments undertaken to the

* The chemical changes in question are represented by the equations:

Carbonic acid and water = formaldehyde and oxygen

$$CO_2 + H_2O = CH_2O + O_2$$

Six formaldehydes, $6CH_2O = C_6H_{12}O_6$, grape-sugar.

like purpose had proved futile. It was Loew who in 1886 succeeded in preparing a more concentrated solution of formaldehyde than could be made before. He found that the vapor of wood-spirit in contact with heated oxide of copper furnishes formaldehyde in abundant quantities. Moreover, he found that condensation of this aldehyde to sugar is easily achieved by digesting a solution of it with slaked lime. The product, to which he gave the name of formose, has exactly the composition of grape-sugar; it has a sweet taste, and acts on Fehling's solution as sugar does; the resemblance extends to several further properties; but still there are some slight points of difference, which have caused a few chemists to raise objections as to its classification among sugars. The question of the formation of sugar from aldehydes would perhaps have remained undecided for the present, had not recent experiments, made by Fischer and Tafel, confirmed the statements before mentioned by giving evidence of the formation of sugar by condensation from other aldehydes. Their statements were supported by Grimaux, who, by subjecting glycerin to the oxidizing influence of finely divided platinum, obtained a substance resembling grape-sugar in all its properties, which in contact with yeast even undergoes fermentation, producing alcohol and carbonic acid, and hereby manifesting the character of a true sugar.

These results not only enable us to prepare by a chemical process this substance, formerly only known to be produced by living plants, but they also afford important facts and proofs which justify us in expecting the synthetical formation of other compounds playing a part in the vegetation of plants, thereby acquiring an insight into those complicated phenomena of organic life which science hitherto has in vain tried to explain. By perfecting our comprehension of natural processes we become more and more enabled to utilize them for the advancement and the welfare of mankind—an attainment which constitutes the chief aim and purpose of natural science in general.

THE experiments of E. H. S. Bailey and E. L. Nichols, upon the delicacy of the sense of taste, indicate that the impression derived from bitter substances far exceeds that arising from any other class. The order as to the substances experimented upon is bitters, acids, saline substances, and sweets. The potency of quinine is very remarkable. Men who tasted could detect on the average one part of it in 390,000, and women one part in 456,000 parts of water; and to sugar it stood in potency as very nearly 2,000 : 1. The range of individual sensitiveness is very extensive. With all the substances tried, except salt, the taste of the women was more delicate than that of the men. But while some of the persons experimented with could detect with certainty one part of quinine in 5,120,000 of water, others failed to notice one part in 160,000. The sense of taste does not appear to be blunted for any substance by long-continued habitual use of it.

INDUSTRIAL FAMILY NAMES.

By Prof. D. R. McANALLY.

THE industrial history of the English-speaking peoples has been faithfully written by able hands, and, until more material accumulates by the growth of science and the progress of industry, little can be added to records already made. The study of what may, for the lack of a better name, be called industrial philology, has not, however, kept pace with the history of industrial occupations. Much has been well done in this line, for long ago students of language perceived that in the proper names of men and places lingered unwritten histories, but all yet accomplished scarcely makes an impression on the huge heap of material, since most proper names once had a significance which, in many cases, has long ago been forgotten.

Even a casual examination of the family names of men discloses the fact that many of the most common must have originated in the adoption, by an individual, of the name of his occupation as a surname, to distinguish him from other men of the same given name. Dr. Adam Clarke, in his "Autobiography," has a learned and critical essay on his own name, and accounts for its use by his family in the manner already indicated. There can be no doubt that this is a typical illustration, nor that, during the period when the English language was assuming its present form, many trade-names became those of individuals, and frequently, when men more than commonly distinguished themselves in a calling, were assumed as distinctive surnames by their children, and were thus continued when the propriety of the appellation no longer existed. In this way multitudes of trade-names are perpetuated, some in their original form, some so modified as to be scarcely recognizable, and others, no doubt, which once were designations of trade, so changed as to bear not a trace of their origin. Concerning the last named speculation is profitless, and even those of the second class may be passed with little notice, since quite enough material is found in family names which plainly proclaim their own ancestry.

The food-providing occupations have always, of necessity, been thronged, and from them come, in more or less altered form, many of our family names. The Butchers and Slaughters tell their own story, so also do Flesh and Flesher, since in Scotland and the north of England the purveyor of fresh meat is even to-day known as the "flesher." But Fletcher and Flitcher need to be introduced as the lineal descendants of Flesher, while Boucher and Bouchelle would be unidentified were not the fact known that

our ancestors had much intercourse with the Normans, and, in the eleventh and twelfth centuries, French was daily spoken by the better class in the British Isles. Our Bakers may be readily traced back to their floury-handed ancestors, but the Baxters must be followed for generations before we find that they were of the same family, being the descendants of the Bagsters, who were the offspring of the Bagesters, who acknowledged that they were the children of the Bakesters, who were feminine bakers. Of the bread-making tribe were also the Breaders and the Whitbreads, the latter perhaps once priding themselves on the color of their stock in trade, while nearly related to them were the Mills, the Millers, and the Mealers. The large and respectable family of the Boulangers came from the French bakers who carried on their trade in England during the ages when family names were growing, while Mr. Lowe suggests that the Bollingers and the Bulliners are of the same origin.

Few points in Great Britain are more than a hundred miles from the sea, and in all ages fish has formed one of the staple articles of British diet. Catching the fish was therefore an important industry, and Fish, Fisher, and Fisherman doubtless had their origin in the occupation of the men who first assumed these names, of which fact there is abundant record. It is quite possible also, as Max Müller suggests, that men may have made a specialty of taking or of selling a particular kind of fish, and thus Salmon from Robert le Salmoner, Hering from John le Heringer, and Trouter from Roger le Trowter, may have arisen without violence to the laws of philology. Bardsley, in his book on English names, derives Possoner from le Poissonier, another relic of the French occupation of England. The selling of fruit was, in the three centuries after the Norman conquest, a special occupation, and mention of John le Fruiterer occurs in the Golden Roll, the conclusion being drawn by philologists that Fruter, Frooter, and several similar names thus had their origin. Cheese was furnished by Roger le Cheseman in the twelfth century, whence our Cheesemans and Chesmans, while condiments of various kinds came from a special store where nothing else was kept and the owner known as le Spicier, no doubt the ancestor of some of our Spicers. Fowls were sold by the poulterer, from which word, it is believed, Polter is derived; while Grocer, as a family name, needs no explanation beyond the statement that in mediæval England his assortment of goods, while not so extensive, was quite as varied as at present.

The preparation of food for immediate consumption gave rise to another occupation and other names. The Cooks we still have with us, also the Cokes, the latter being the more common spelling of the word in the thirteenth century. From these, by natural

succession, come the Cooksons, the Cokesons, the Coksons, and, one scholar suggests, the Cocks and the Cocksons—the last two, however, appearing to be far-fetched. As drink was to our forefathers quite as indispensable as meat, it also gave rise to family names, being manufactured by Brewers, Maltsters, and Vintners or Wintners, remaining as Winters, and dispensed by Tapsters and Drawers. Nor should it be forgotten that receptacles for the liquors were from the hands of the Barilers, Hoopers, Coopers, and Cowpers; nor that the contents of the casks were carefully ascertained by the Gaugers and Measurers. Bowlers and Bowlings, with Cuppers, made the drinking-vessels in use among the common people, Horns and Horners those of a better class—all of whom, with verbal changes, remain to attest the former popularity of their respective callings.

Workers in wood have left their record among our proper names to such an extent as to justify the conclusion, even if it were not to be reached from other sources of information, that this branch of industry was important during the ages when men were assuming family names. Caring for the raw material in its growing state gave us the Forrests and the Forresters, the Woods, Wooders, Woodsons, and Woodmans. Cutting the timber into proper lengths was the business of the Sawyers, perhaps also of the Hewers, while dressing the lumber originated the Carpenters. The Carvers did the ornamental work, so, according to Lowe, did the Cutters and Cuttings, though about these names there is a difference of opinion, some assigning them to the leather trade and others to the stone-cutting.

Akin to the lumber business is the Houser, who, according to one authority, is of the same family as the Bilders and Bildermans, which names, it is supposed, originated with master-workmen who undertook the general contract of setting up a house. Nearly related also are the Thatchers, the Thackers, the Thackerers, and the Thackerays, who, always in the country, and frequently in town, covered the house after it was erected. But houses in Great Britain were more generally constructed of stone or brick than of wood, and artisans in these materials must have been numerous, as is evidenced by Stone, Stoner, Stonebreaker, and Stoneman, the Masons, the Carvers, and, as already mentioned, the Cutters also. The Tylers made and placed in position the tiles used for roofing, while the Painters, Paynters, and Penters made both exterior and interior of the building presentable.

The Tylers just mentioned were workers in clay, which suggests another branch of industry, from which numerous family names have sprung. Not to speak of Clay, Claye, Clayer, and Clayman—the preparers of or dealers in the material—there are Pott, Potts, Potter, Pottman, Crock, Crocker, Crockman, Jarman,

Plater, Disher, and, according to Taylor, Turner also, though some assign this name to the worker in wood. The burden of proof, however, seems to make the original turner an artist in jugs, the propriety of the name in this case being manifest.

From wood, stone, and clay the transition to the metals is easy and natural, and of the skill of our Saxon forefathers in this direction there are abundant records in the family names still remaining in common use. Iron, Ironer, and Ironman are common; Copper, Coper, Copperer, and Coperman equally so; while Leader, Lederman, and Lederer come down almost unchanged from Roger le Lederman, mentioned in a parliamentary writ of the thirteenth century. Brasser and Brassy still exist, along with Tiner and Tyner, to testify to the variety of metals used, while Silver is as rare as Golden, though both exist in our directories, and doubtless tell of the occupations of their originals.

When metal-working is considered, the family names indicative of occupation are equally significant. Smith needs only a mention as a sort of generic term; Coppersmith is often seen, together with Goldsmith. The manufacture of special articles of metal gave rise to several family names—such as Spooner, Knifer, and Nypher—Ralph le Spooner and John le Knyfere appearing in the records of that period. The cutler then as now dealt in small articles of hardware, and the Cutlers remain to bear witness to the popularity of the business; while Armour speaks of the development of the craft in another direction.

Leaving metal-working for the manufacture of textile fabrics, Prof. Müller has some very interesting notes on the manufacture of flax as connected with the growth of the English language. From these it is evident that several family names originated with the linen trade. There are Flax and Flaxman, Linn, Lynn, and Lynnman, who doubtless provided the material, lin being a Saxon name for Flax; and, with some probability, it has been suggested that White, Whitener, Whitner, Bleach, Blake, Blaker, and Blakeman had their origin in the process of bleaching the goods. Leather, too, furnished names as well as occupation to those who dealt in it or busied themselves in various branches of its manufacture. The records of the twelfth century have preserved for us the names of Ralph le Hyder, Roger le Skinnere, John le Curier, Thomas le Tannere, whose philological descendants still appear on the pages of our directories in varied spellings, while the Shoemakers are almost as numerous as the Glovers. Sowter, Sutter, and Soter are modifications of Souter, once a common name for a shoemaker, while Clouter, Cloter, and Cloutman, together with Cobbler, Cobler, and Cobbleman, are forms of a different word of the same signification, and the Pattens, Pattons, Pattenmans, Pattermans, and perhaps Pattersons, took their names from

the patten, a sort of clog much worn during the twelfth, thirteenth, and fourteenth centuries. Taylor finds Bark and Barker in the old writs of that period, and suggests that the occupation of the first owners of these names was to provide the tanners with the material for converting the hides into leather. This may or may not be the case, but it is reasonably certain, according to the best authorities, that our Butlers were once the Botelers, bottles in that day being frequently made of leather, and the name being applied first to him who made the bottles and, after a time, to him who looked after them and their contents.

Rope-making is not distantly related to the leather trade, and of the manufacture of ropes relics are still seen in Roper, Corder, Stringer, and Twyner.

One of the most curious pages of philological history is that written by Bardsley in recounting the proper names which grew out of the wool trade. For ages wool was the staple of England, and thousands of busy operatives were employed in the various processes necessary before the wool could be transferred from the back of the sheep to the back of the man; before the raw product could be converted into the finished manufacture. At every step, proper names indicative of the calling of those who bore them sprang up, so that, were we ignorant of the fact that the Saxons dealt in wool and made cloth, we might draw perfectly correct and legitimate conclusions as to the business, its extent and various departments, from the family names still surviving. To follow Bardsley in this quaint pilgrimage through the woolen-factories of Old England: the sheep were cared for by the Shepherd or Sheepherd, a name which with variations of spelling is extremely common. Shearing was the first operation requiring either delicacy or skill, and Shearer, Shearman, Shurman, and similar names bespeak their own ancestry. The wool was then placed in bags, made by the Sackers or Canvassers, and was ready for the merchant, an individual often known as Stapler, Wool, Wooler, Woolman, or Woolsey, or in French as Lanier or Lanyer. He consigned it to the care of persons who transported it from place to place on the backs of pack-horses or in vehicles, and were thus known as the Packers, the Carters, or the Carriers. The wool was then handed over to the Carders and Combers, or Kempers and Kempsters, as they were variously called, and passed from their hands to those of the Spinners, who used implements made by the Spindlers and Slayers, afterward going on to the Weavers, Weevers, Webbs, Webbers, or feminine Websters. The cloth was next "teased" to bring out the nap, a process done by the Teasers, Tosers, Tousers, Teazelers, or Taylors, when it was finished and ready for the Dyer, Litter, or Lister, or the Norman Taintor or Taintur. Woad, the common dye-stuff, was provided

by the Woader or Woadman, while there is some indication of another material in the names Madder, Madderer, and Madderman occurring in the Hundred Rolls. The Fullers, Fullertons, Fullersons, and Fullmans undertook the process of whitening the cloth, if it was to be white, in which they were assisted by the Walkers, who trod it with their feet, accompanied by the Beaters, Beatermans, Bates, Batts, and Battmans, who used sticks instead of heels and toes.

The designation of the process is seen to give a name to all engaged in a special work, just as at present, and further to be adopted as a family name by some who perhaps attained notable excellence over their fellows, or were led by chance or caprice to adopt the title of their calling as their own surname. The list might be indefinitely extended. Tuck and Tucker, Sticher, Seamer, Sower, Braider, Wash and Washer, Lavender and Launder, terms formerly designating the cleansing of linen, are illustrations to the point, and many others can easily be gathered by any one having the time and patience for such research.

Particular articles of apparel, either in the course of manufacture, or completed and in use, have left their imprint in several family names. The hat gave us the Hatts and Hattars; also, according to Taylor, the Blocks, Blockets, Blockers, and Blockmans, the last four taking their names from the wooden instrument on which the hats were shaped. Caps gave us the Cappers and the Capers; smocks, a loose, shirt-like outer garment worn by peasants and workingmen, the Smockers and Smookers; the pilch, a fur cloak, the Pilchers, Pulchers, and Pitchers. The manufacture of belts gave a name to the Girdles, Girdlers, and Girdleys, while the wearing of laces originated Lacer, Lacy, Pointer, and Poynter. The use of furs originated the Pelters and the Furriers. The cowl, as an appendage to a great-coat, was much in use when family names were growing, hence Cowler, Cowley, Cowlet, and the like; while another name for the same article originated the Hoods and the Hoodmans. Fastening the clothing with buttons originated the Buttons and Buttoners; with buckles, the Buckles and Bucklars; while the use of pins, at first of great size, gave names to Pinners, Pinnets, and Pinneys; and the manufacture of a small bag for the safe keeping of money was the original employment of our Pursers, Bursars, and Pouchers. A call for precious stones was answered by the Jewells, Agates, Rubys, and perhaps Crystalls, and the necessity for light in the houses and streets was met by the Candlers, Lampers, Lighters, Links, Linkers, and Torchers.

Mention of the last classes suggests the nature of the service they rendered to our belated ancestors in the unlighted, muddy, and otherwise dangerous streets of mediæval London, and this

calls to mind the fact that in personal service have originated a number of family names. The old Saxon had his face scraped by a barber, whence our swarm of Barbers, Barbars, Barbors, Barbours, and Burbers; while in those days the hair of the ladies was artistically "tired," whence the Tyers, Tyrers, and Tyermans of the present day. When sick, or "ill," as his descendants now say, he sent for the leech, and this worthy has left a numerous progeny among the Leeches, Leaches, and Leachers. His letters were written by scriveners, who still remain among us as Scribners; and, when he needed relaxation, he was entertained by Players, Dancers, Whistlers, and Singers.

THE HOME OF THE FERNS.

By T. JOHNSTON EVANS.

IN the New World, as well as in the Old, there is many a charming spot, far away in the wild woodland or within the sunless recesses of deep-furrowed mountain gorges, which might well merit the designation by which this paper is prefixed. Indeed, for a very long period the ferns of North and South America have received considerable attention at the hands of botanists; nor must it be forgotten that, centuries before the white man set his foot upon the great continent of the West, several species of these beautiful plants were much sought after by the aborigines. The common polypody (*Polypodium vulgare*), which is one of the most frequently met with ferns in the Eastern States, was highly valued by the various Indian tribes for its medicinal properties, while Kalm also relates that the red man seems to have universally used the beautiful maiden-hair (*Adiantum capillus Veneris*) as an infallible cure for cough and difficulty of breathing. Fascinating, however, in the eyes of botanists, as are the various homes of these beautiful plants in the Northern and Southern States, there is beyond the Atlantic one spot above all others upon which Nature has lavished her most glorious gifts, which, *par excellence*, may well be termed "the home of the ferns."

Justly celebrated for the wondrous beauty of its diversified scenery of waterfalls and lakes and towering mountains, crimson in their autumnal glory with the ripe berries of the arbutus, this favored locality is also especially remarkable for the luxuriant growth of the rarest and most highly prized by collectors of European ferns.

Accompanied by a few scientific friends, among whom were a practical geologist and a skillful field botanist, I recently paid a visit to this fascinating region. It was toward the close of Septem-

ber, the best period of the year to see Killarney in all its many-hued glory. The morning after our arrival at the Lake Hotel looked, indeed, most unpropitious for our proposed pedestrian excursion around the upper and lower lakes. A dense mist enveloped everything in its vapory folds, preventing objects, even within a few feet of us, from being distinctly visible. Our aneroids were, however, rising rapidly, and we were assured by the weather-wise folk that before midday the fog would be "lifted" by a light breeze, which would be sure to spring up. After having breakfasted, we set out on our not particularly inviting tramp, selecting the route in the direction of the lower lake. Along that exquisitely beautiful and well-known path which, canopied by trees of various foliage, winds close by the marge of this charming sheet of water, we took our course, preceded by the inevitably loquacious guide. As we pursued our beclouded way, the rush of the foaming cataracts dashing madly from the hills, which rose to the height of some three thousand feet above us, came upon our ears from time to time, and splashed us with their spray, but yet were completely invisible. Even the water which rippled on the pebbly beach at our feet was as much hidden from our view by that all-enveloping mist as though Egyptian darkness surrounded us. As may be imagined, our walk was not a very enjoyable one, but we were soon destined to be amply recompensed for our pains. Two hours had elapsed from the time of our setting out, and noon found us sitting on the parapet of that romantic bridge which spans the outlet between the upper and lower lake. While we were deliberating whether to return or continue our walk, it suddenly became evident that the surface of both lakes was agitated by a strong gust of wind, which, as we afterward learned, came down through the celebrated Gap of Dunloe. The previously motionless mist began immediately to wreath itself in upright columns, to which the breeze gave a kind of rotatory motion as they were suddenly lifted up from the surface of the water. Then followed, with startling rapidity, one of the most wondrous natural transformation scenes it is possible to conceive. In less than six minutes, not merely were the two lakes spread out before us, from shore to shore, in all their beauty, but the thick masses of vapor had rolled up the sides of those gigantic hills which overhung them, and the brilliant sun was shining merrily out of the bluest of skies. I had previously witnessed similar cloud-phenomenon amid the peaks of the higher Himalayas, but nothing which for startling effect and scenic beauty could bear comparison with this.

It was the first acquaintance which every one present, myself excepted, had made with Killarney, and it was scarcely to be wondered at that from every lip burst an ejaculation of glad sur-

prise. In the splendid surroundings which, as if by the wave of a magician's wand, had been so suddenly unfolded to our view, the mere worshiper of the beautiful in nature had sufficient to demand his warmest devotion; but to the scientist the spot was more especially holy ground. My friend the geologist beheld in those great Kerry hills—the Magillicuddy Reeks, the Toomies Mountain, and magnificent Mangerton—one of the oldest formations in Europe; while the botanist speculated upon the treasures which lay scattered above and around him in the shape of ferns and club-mosses and purple broom.

The following day we specially dedicated to the collecting of those rare and delicate ferns which abound in mossy nooks and in spots kept constantly moist by the spray of some foaming cascade as it leaped from ledge to ledge in its impetuous course. One of the ferns, specimens of which we were most desirous to obtain, was the *Trichomanes*, or bristle fern. This exceedingly beautiful plant, though plentiful in Madeira, is absolutely unknown in any European country except Ireland, and even there is only now to be found in certain districts of the extreme west. It may be described as having fronds three or four times pinnatifid, segments alternate, linear, entire or two-cleft, obtuse; involucres solitary in the axils of the upper segments. The bristle fern delights in shade and moisture, and our first find was in a rocky cleft in the immediate neighborhood of the Tork waterfall. Subsequently, within the dim recesses of a cave, the mouth of which opened upon the upper lake and could only be approached by a boat, we discovered several splendid specimens, one of which, with a creeping rhizome, some three feet long, contained no fewer than thirty perfect fronds. Nothing that I have ever seen in my varied experience of fern-life equaled the delicacy and pellucidness of these fronds, nurtured in the darkness and the mist. The veins were so prominent, and the green portion so like a membranous wing around the veins, that it resembled more a beautiful sea-weed than a fern. In this natural cave we also discovered some of our finest specimens of the *Adiantum*, or maiden-hair fern. This plant is called the true maiden-hair, to distinguish it from some other ferns which share its familiar name. The bright evergreen tint, the elegant form, and lightly waving attitudes of this fern render it very attractive, and when growing against the sides of the sea-washed rock, or any moist place in any abundance, no fern exceeds it in beauty. It has not been found in Scotland, and in but few districts in the south of England; in the ravines and mountain gorges throughout the west of Ireland, however, the collector is seldom permitted to go unrewarded for his diligent search. Two other rare species we also discovered in this "home of the ferns"—that exquisite variety of the polypody denominated *Hibernicum*, and the beautiful beech

fern, *P. phegopteris*. The latter plant is also called the sun fern; it has a decided preference for mountainous districts, where it often grows at a great elevation, though it may frequently be found clinging to rocks in the recesses of dark woods, or, as in the present instance, festooning the mouths of natural caverns. Several little variations occur in the form of the common European polypody, the lobes being more or less cleft, or acute, or serrated. One of the most important is that termed *Cambricum*, the Welsh polypody, in which the lobes become broader and are again irregularly lobed and toothed. This is always barren. The variety *Hibernicum*, or Irish polypody, has a broader, twice or thrice pinnated frond, and is fertile. It is an exceedingly handsome form of the fern. The French call this fern *le polypode;* the Germans, *der Tipfelfarren*. It is the *boomvaren* of the Dutch, the *polepodio* of the Spaniard and Italian, and is known in Russia by the name of *osokor*.

Having thoroughly explored the treasures of the cave, and possessed ourselves of specimens of some twenty different species of ferns which had made their home within its damp and sunless interior, we once more set out for pastures new. Almost immediately beneath the Gap of Dunloe a beautiful object met our sight. In the midst of a group of immense gray bowlders, which lay in wild confusion at the opening of a romantic gorge, grew in luxurious abundance quite a large bed of the superb holly fern (*Polystichum lonchitis*). How fresh and beautiful those evergreen fronds looked in one of the wildest spots to be found in all Killarney may well be imagined: higher up the "Gap" we subsequently discovered other and smaller beds, but, remembering how difficult of cultivation the holly fern is, we refrained from taking more than two or three specimens. The higher we ascended the mountain the more stunted became this remarkable species, until at length it grew only to the height of some six inches, still retaining its marked characteristics. The stalk of the frond of this fern is exceedingly short, and the dark, glossy green leafy part is firm and rigid, and sufficiently prickly to remind us of the holly. The young fronds appear early in spring, among the yet verdant fronds of the previous year. They are pinnate, with short, crowded, overlapping, twisted pinnæ, which are somewhat crescent-shaped; the upper side having at the base an ear-shaped projection, while the lower side has the appearance of having had a piece cut out. The veins are twice or thrice branched, reaching nearly to the margin without uniting with others. The indusium is a membrane-like scale, and the clusters of fructification form a continuous line on each side of the midrib, and even with it. They are frequently very numerous on the upper pinnæ.

Our small party unanimously agreed that the fern which

formed the most prominent feature throughout the Killarney district was the *Osmunda regalis*, or flowering fern. This stately species is not unfrequently called the king fern, and certainly it well deserves its regal name, which, however, appears to have been bestowed upon it through other circumstances than its crested form. Its name, *Osmunda*, is of Saxon origin, and perhaps was given in honor of some chief who in olden time bore the name of Osmund, that being one of the titles of Thor, the Celtic Thunderer. This attractive plant is so different in its appearance from other species that the botanist only would recognize it to be a fern, unless the veining of its leafy frond were examined. It generally rises to the height of five or six feet, and in congenial situations not unfrequently attains the height of ten feet. The young fronds of the *Osmunda* are usually about ten or twelve in number. Their large leaf-sprays are thin and crisp, and of a bright sea-green color, usually assuming a deeper green as the plant grows older. The stalk, which is at first reddish brown, afterward becomes green, and contrasts well with the rich rust-brown spikes of fructification. Nothing could be more beautiful, more in accordance with the surroundings, than the manner in which a considerable portion of the two lakes were literally fringed by the *Osmunda*, the long fronds of which arched gracefully over and dipped their masses of seed in the crystal water, while beneath the canopy thus afforded them the saucy coots flitted to and fro and gazed fearlessly upon the passing stranger.

Though some of the ferns I have mentioned may have superior claims in the eyes of botanists and collectors of rare species, it must be acknowledged that there is not one more universally popular than the graceful *Athyrium filix fœmina*, or lady fern. Indeed, not a few botanists have pronounced it to be the loveliest of all British ferns, possessing as well the great charm of commonness. Walter Scott, alluding to this plant in "Waverley," mentions its love for the moist, shady woodlands:

> "Where the copsewood is the greenest,
> Where the fountain glistens sheenest,
> Where the morning dew lies longest,
> There the lady fern grows strongest."

Undoubtedly, among the copsewood which covers a considerable portion of those grand hills which cast their shadows over the upper and lower lakes of Killarney, the lady fern attains a perfection not observable elsewhere, though the writer has gathered a somewhat scarce variety (*A. latifolium*) near Keswick, in Cumberland, and also a very peculiar species called *crispum* at Braemar, in Scotland. The plant is doubtless too well known to need description here, though it may be observed that its fecun-

dity is such that a celebrated botanist has said of it that "if a single plant were uninterrupted in its possible increase for twenty years, within that time it would cover an extent equal to the entire surface of the globe."

Our botanizing excursion, so successful, so full of interest, and so much enjoyed, having concluded, we bade adieu to matchless Killarney, and will not soon have effaced from our memories "the home of the ferns."

ORIGIN OF SOME GENERAL ERRORS.*

By Herr S. EXNER.

WHILE we endeavor to distinguish between instinct and reason, we are accustomed to speak of such skill and conformity of actions to a given end as are exhibited by birds in building their nests, or by societies of insects, as more resembling what we call reason. We may mark the difference, however, by observing that instinct develops its qualities only within a limited sphere and in view of a limited end. Birds can weave filaments into nests, attach them to branches, and adapt the forms of their work to those of the tree and its limbs; but their talents in weaving are of no use in helping them release themselves when caught in a snare, and they will then struggle as wildly and vainly as an animal that never built a nest. A hen will lay an egg every day in the same place till the quota is completed, and will then sit upon them; but many hens will sit all the same, and for the full time, if the eggs are taken away as they are laid. These examples illustrate how instinctive processes are produced simply as determined combinations—or work only in view of a special end. The actions provoked by them will remain the same, even when they have become purposeless. On the other hand, the associations of the processes can not be broken, and the skill which the bird directs to building her nest is not capable of being employed for any other end.

The more developed the instinct, the more stable are the combinations of phenomena and nervous conditions under which it works; the weaker the combinations, the more nearly the animal's mode of action approaches what we call reason. We should judge of the intelligence of an animal, not by single acts surprising to human understanding, but according to the diversity of the situations in which that animal can use its faculties. The weakness of reason in the animal always has the same character, and lies in the impossibility or difficulty of breaking certain associations and the incapacity to produce out of two combinations, by transferring a

* From a communication to the Sixty-first Congress of German Naturalists and Physicians.

number from one to the other, a third. Hunting-dogs show great skill in threading mountain-paths and overcoming or avoiding obstructions, but no dog will remove a branch interposed in his way. When the associations by which instinct works come into play outside of or against their ordinary end, we may speak of their working as imperfect, and may say that the animal is mistaken.

We also have instincts that are characterized by the narrowness of their end. Among them are the reflex actions. The eyes wink when they are threatened with injury; but they also wink when a beneficial operation is performed upon them, to which the winking is an obstacle, the action going on all the same when it is useless or injurious.

I believe it can be shown that this type of instinctive action is also found in man, and that the origin of many types of errors may be found in the application to particular cases, but exceptional, of what is generally right. This proposition is confirmed by some errors of the senses. When a point on our retina is excited by an external pressure, we fancy we see something luminous in the ordinary field of vision of that point. Were it not for the experience of previous observations of objects and their reflections, we should localize as things behind the glass the reflections which we see in mirrors. In this and most like cases, we are acquainted with the mechanism of the phenomenon, and can distinguish between what is only the sensorial impression and what we owe to memory. The separation vanishes in the higher regions of psychic life. If we draw a line on a sheet of paper and cover the end of it with another sheet, an observer not in the secret will imagine it to be much longer than it is, because his conception is based upon the fact that when one object lies upon another, it usually covers a considerable portion of it. We are subject to a considerable number of illusions of this kind. The prestidigitator takes advantage of one form of them when, by a quick look to one side, he turns the eyes of the audience away from his manipulation and gains an opportunity to execute the trick without detection, although every one of his spectators had determined not to lose sight of his hands. He is aware that a glance and particular adjustments of the head and eyebrows and lids will usually suggest to the looker-on that he will see at a particular point something more interesting than anywhere else within his field of vision. At the same time the audience will not know why they looked in that direction, and may not even be conscious of having looked there.

We thus deal on this domain, remote from the physiology of the senses, with functions of the nervous system similar to what we have seen in the hen and the winking. Thought follows its course according to the usual process; with more or less of con-

sciousness the ordinary train of associations is formed, and the judgment corresponds with what is correct in most cases. There is, therefore, no precise limit between instinctive actions and conscious thought; for every one can observe in his own mind that thought rests considerably on phenomena of association. An elevated intelligence is, however, distinguished from an inferior one by its richness in associations. The faculty of transposing the elements of one complexus of observations into another, the possibility of making a new combination, and the wealth of associations, are prime factors in determining the degree of intelligence. A large proportion of the mistakes to which we are liable originate in this kind of instinctive succession of associations usually correct and effective, in which associations important to the particular case are wanting. In other words, they arise from the association of the habitual with the omission of the special.

The thought can be illustrated by the citation of a few widespread logical errors. Where lotteries are drawn, the lists of the drawings are earnestly scrutinized by unsuccessful investors, who, if asked why they do so, will reply that, as all the numbers must eventually be drawn an equal number of times, those which have not been drawn for a long time stand the best chance of coming out soon. People often say, when it is raining hard, that it will be made up for by fine weather afterward. A kind of belief exists in a compensating providence that will bring grief after a long run of happiness; and it is illustrated in the legend of the ring of Polycrates. The mental processes leading up to error in these instances start from the premise that all the numbers have the same chance of winning; with which is associated the anthropomorphic idea of distributive justice, taking, in the legend of Polycrates, the form of divine jealousy; our recollections witnessing to a tendency to change; and past experience, teaching that, among a given number of objects, the probability of a particular one being found soon increases in proportion as the others are sorted out and put away; or, as in the filing past of a regiment, our expectation of finding our friend in the next rank grows as companies pass in which he does not appear. All this is true in general. The factor the omission of which in the particular case leads to error is that in the lottery all the numbers are put back into the urn before each drawing, and consequently what has been done has no influence on the probabilities of the present case.

So, when a certain person is spoken of as having "luck" at play; while he may have had unusual success—that is, a high number of favorable chances among all the possible ones—for a day or several days in succession, any association of his "luck" with his personal qualities is mistaken. We usually reason correctly that men succeed in their lives and enterprises whose per-

sonal qualities contribute to their success; but in this case there is no possible connection between the disposition of the cards and the qualities of the player. These associations are generally based upon supposed experiences, in which, besides the impossibility of securing exact observations, we commit the mistake of confounding coincidences with causal relations. We need not be surprised at them. They are incident to the relations of men with one another, and are confirmed by false observations and tradition, and they are what give its special character to each epoch.

These typical errors are not only met in the domain of common life; preserving their character, they possess the highest spheres of our activity, art and science; and in those domains we can see the fundamental difference between these two modes of the mind's action. While in science, the object of which is the truth, every error involves mischievous consequences, in art, which looks to the beautiful, illusion has full play, and in many instances even forms the basis of the best conceptions. Thus, in architecture, a balcony supported on slender bars of iron does not offer a pleasant appearance to us, while we are ready to admire the same structure if it rests upon shapely brackets of stone projecting to an equal distance from the wall. The apparent disproportion between the structure and the support in the former case is an artistic fault. It does not lie, however, in the calculations of the architect, which may be perfect, but in the "instinctive" judgment of the speaker. The prejudice is so general that architects often dress slender supports of iron with false brackets of plaster that will convey a more agreeable impression.

The psychological origin of this prejudice is found in our familiarity, from experience, and from having seen it used in buildings, with the solidity of stone, while we are not so well acquainted with the equivalent strength of less massive iron. In most cases the impression of solidity agrees with the sense of beauty, while the apparent disproportion of iron supports grates upon it. The balcony continues to look unwieldy even after we have become assured that the iron bars are amply strong. Our sense of beauty, therefore, rests upon an illusion in the presence of which it can not adapt itself to the particular case; but it is an illusion that every artist ought to regard. Such illusions are common in all art.

The proposition, "Style is the concordance of an artistic work with the history of its development, with all the circumstances of its production," which is elucidated in Gottfried Semper's work on "Style," defines the psychologic basis of every artistic production. For a work can have style only as it is in harmony with the mass of associations, mostly unconscious, which the spectator forms on the subject of its composition. This is why a majolica

cup should have a different shape from one of metal; why a cup of hammered metal should be distinct from a molded one; and why vessels of other materials should have their specific forms.

I have intimated that many of our most common associations arise from impressions that have acted upon us from our youth. The nature of these impressions is conditioned on the experiences of the generations that have preceded us. In other words, these traditions play an important part in our æsthetic impressions. The Greeks employed in their marble temples motives that dated from a distant epoch when building was done with wood. A diversion from these rules would have produced an unpleasant impression on the Greeks, and would have been contrary to the "style." Our case is not different. All of our ornamental motives are derived from time-honored traditions; and our æsthetic satisfaction in them continues unharmed by the reflection that in many cases they are no longer adapted to present conditions.

We meet errors of a similar class on scientific ground. Take, for example, the paradox of Zeno the Eleatic, concerning Achilles and the tortoise. The swift Achilles, it supposes, can never overtake the tortoise, because a distance intervenes between them, and he will have to run for a certain time before the distance is reduced by half, another length of time to reduce it to a quarter, to an eighth, and so on to infinity. More time is required to reduce the rest of the distance by half, and the number of these possible parcels is infinite; hence Achilles will never catch up with the tortoise. Now, since we know that he will overtake it, wherein is the sophism? It is not in any real contradiction between the laws of our thought and experience; but a typical error is involved, in which thought, moving in a way that generally leads to the truth, is at fault in the special case. It is true, in ordinary cases, that when we continue adding indefinitely new intervals to any interval of time, the sum of all will be infinite. This fact, generally valid, in the particular case leads our judgment to a false conclusion. The special feature in the problem is that if parcels of time, infinite in number, diminish according to certain laws, their sum will not be infinite, but may be very small. We do not have to be accomplished in mathematics to comprehend the sophism and find its solution. Every one knows that we can divide a length of one metre into a half metre plus a quarter, plus an eighth, etc., of a metre, and thus obtain an infinite number of factors, the sum of which, however, shall always be within a metre. The general error involved in the discussions of this sophism is also a typical one, for it originates in the predominance in our consciousness of the general law, with the non-association of the particular case. The phenomenon is therefore

analogous to those which we have observed in animals, to errors of the senses, and to other illusions of the reasoning faculty.

From the hen that sits on its empty nest to the problem of Zeno the Eleatic, there runs through animals and men a continuous series of errors, all of which have a common origin in the working of the nervous system conformably to the majority of cases without regarding any certain special and exceptional case, The typical character of these errors is related to the phylogenic development, and casts a degree of light on the unfolding of thought.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE PLEASURE OF MOTION.

By M. P. SOURIAOU.

MOTION gives both physical and moral pleasure. Physically, it enables us to remove ourselves for the moment from pain. Morally, it furnishes a satisfaction for our self-love, which is remarked especially in play and in our struggles against the forces of nature.

Before being a source of positive pleasure, our physical activity is stimulated by pain. Those movements, called spontaneous, which are the first signs of vitality in the child or animal, are explained by supposing them to be the reflex of some indefinite discomfort. Our organism is not a machine, as some say, in any of its parts, but is living and animated throughout. Even the organs that perform without the intervention of the will, and the play of which seems to be mechanical because it is not accompanied with a recognizable sensation, may have the rhythm of their movements determined by some local sensibility.

When I feel any suffering, I have only to execute some motion, to feel it less. Motion is the best of anæsthetics. It disperses at a stroke all the little uneasinesses that accompany even the normal working of our organs, and which we experience when we are occupied only with feeling ourselves live. When we make an energetic effort, we are nearly insensible to pain as long as it lasts. When I am at rest, a blow on the shoulder will hurt me. In the ardor of sport, in the excitement of a violent exercise, the roughest shock will hardly be felt. Every very intense sensation, we also know, provokes convulsive movements, sudden and violent muscular contractions. These movements are not mechanically determined by the sensation; they are produced voluntarily, although they will not remove the cause of the pain, at least to mitigate its effect. The howling of the wounded dog, the squirming of the worm that is cut in two, are a voluntary effort to escape suffering.

If the same pain recurs frequently, the animal soon remarks that some among these vague movements will contribute more directly than others to assuage it, and will give the preference to them. The habit of resisting a particular suffering by a special movement, becoming hereditary, forms a veritable instinct. In conformity with the general laws of evolution, there is established a selection between injurious and useful reflex actions, and the latter will gradually predominate.

Even when we are not suffering from any accidental uneasiness provocative of special muscular reaction, we are impelled to move by the simple need of motion. Every animal has to expend daily a more or less considerable sum of energy to procure food for itself. The oyster, fixed on its rock, imbibes, without effort and almost passively, the vegetable matter which the waves bring to it. A snail, drawing itself slowly along on its belly, easily reaches the leaves which are in its way. The ox marches, step by step, in the field for hours, feeding upon the grass-leaves with which its lips come in contact. A wolf has to make journeys of leagues every day in search of its prey. The swallow has to keep in incessant motion to procure enough insects to satisfy its appetite. To the necessity for eating is added that of escaping enemies, and this exacts an increase of activity from the animal. Thus, each one, according to its kind, is obliged to be in motion more or less every day, and is organized for it. If, through accidental circumstances, its activity ceases to be useful, it is nevertheless obligatory upon it, for its physical constitution, having become adapted by heredity to the normal life of the species, can not abruptly bend itself to other conditions of existence. Its organism continues to furnish it the same quantity of energy, which it has to expend in some way. Hence the movements of the captive animals—of the lion which paces its cage, and of the canary-bird that leaps from bar to bar. Hence the physical exercises with which persons whose occupation condemns them to a too sedentary life relax themselves. This necessity for motion is especially great in youth, because the young animal must train itself in all the movements it will have to perform at a later age, and must also exercise its muscles and joints to develop them. Thus every animal has a tendency daily to expend a certain quantity of force, which is determined, not by the accidental wants of the individual, but by the general wants of the species.

How is this expenditure regulated? By what criterion do we know when we need exercise? A matter so indispensable to the good working of our organization can not be the product of reflex action. It is evident that animals can not take exercise by rule, after the manner of a gentleman who imposes upon himself the

obligation of taking "a constitutional" every evening. Even man can do this only exceptionally. Our intelligence permits us to satisfy these physiological exigencies in a more rational manner; but it does not give us notice of them. What would become of the most reasonable being in the world if he had to depend upon his reason to tell him what he needed? A real necessity exists for us to be warned by special sensations.

We sometimes dispose of this explanation cheaply by speaking as if we had direct knowledge of our strength. Nothing could be more simple were this the case. Strength accumulates in us while we are inactive, ending by giving us a painful sense of nervous tension, which prompts us to expend our excessive energy in certain exercises. We go through these first as a relief; then, our reserve force having been exhausted, we feel our strength failing, and the need of repose comes upon us. There would be no considerable objection to speaking in this way if our purpose was simply to indicate a correspondence between our muscular sensations and the dynamical state of our muscles. But we must take care not to believe that there is the shadow of an explanation in it.

What is it that takes place in us during that period of repose when we say that energy is accumulating in us? Our muscles are undergoing restoration, are getting into a condition to form new chemical combinations. But I have no knowledge how much force they can expend at a given moment; it exists in them in a purely virtual condition. I do not feel it any more than I feel the expansive force of the powder contained in a certain flask, or the heat that may be disengaged from a particular piece of charcoal. We have not, therefore, any degree of consciousness of our disposable energy. The anticipatory sensation which we feel just as we are about to make a movement, and which we take for a consciousness of the force we are going to expend, is only a preconceived imagination of the sensation of effort that will accompany the contraction. Even at the instant when the contraction is effected our sensation of effort only indicates to us the extent of the actual tension of our muscles. It answers so little to the real expenditure of our energy, that it would be exactly the same if we should stretch them in that way without performing any work. We shall therefore have to give up these conventional explanations and regard matters more closely.

When we have continued still for a long time, we feel, first, a great desire to move. Like all our appetites, the inclination to move is recognized, even before any sensation can give us cognizance of it, by the effect which it produces on the imagination. In unconscious hunger or thirst, we think, not precisely that it would be agreeable to drink or eat, but that some broiled chicken

or a pot of beer would be very nice. So the young man who has been confined too long dreams of canoeing and horseback-riding; before thinking that those exercises will do him good, he pleases himself with representing them to himself. This desire, as it defines itself, becomes more intense; and, if it is opposed, intolerable. At the same time physiological phenomena become apparent, augmenting the uneasiness. A process of nutrition and reintegration is carried on in the muscle during rest. The products of combustion, or the molecules that form stable compounds, are eliminated and replaced by fresh combustible matter, or unstable compounds. The muscle is then in what Rosenthal calls the sensitive condition. The most minute spark will bring on an explosion; the slightest impression will provoke violent reflexes. In such a state we feel nervous, as it is called; or can not keep still. The expression is exact. Our sensitive condition requires the spontaneous movements which the mere idea of motion provokes. A typical example of such suffering from forced rest is afforded by the pupil waiting for school to be dismissed. He feels as if his back was breaking and his legs were growing stiff. When will the bell ring? He wishes with a frantic inclination that he could jump from his seat, shout, and run. He wriggles and drags his feet on the floor. A hard look from the teacher fastens him to his place, and he quiets himself; but what a punishment it is to endure it!

Motion also procures a positive physical pleasure for us. When we give ourselves up to an exercise, or go at anything with great energy, all the functions are accelerated, the heart beats more rapidly, breathing becomes more frequent and deeper, and we experience a general feeling of comfort. We live more, and are happy in living. Rapid and boisterous movements produce also a kind of intoxication and giddiness that have a peculiar charm.*

"Let us imagine," says M. Guyau, "what are the feelings of a bird as it opens its wings and glides through the air like an arrow; let us recollect what we ourselves have experienced in being carried by a horse at a gallop, or upon a boat dipping into the hollows of the waves, or in the whirl of a waltz; all these motions evoke in us the undefined idea of the infinite, of unbounded longing, of superabundant and careless life, a vague rejection of individuality, a craving to go without restraint, to be lost in immensity; and such vague ideas enter as an essential element in the impression which a great number of movements cause us." The observation is correct; but I believe that this kind of pantheistic intoxication is at bottom only a cerebral congestion. A horse,

* The modern infatuation for round dances is chiefly explained by this intoxication of dizziness. It is shown in children at a very early age.

plunging into a rapid gallop, and seeing a large void space opening out in front of him, will never fail, as the saying is, "to do himself up." The mere rapidity of his motions gives him vertigo; he loses sight of danger; and when an obstacle suddenly rises against him, if he does not jump over it, he breaks himself against it. So, all rapid movements deprive us of complete possession of ourselves; we go on, we follow our impulse. It may be a foolish one; so much the better. Go on! up! quicker! What is such behavior but sheer intoxication?

To the physical pleasure of motion is added a moral and emotional pleasure. In like manner as it helps us to escape from physical suffering, muscular activity may serve as a remedy for disappointments, for moral pains. We weep and struggle when we have a great grief, as well as when we are suffering from a physical wound. The most afflicted man forgets his trouble while he is performing a vigorous exercise. Byron had his boxing-gloves brought to him, and went through his accustomed practice with a servant, while his mother was being buried; but the servant felt that his touch was stronger than usual, and all at once he threw down his gloves and fled to his room. Who has not felt the necessity of what is called throwing off his grief? When we remain quiet our mind is, as it were, bent back upon itself, and all the pains that can affect us are augmented, as it were, by the very attention which we give them. In action we forget ourselves, directing our thought to the attainment of the purpose upon which we are fixed.

Physical exercises also give us positive mental pleasures, the chief among which is the satisfaction of our self-love. When I execute any movement, or devote myself to an exercise, I try to get as much as possible out of it. I want particularly to acquit myself better than any one else, and have a feeling of pride when I have succeeded. This leads to a real increase of ardor, and a luxury of physical activity. Observe youth who are indulging themselves in any sport together; is not emulation the essential principle of their activity, which enables them to expend all they have of available energy? Tell a child to run as long as he can; he will stop in a short time, out of breath. Give him rivals, and the fear of being left behind will prevent his feeling fatigue and provide him with unaccustomed nervous resources, and he will go till his strength is exhausted. It is a recognized rule with all couriers, gymnasts, canoeists, etc., that one should not train himself alone in exercises of speed; there should be at least two, to excite one another by competition. Some persons have tried to show that the pleasure of play is disinterested. They are speaking without knowledge. When we are playing, we are entirely occupied with the result of our activity. We may not be very

particular in the choice of the end we shall seek; we may not care whether that end is worth the trouble we are taking; but, for all that, we may not be willing to have our faculties at work for nothing. We fix upon some end that we shall reach. If I take a walk, I say that I am going here, or there, or will walk so many miles. If I play a game of skill, I want to win, to make so many points, to accomplish something; I am not, then, seeking merely the pleasure of acting, but I try to reach a result agreeable in itself. Games of chance have no attraction if one is not interested in the play. Sometimes, this interest is conferred by the hope of a material or pecuniary profit; most frequently in the pursuit of the honor of having won. But, is working for glory disinterestedness? Pascal's analysis was more complete. The hunter loves to hunt, not only for the pleasure of walking in the fields in pursuit of a hare, not only for the pleasure of bringing his game home, but chiefly for the proud joy of exhibiting it. It may be said that this is all vanity; that the object is not worth the pains it has cost. But that matters not to the argument. I do not say that play is an affair of well-defined interest; but that we are excited in it by considerations of interest. At the moment when I am striving to arrive at that end, I do not measure its importance, I do not think of the reasons that first started me; there is the goal I have proposed to myself, and I run for it. If the thought occurred to me for an instant that this was all futile, only a pretext, my ardor would be cooled down at once. It is also easily seen that, when we engage in any exercise or game, we by a mental effort exaggerate the importance of the end sought. If we play billiards with a strong adversary, we call it a match, and hire a hall; and the players please themselves by imagining that they are staking their reputation on each carom-shot. A game of chess becomes very dramatic, and the player's hand trembles when he makes a decisive movement. When we start on a canoeing excursion, it pleases us to imagine for the moment that we are going to travel into distant regions. Walking in the forest, we say that we are exploring the country, and are going to make discoveries. In this way we try to satisfy the spirit of adventure that the usages of our too well regulated society have not wholly stifled. It is, therefore, an essential quality of play that, to take pleasure in it, we must mount the imagination, and fancy that what we are doing on a small scale is done on a grand one; must substitute mentally, for the futile activity in which we desire to be absorbed, some mode of superior and more fascinating activity. Tell me that I am willfully fooling myself, if you please. Tell me even that I have a secret consciousness that it is an illusion, and that I am more than half a dupe of the pretext that I have given myself. It is nevertheless true that the pleasure of action for the

sake of action is not enough, and that I take interest in the game only so far as my self-love is seriously interested in it. It is still necessary for me to have a difficulty to overcome, a rival to surpass, an advance to make. In dismounting from a horse, in taking off our skates, in putting away our oars, we congratulate ourselves that we have become stronger, and we feel an imperious necessity for telling of our prowess. We should take less pleasure in a game of skill if we could not convince ourselves after each essay, and convince some one else, that we had become more adroit in it. Every exercise in which one is decidedly a past master inspires a vague distaste.

We are able also to determine, in every physical exercise, a particular kind of pride. Very simple or childish, if you please, but all the deeper and more instinctive—that which one feels in conquering the forces of nature. We delight to refuse what they solicit us to do, and to accomplish what they seem to forbid. Hence the pleasure felt in climbing a hill, putting down an obstacle, leaping a ditch, and walking against wind and rain. In canoe-sailing we would rather stand close to the wind than be carried with it, and prefer running over the waves to flying before them. Of all these forces we struggle most earnestly against and most delight to overcome that of gravitation. It binds us to the earth by fetters which we are anxious to unloose, and inflicts disabilities upon us and exposes us to dangers that we are glad to escape. Motions of speedy transport are pleasant, because they relieve us for the moment from the burden of the feeling of inertia. Hence the agreeableness of riding, driving, cycling, spring-board jumping, vaulting, and riding in an express train. There is a charm in dreaming that we are leaping immense distances and prolonging the bound by the force of the will alone. In the struggle against height, falling is defeat; equilibrium is the defensive; motion of simple translation is the beginning of enfranchisement; and movement upward is triumph.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE Niagara-studies of Prof. Julius Pohlmann have led him to predict that, after the falls have receded one mile—or in two thousand years—there will be but one fall, the American fall having disappeared, and its islands will be represented by low hill-tops on a peninsula projecting from the American shore; but the fall will be nearly two hundred feet high. After a recession of three miles more, there will be again two falls at the foot of Grand Island, the Canadian fall being the larger. The height of the falls will thereafter diminish thirty-five feet for every mile they travel south; and long before they have receded twelve miles, or to the southern end of Grand Island, they must disappear entirely as falls, and present only a long series of rapids. The second American fall will recede more slowly than the Canadian fall, but will ultimately be reduced to the same condition, forming a river with swift-flowing current and perhaps a few short rapids.

THE HISTORY OF THE FORK.

By J. VON FALKE.

THE Duchess of Beaufort, dining once at Madame de Guise's with King Henri IV of France, extended one hand to receive his Majesty's salutation while she dipped the fingers of the other hand into a dish to pick out what was to her taste. This incident happened in the year 1598. It demonstrates that less than three hundred years ago the fingers were still used to perform the office now assigned to forks, in the highest and most refined circles of society. At about this time, in fact, was the turning-point when forks began to be used at table as they are now. When we reflect how nice were the ideas of that refined age on all matters of outer decency and behavior, and how strict was the etiquette of the courts, we may well wonder that the fork was so late in coming into use as a table-furnishing. The ladies of the middle ages and the Renaissance were not less proud of a delicate, well-kept hand than those of our own days, and yet they picked the meat from the platter with their slender white fingers, and in them bore it to their mouths. The fact is all the more remarkable, because the form of the fork was familiar enough, and its application to other uses was not uncommon. It was even used in cooking in the epic period of the middle ages, as a spitting instrument, though rarely as an aid in cutting. It appears with some regularity in the inventories or treasure-lists of kings and noble houses after the fourteenth century, but only in isolated or very few specimens as compared with the large numbers of knives and spoons. In Clement of Hungary's list in the fourteenth century thirty spoons are mentioned, but only one fork, and that of gold. The proportion is nearly the same in the Duke of Anjou's inventory of 1360. King Charles V of France in 1380 listed along with many other objects two silver forks with crystal handles; and this monarch is said to have had in all twelve forks in a million francs' worth of silverware. The Duchess of Touraine in 1389 had only two forks to nine dozen spoons. The instrument was then called by the same name it bears to-day in French—*fourchette*—and this was the diminutive of *fourche*, pitchfork, with which all the farmers at least were acquainted. Forks are not oftener mentioned, nor for a different purpose, in the fifteenth century; but Duchess Charlotte of Savoy had, in 1483, two spoons and a fork, of silver, "to eat comfits with."

These examples show that forks were known as rare and costly articles, but were not used for the purposes they now are. Among the miniature pictures on Anglo-Saxon manuscripts are representations of meals, but none in which a fork is shown lying on the

table or held in the hands of any of the guests—except that, in a single picture in a manuscript of Herrad of Landsberg (since destroyed by fire), an instrument resembling a fork, but more like a double-edged knife split in the direction of its length, was lying on the table.

The fork is likewise not mentioned in any of the numerous descriptions of feasts by the chroniclers of the middle ages; not in Alienor de Poitiers's account of the ceremonies and table usages of the Burgundian court; nor in the account of the setting of the table given in the "Ménagier de Paris"; nor in that of the great feast given by the Duke of Burgundy to the English ambassadors in 1462. But it does appear from these stories that the guests took the meat and other viands which the carver prepared for them, and carried it to their mouths in their fingers. In some distinguished houses they took the pieces out of the common dish, or cut them themselves to eat them by the aid of their fingers. The guests did not even receive separate knives, and it was the custom in England in the sixteenth century for each to bring his own knife and sharpen it upon a common steel that hung upon the wall.

The absence of forks explains the careful attention that was paid to washing the hands before and after meals. Servants were all the time going around with basins and pitchers, and a towel slung over their shoulders, and pouring water on the hands of the guests, and the napkins were frequently changed. Sometimes the water was perfumed; and every pains was taken to remedy the soiling of the fingers that inevitably took place, and make it as little unpleasant as possible.

It seems clear enough, in the light of this negative evidence, that the few forks included in the silver-ware of the middle ages were not used as forks are used to-day. Since kitchen-forks served as spits and for holding roasts, it is probable that the high-born lords and ladies of those times, who only appear to have possessed these implements, used their silver forks for toasting their bread at the breakfast-room fire. There is some direct evidence that they were employed to hold substances particularly disagreeable or inconvenient to handle, as toasted cheese, which would leave an unpleasant smell; or sticky sugared dainties; or soft fruits, the juice of which would stain the fingers.

Only one incident is related of the use of the fork in the nineteenth-century fashion. This was by a noble lady of Byzantium who had married a Doge of Venice, and continued in that city to eat after her own custom, cutting her meat very finely up and conveying it to her mouth with a two-pronged fork. The act was regarded in Venice, according to Pietrus Damianus, as a sign of excessive luxury and extreme effeminacy. It suggests a probability that the fashion of eating with forks originated at the imperial

court of Byzantium and thence extended to the West. Some hundreds of years had still to pass before it could be domiciliated in Europe, for this Byzantine doge's wife lived in the eleventh century, while the fashion of eating with forks did not become general till the seventeenth century.

It was the duty of the waiters to deposit the meats with large, broad carving-knives upon the plate, from which the guest took it and broke it up with his fingers, and with them conveyed it to his mouth. The nails were also sometimes called into requisition, if we may credit the verses which read—

"Ongle, riche et précieux;
Ongle qui tranche, quand tu veux;
Ongle qui en lieu de forcettes
À la belle sert de pincettes."

[Nail, rich and precious;
Nail, that cuts when you will;
Nail, which, in place of forks,
For the fair dame plays at tongs.]

Meat, when not cut with the carving-knife, was taken up in the fingers. It was the rule with respect to other viands for which the hand had to be put into the dish, to take them always from the same side, so that each guest might have his particular spot to pick from. A polite man should pick meat neatly with three fingers, and should take care in conveying it to his mouth not to touch his nose with it ("*Ne touche pas ton nez ci main nue, dont la viande est tenue*"). Erasmus, of Rotterdam, who was versed in good manners, said in 1539: "Take what is offered you in three fingers, or present your plate to receive it. There are people who can hardly wait till they have sat down before putting their hand into the dish; one must receive on his plate whatever he can not take out with his fingers." Monsignor della Casa, Bishop of Benevento, wrote in 1544 a kind of manual of etiquette entitled "Galatea," which was published in a French translation by Jean de Tournay in 1598. Among other things it directs: "One ought not to wash his hands before everybody, but in his room, not in society. Nevertheless, when one is sitting at table, he should wash his hands in the presence of the others, even if it is not necessary, so that those with whom he puts his hand into the dish may know that it is clean. A well-bred man," continues this author, "will avoid greasing his fingers, lest he soil the table-cloth, which would be disagreeable to those who witnessed it. It is also not proper to wipe the fingers with the bread which one is about to eat." The practice of some persons, of eating only with gloved hands, does not seem strange in the light of these facts.

As has already been remarked, the change from fingers to forks began to be made at about the end of the sixteenth and the begin-

ning of the seventeenth centuries. An evidence of it may perhaps be found in the silver-list of Gabrielle d'Estrée in 1599, which included twenty forks. There was a society of fops connected with the court of King Henri III of France, who were distinguished for their ultra-refined notions concerning manners and dress, and were called *Mignons*. The king himself, who invented a new kind of starch for his collars, was in sympathy with them. The ways of this circle were ridiculed in a satirical pamphlet called the "Island of the Hermaphrodites," which was published in the earlier years of the seventeenth century. The custom of eating with forks was held up to scorn in this publication; stress was laid upon the accidents that it was presumed would happen to those who had not become adepts in the use of the instrument; and it was thought funny that, when it came to washing the hands after eating, they should be found not to have been soiled.

The custom seems to have extended by way of Italy to Germany, France, and England. Coryate, an English traveler, relates in his "Crudities," published in 1611, that he had thought it best to follow the Italian fashion of cutting meat with the aid of the fork, not only while he was in Italy, but also in Germany, and even after he had returned to England. "The Italians and also many foreigners residing in Italy," he says, "use a little fork when they cut meat at their meals. While they cut with the knife, which they hold in one hand, they hold the meat firm in the dish with the fork, which they hold in the other hand; and any one who should unthoughtedly touch the dish from which they were all eating, with his fingers, would give offense, and be accused of violating good manners."

The fork did not rapidly come into general use, even in the higher ranks. An English writer, Heylin, mentioned it in 1652 as something that had been taken up by the elegants. It is remarked in a "Nouveau traité de la civilité, qui se pratique en France parmi les honnestes gens" ("New Treatise on Civility as it is practiced in France among Well-bred People"): "When one takes from the dish, he should wait till his superiors have been served; he should also select once for all what he is to take, for it is impolite to put the hand into the dish twice, and still more so to move it around seeking for piece after piece." Louis XIII adopted the fork, but his queen, Anne of Austria, who had been brought up at the Spanish court, never could accustom herself to it, and always used her fingers, although she was very proud of her pretty hands. A verse is cited from the "Muse historique" in 1651, which indicates that departures from the old fashion of eating were still exceptional at the French court; and a pair of verses, of about the same period, contrast the old way with the new.

One of the most active agents in introducing the fork to polite

society was the Duke of Montausier, who was a constant visitor at the Hôtel Rambouillet, the seat of the most refined manners of the day, and married the daughter of the marquise of that name, Julie d'Augennes. This house was of Italian origin, and probably received the fork along with its other Italian heritages. The duke, as the first chamberlain of King Louis XIV, had excellent opportunities, which he improved, to introduce the fork among the aristocracy and make its use common.

The history of the fork after the middle of the seventeenth century chiefly concerns the extension of its use and its spread from the aristocracy to humble circles of society. Its form has also been gradually improved, and changed from that of the straight, two-pronged instrument of the olden time, of little use except as a spit, to the gracefully and conveniently curved, broad, many-pronged English fork of the present day, spoon-like in shape, and precisely adapted to its purpose.—*Translated for the Popular Science Monthly from Ueber Land und Meer.*

SKETCH OF CAROLUS LINNÆUS (CARL VON LINNÉ).

WHATEVER may be the future progress of the sciences of botany and zoölogy, Prof. Flower has said, in the British Association, "the numerous writings of Linnæus, and especially the publication of the 'Systema Naturæ,' can never cease to be looked upon as marking an era in their development." In the "Systema Naturæ," the speaker added, the accumulated knowledge of all the workers at zoölogy, botany, and mineralogy, since the world began, was collected by patient industry, and welded into a complete and harmonious whole by penetrating genius.

CAROLUS LINNÆUS, afterward called Carl von Linné, was born at Råshult, in the parish of Stenbrohult, in the province of Småland, Sweden, May 13, 1707, and died at Upsala, January 10, 1778. He was the eldest child of Nils or Nicolas Linnæus, commissioner and afterward pastor of the parish, and Christina, the daughter of the previous incumbent. The father was versed in natural history; a well-stocked flower-garden was attached to the house; and the child, hearing his father talking about the virtues of certain of the plants, at four years of age became interested in them, and formed the habit of asking about the names and qualities of all that he saw. The father, as a condition of further answering his questions, insisted that he should remember all that he had been told before. The child thus received a valuable mnemonic discipline that served him through life, and was familiar from the start with the Latin and the vernacular names of plants. His

mother used to relate that he could always be soothed, when crying, by giving him a flower. When seven years old he was put under the private tuition of Telander, a teacher of only the ordinary stamp, and three years later was sent to Wexiö to school, his father wishing to prepare him for holy orders. The story was the same at both places. He made no progress in the routine studies of the course, except in mathematics and physics, but used every opportunity to look after flowers and turn over books of botany. With Gabriel Hök he did a little better, for that teacher allowed him some liberty to gratify his tastes; but the people at the gymnasium were again troubled by his perversity. Finally, the father and the teachers held a consultation, and it was decided that, although his moral record was unexceptionable, he offered no promise as a scholar, and must learn a trade. So he was, or was about to be, apprenticed to a shoemaker, when the father, having some bodily malady for which he had to visit Dr. Rothman, spoke incidentally of the trouble Carolus was giving him. The doctor thought the boy might succeed in medicine and natural history, and offered to take him to board, and help him in his studies. He gave him private lessons in physiology, and introduced him to Tournefort's botanical system, by the aid of which Linnæus continued to study the local plants. At the end of a year, Linnæus was sent to the University of Lund, recommended as his private pupil by Hök, who, taking great liberties with the facts, substituted his own good opinion for the curious letter with which the principal of the gymnasium had armed the candidate. This letter was to the effect that pupils might be compared to young trees in a nursery: there would sometimes be some that would grow up wild in spite of all the care that might be spent upon them, but which might still do well if transplanted to a different soil. "It is with such a hope that I send this youth to your institution, where, perhaps, another atmosphere may favor his development." At Lund, Linnæus found employment as a copyist with Dr. Kilian Stobæus, Professor of Medicine and physician to the king, who had a museum of minerals, shells, and dried plants. The professor was not at first aware of the kind of treasure which he had in his house; but Linnæus, having formed a friendship with a fellow-student who had access to the doctor's library, borrowed books from it and sat up till late in the night reading them. Mother Stobæus observed the light in his room, and, being worried about danger from fire, warned her son of it. He detected Linnæus at his reading; but the explosion and subsequent explanations resulted in a widening of the young man's opportunities for pursuing his favorite studies. On Rothman's advice, Linnæus determined to go to Upsala, where the advantages seemed to be better than at Lund. The three hundred francs that he was able

to take with him were soon exhausted, and he was reduced to poverty, having, it is said, to wear other students' cast-off shoes, or mend his own with paper, when Olaf Celsius, Professor of Theology, observed his attention to botany, looked at his collections, and concluded that he would make a good assistant on the "Hierobotanicon," a treatise on the plants of the Bible, which he was preparing. He took Linnæus to board, gave him the free use of his library, found him some private pupils, and recommended him to Olaf Rudbeck, Professor of Botany. Linnæus had in the mean time had his attention directed to the sexuality of plants, by reading a letter from Burckhart to Leibnitz, a review of an address by Vaillant, and a work by Wallin, all bearing on the subject. He himself wrote a treatise on the sexes of plants, and it was this that Celsius made the occasion for the introduction. Rudbeck's advanced age did not permit him to attend personally to all his lectures, and he made Linnæus his deputy. The hand of the struggling student, who now at last, in his twenty-fourth year, saw his career taking an upward direction, was soon visible also in the remodeling and restocking of the academic gardens—he having become director in a place where his application to be employed as a subordinate had been refused a year before.

His equivocal position at the university having become unpleasant by reason of the jealousy it excited among the professors, Linnæus accepted a proposition from the Academy of Sciences of Upsala to make a scientific exploration of Lapland. He accomplished this task in the summer of 1732, depending mostly on his own resources, and, in the face of great difficulties and with no little danger, accomplishing a journey of forty-six hundred English statute miles, and brought home from it valuable fruit in knowledge and specimens. In 1734, after having been defeated by the hostility of one of the professors in an attempt to resume his lectures at Upsala, he performed, attended by seven pupils, a similar exploration of Dalecarlia. While on this journey, he lectured at Fahlun, to large audiences, and determined, at the suggestion of Chaplain (afterward Bishop) Browalius, to attend a foreign university for the degree of M. D. This would give him a position in society and science.

Arriving at Hamburg, he exposed the spurious character of a seven-headed hydra in a museum there which was composed of weasels' heads artfully sewn together, and so offended the proprietor of the establishment that he was obliged to leave the city at once. At Hardewijck he passed his examination, defended a thesis on the cause of intermittent fevers, and received his degree from the university. At Leyden he called upon Gronovius, who, upon being shown the "Systema Naturæ," was so delighted with it that he undertook to publish it at his own expense. The great

physician Boerhaave, after some delay, gave him a cordial reception, and recommended him to Burman, at Amsterdam, with whom he stayed a year. Here he accepted an invitation from the wealthy banker Cliffort, who had a great garden and fine library at Hartekamp, and stayed with him three years, living at ease, working in the library and garden and at his studies and his books, and sparing no pains, through the "Hortus Cliffortianus," and his description of the banana, *Musa Cliffortiana*, to make the fame of his patron lasting.

In 1736 Linnæus visited England, bearing a letter of introduction from Boerhaave. He was received by the botanists there with a reserve which soon thawed and gave place to warm appreciation. Returning to Holland, he completed the printing of his "Genera Plantarum," finished arranging and describing Cliffort's collection of plants, spent a year with Van Royen at Leyden, rearranging the garden, and in 1738 started for Sweden by way of Belgium, Paris (where he formed a lasting friendship with Bernard de Jussieu), and Rouen. Hence he sailed direct for Sweden, intending to establish himself in the practice of medicine at Stockholm. Patients were slow in coming to him, and in his discouragement he said that "if he had not been in love he certainly would have left his native country." His fame, however, which had become conspicuous abroad, had at last reached Sweden, and he gradually obtained a practice, was appointed naval physician, Professor in the School of Mines, etc., and was able to marry the daughter of Dr. Moræus, who had waited for him for several years. He enjoyed the support of influential friends—Marshal the Baron Charles de Geer and Count Tessin—and by their aid succeeded, in 1741, in reaching the summit of his ambition—a professorship in the University of Upsala, which he occupied for thirty-seven years. His fame grew rapidly. "He was long a center to which all important researches in natural history were reported. Numerous disciples attended his lectures and propagated his doctrines verbally, while his own works, scattered abroad, made his system and his reforms popular. His correspondence was extensive, and his letters, many of which have been preserved, exhibit his character in the most favorable light. On his recommendation, the Swedish Government intrusted several young men with distant scientific missions. Among the most distinguished of these travelers were Ternstroem, who traversed the East Indies and died at Poulo Condor, in the China Sea, in 1743; Kalm (whence the name of our mountain laurel, *Kalmia latifolia*), who explored North America from 1747 to 1751; Hasselquist, who visited Smyrna, Egypt, and Palestine, and died in Smyrna in 1752; Osbeck, who explored China from 1750 to 1752; and Loeffling, who traveled in Spain in 1751 and South America, where he died in 1756."

The numerous works of Linnæus appeared now in rapid succession, and honors and invitations came to him. He declined a liberal offer from the King of Spain to settle in that country; purchased the estates of Sofja and Hammarby, at the latter of which he built a museum of stone; was made a Knight of the Polar Star, and in 1761 received a patent of nobility, antedated to 1757, in deference to which he Gallicized his Latin name, inserted a *von* in it, and became Carl von Linné. The last reward was, however, not for his scientific achievement, but was granted in recognition of his having devised a way to improve the quality of the pearls of the fresh-water mussels of Sweden. When sixty years of age, Linnæus's memory began to fail; in 1774 he suffered an apoplectic attack; two years later he lost, by another stroke, the use of his right side; and he died of a hydropsy in 1778. While all the academies of Europe made him their associate, and princes gave him the most striking marks of their consideration, still "in the simplicity of his life he was little accessible to the honors of the world. Living with his pupils, whom he treated as if they were his children, some singular plant, or some animal varying a little from the ordinary form, would give him more joy than anything else. He was never troubled by the attacks of his antagonists; and although he had some distinguished ones—Haller, Buffon, and Adanson—and they frequently treated him unjustly, he was never at the pains of replying to them. . . . His society was charming, and all who came in contact with him conceived a tender attachment to him. His only weakness seems to have been a too great fondness for praise. Strongly attached to religion, he never spoke of the Deity but with respect, and embraced with marked pleasure the numerous occasions which natural history offered him to declare the wisdom of Providence."

The publications of Linnæus are described under more than one hundred and eighty titles. The earliest in date was the "Hortus Uplandicus," or list of cultivated plants of Upsala, in which he first outlined his plan for classifying plants according to their organs of reproduction—stamens and pistils—which appeared in 1731; and the last was his "Plantæ Surinamenses," 1775. The period of his literary activity thus lasted forty-four years. His great merits were the introduction of a system of botanical classification which, though wholly artificial and unnatural, served as an efficient tool till a philosophical system, based on affinities, could be worked out, and the extension and general application of an exact system of nomenclature. He sought to cover the whole domain of nature, and therefore wrote on minerals, animals, and plants. In mineralogy he paid particular attention to the forms of crystals, and based his classification on them. In zoölogy he looked to the organs of mastication and digestion,

to the feeding, to the wings in birds, and to the presence or absence of elytræ in insects. But his distinction rests pre-eminently on his work in botany, and to this most of his publications relate. He was not the originator either of the sexual system of classification or of the binary nomenclature; for the former, as we have seen, was suggested by other students whose essays he read and whose ideas he put in practice; and the latter was applied, as has been shown in a sketch in a previous number of the "Monthly," nearly two hundred years before him, by Pierre Bélon. But Linnæus made it general and established it in science. The formal introduction of his system of classification was made in the "Systema Naturæ," which Gronovius published at Leyden in 1735, in three sheets, according to one authority, or in eight folio sheets, according to another. It was enlarged in successive subsequent editions, of which the twelfth appeared during the author's lifetime. It was followed in 1736 by the "Fundamenta Botanica," of twenty-six pages, which contained an exposition of the author's theory as worked out after seven years of study and the examination of eight thousand plants. This work, amplified, afterward developed into two—the "Bibliotheca Botanica," Amsterdam, 1756; and the "Classes Plantarum" or "Systemata Plantarum," Leyden, 1738; while a more detailed explanation of the system of nomenclature was given in the "Critica Botanica," Leyden, 1737. These three works were the beginning of the great reform in botany; but the doctrine of Linnæus on these subjects, co-ordinated in its parts and illustrated by examples, was reproduced as a whole in 1751 in the "Philosophia Botanica," Stockholm—a work which served as the foundation for most of the minor treatises till Linnæus's artificial system of classification was supplemented by the natural system. The "Genera Plantarum," 1737, gave full descriptions of the genera, "according to the number, shape, position, and proportion of all the parts of fructification," and is pronounced by Mr. B. Daydon Jackson, in the "Encyclopædia Britannica," "a volume which must be considered the starting-point of modern systematic botany." In the "Species Plantarum," 1753, "the author's most important contribution to scientific literature," the trivial names expressing some obvious character to designate species are fully set forth.

The nomenclature introduced by Linnæus has endured, and the names he gave to species are still living; so that "in whatever part of the world one may be, if there are botanists or professional gardeners, there it is enough to give the Linnæan name of a plant to have its identity understood at once." His system of classification has given way to the more philosophical natural system by affinities based upon comparison of all the parts and qualities of the plant. There is reason to believe that he foresaw

this, and regarded his system as simply a stepping-stone to something better. He is quoted as having said that whoever should found a natural system on a solid basis would be his great Apollo. An account in the "Philosophia Botanica" of a series of naturally allied families is prefaced by the words that "a natural method is the first and last thing to be desired in botany; Nature does not make leaps. All plants show affinity on either side, like the territory in a geographical map." He and Bernard de Jussieu corresponded on the subject, and the latter urged him to institute a natural system. Such a system, however, could not be built at once, or by one man, and Linnæus had to content himself with furnishing the staging by the aid of which others could more slowly build up the permanent structure.

Linnæus is described as having been a little above the medium height, rather slight, but well shaped; with broad head and frank and open physiognomy; lively and piercing eyes, with a peculiarly refined expression. He was quick-tempered, but soon recovered from his passion. "He lived simply, acted promptly, and noted down his observations at the moment. . . . He found biology," says Mr. Jackson, "a chaos; he left it a cosmos. When he appeared upon the scene, new plants and animals were in the course of daily discovery, in increasing numbers, due to the increase of trading facilities; he devised schemes of arrangement by which these acquisitions might be sorted provisionally, until their natural affinities should have become clearer. He made many mistakes; but the honor due to him for having first enunciated the true principles for defining genera and species, and his uniform use of trivial names, will last so long as biology itself endures."

Another biographer gives as the peculiar features in which he surpassed, "the distinct study he made of each species, the regularity and detail of the characteristics he gave of genera, the care which he took to put in the background variable circumstances like size and color, the energetic precision of his language, and the convenience of his nomenclature."

A scheme was started for erecting a monument to Linnæus in connection with the centenary of his death. As is usual in such affairs, the subscriptions were slower in coming in than was contemplated by the promoters of the enterprise, and the completion of the monument was delayed. The statue, by Prof. Kjelberg, was unveiled on the 13th of May, 1885. It stands in the Humlegarden in Stockholm, and represents the "flower-king," as he is called in Sweden, at the age of sixty years, in a meditating attitude, holding the "Systema Naturæ" and a bunch of flowers in his right hand. It is surrounded by allegorical female figures representing botany, zoölogy, medicine, and mineralogy.

EDITOR'S TABLE.

THE DOMAIN OF SCIENCE.

A FEW months ago one of our contributors had occasion to notice the attacks made upon the scientific tendencies of the age by writers who might have been supposed to be themselves highly qualified representatives of the general scientific movement. In these columns, too, we have ourselves found it necessary, from time to time, to maintain the position that, if all is not well in the world to-day, it is not because we are troubled with too much science, but because we have as yet too little. Science has reduced to tolerable order certain departments of thought and knowledge; but there are whole sections of life that as yet it has barely touched. So long as this is the case, the social body must suffer. Until the true laws of life are discovered, and set in such a light as to command obedience, there must be more or less of confusion, distress, and waste of effort. It is evident, therefore, that the duty which lies at the door of every one capable of grasping the situation is to do all in his power to help science to have its perfect work—its work of social reorganization and regeneration.

Many persons, we are persuaded, fail to understand that science has any application outside of the investigation of physical laws. They think of it as something that has to do with astronomy and geology, with physiology and chemistry, with steam-engines and telegraphs and telephones. They do not think of it as a method of research valid in every department of life, and coextensive with the whole reach of human knowledge. The time has come, however, when the claims of science to be the supreme mistress of thought and action can not be too boldly or earnestly advocated. The spirit of science is a spirit of order; wherever, therefore, there is disorder, science is lacking, or, at least, exercises but imperfect control. We see the perfect control of science in the exactness with which astronomical observations and predictions are made; we see it in the wonderfully accurate determinations of the chemist; we see it in the formulæ of the electrician. When we come to the so-called science of medicine we see real science struggling for the mastery and too often overborne by ancient prejudice and lazy empiricism. When we come to education, we see an enormous parade of technique, but, on the whole, poor results in the way of disciplined intellects and harmonious characters. When we ask how science is applied to the government of individual lives, we find that it is scarcely so applied at all. Some notions of physical hygiene are more or less diffused throughout the community, at least among the more intelligent classes; but how rarely do we discover any clear recognition of the fact that there is such a thing as moral hygiene, the object of which is happiness just as that of physical hygiene is health! To "minister to a mind diseased" is now, as long ago, an almost desperate task, but to prevent the formation of morbid habits of body or mind is, or should be, quite within the scope of the science of to-day. Dr. Maudsley, in his very interesting work on "Body and Will," gives copious illustrations of the gradual progress of moral and intellectual decline through successive generations. Inordinate vanity or selfishness in one generation may mean a decided development of mental or moral insanity in the next. It is consequently of the utmost importance to watch and resist the very beginnings of evil, seeing that it is impossible to say what these may lead to if allowed to

gather force. Much may be done by each individual to promote and strengthen his own mental soundness by exercising control over his casual thoughts. "Were anybody," says Dr. Maudsley, "to observe carefully what goes on in his mind during waking, he would perceive that it was the theatre of as many fantastic, grotesque, incoherent thoughts as in dreams. . . . Obviously it will depend much on the occupation that each one gives his mind, and on the habits of attention and thought that he has trained it to, how large a part these incoherent vagaries of thought shall play in his waking mind, and in some degree in his dreams also. . . . Now, if it be thus possible by good and regular exercise of the higher faculties of mind to gain some mastery over thought in dreams, how much more is it within our power, and shown to be our duty, to obtain and exercise dominion over the vain and evil thoughts, inclinations, and imaginings of the day, and so hinder their luxuriant growth!"

In the ordinary conduct of life much that is harmful would disappear if life were once regarded as something that should and must be brought under scientific rules. Feelings, opinions, actions may all be brought to a scientific test—that is, to the test of outward reality—or, in other words, of conformity to our necessary environment. With some people it is enough to say that they *feel* so and so: their feelings are assumed to be unalterable, and to carry their own justification with them. Such a temper is not far removed from the hysterical, and, if it should assume that unhappy character some day, the result should not be considered surprising. The human being who persistently looks inward rather than outward for guidance, and makes more of his or her subjective impressions than of the teaching of objective facts, is in an unstable and dangerous condition. Again, in the matter of opinions, some persons esteem it a precious privilege to be able to think and believe, as they say, whatever they please. Their opinions they regard as their property, which no one must venture to trespass on. But the true test of opinions, it is needless to say, lies not in conformity to personal inclination, but in their agreement with some established order of things. It is folly to talk of believing whatever we please; if we are rational people at all, we believe *as we must.* Reason constrains us, and we have really no choice. In regard to actions there is perhaps a more general feeling of responsibility; and yet even here how much we are inclined to trust to hap-hazard! How little we keep before us a rational scheme of life, or steady, uniform principles of action! The very man who would sink in his own estimation if he played a card unscientifically in a game of whist, will play many a card most unscientifically in the much greater game of life. Why? Because, while he believes in a science of whist, he does not believe in a science of life. He studies the laws of whist, but does not study the laws of life. Yet science is prepared to step in and shed a clear light upon every department of human duty. All that science needs as a basis is a fixed order of things. Such a fixed order is discoverable in human nature and its environment. Here are facts, and every fact yields its own lesson. The time, we have no doubt, will come when men will see that life is a network of cause and effect, and that trouble does not spring out of the ground, nor promotion come at haphazard from the east or the west, but that whatever "happens," as the expression is, has its own adequate antecedent. But why should we not hasten the coming of that time by proclaiming —those of us who believe in it—the efficacy of science for the direction of individual and social life?

That science lays claim to the region of politics is evident from what has been said, but that it is conspicuously

absent from that region is evident from —the newspapers. So long as we understand by politics merely a scramble for office, so long will there be a very slight and indirect relation between political action and the general welfare; but it rests with an intelligent community to bring its politics up to a higher plane of a constant striving after social and economic harmonies and the realization of justice in all human relations. We are only able on this occasion to glance at one or two points of our subject; we think, however, that the lesson we would impress is sufficiently obvious. Science is not merely a thing of machinery and apparatus; it is not confined to the measurement of material forces or the explanation of physical phenomena. It is a method for the observation and co-ordination of facts and the forecasting of results; and wherever facts are to be found there Science is prepared to establish her kingdom. The unwise flout her pretensions, preferring the worship of Chance and Caprice; but the wise will range themselves on her side and strive to set up her peaceful reign, the benefits of which they know will extend to all, and increase from age to age.

THE TORONTO MEETING OF THE AMERICAN ASSOCIATION.

For the third time in its history the American Association this year peacefully invaded Canada, with hearty repetition of former hospitalities at the hands of Northern friends—indeed, hospitalities were so abounding as to encroach a little upon the serious work of the meeting. Receptions, official and social, followed one another in quick succession, and excursions were organized to Niagara Falls, Muskoka, and the Sudbury mines. The local committee is to be congratulated on its appointment of Prof. Charles Carpmael as chairman; he is Director of the Toronto Observatory, and the weather during the week was therefore delightful. Canada is proving very attractive of late years as a meeting-place for American scientific organizations; its latitudes are a guarantee for comfort in vacation months, and its new railroads have developed immense tracts of the highest scientific, economic, and scenic interest. It promotes international amity that Americans and Canadians at work in the same fields of research should gather in the same rallying centers, and, as a consequence, form the friendships of men having aims in common. In crossing the border an American finds himself amid differences, social and political, sufficiently marked to make his visit instructive — differences, nevertheless, not so pronounced that he can persuade himself to regard Canadians as a foreign people.

Prof. T. C. Mendenhall, Superintendent of the United States Coast and Geodetic Survey, was the presiding officer at the Toronto meeting. His ability and tact won him golden opinions on all hands. The addresses of the vice-presidents of the Association to their various sections were excellent—with one exception, which does not call for more specific mention. Prof. George L. Goodale, of Harvard, chairman of the Biological Section, delivered an address on protoplasm, treating his theme chiefly from the standpoint of vegetable histology and physiology—the field of science in which he is the leading American authority. General Garrick Mallery, of the Bureau of Ethnology, Washington, chairman of the Anthropological Section, made Israelite and Indian the subject of his address. He showed their parallelism in planes of culture, in methods of government, social observances, and religious faith. General Mallery's address will be presented in "The Popular Science Monthly" at an early date. Prof. H. S. Carhart, of the University of Michigan, Ann Arbor, as chairman of the Physical Section, gave a lucid presentation of theories of electricity.

Describing the experiments of Prof. Hertz, of Carlsruhe, and other investigators, he declared it certain that all radiant energy is transmitted as electromagnetic waves in luminiferous ether. In the Chemical Section, Prof. W. L. Dudley, of Vanderbilt University, Nashville, chose amalgams as his subject. His treatment was clear and suggestive, but of necessity technical. Mr. R. S. Woodward, mathematician to the United States Geological Survey, Washington, presided over the section of Mathematics and Astronomy. His address on mathematical theories of the earth was a successful endeavor to make clear to hearers, scientific and unscientific, the history of a theme usually wrapped up in the rigid mummy-cloths of mathematical formulæ.

Among the more noteworthy contributions to the various sections we may mention, in Section A, the paper of Prof. J. R. Eastman, of the Washington Observatory, on stellar distances. He argued that no relation exists between the magnitudes, distances, and proper motions of stars. Prof. Charles Carpmael made a plea for numbering the hours of the day from one to twenty-four, abolishing the necessity for writing A. M. and P. M. The plan has been adopted by the Canadian Pacific Railway on its Western and Pacific divisions. In accordance with Prof. Carpmael's suggestion, the Association memorialized the Governments of the United States and Canada, of the various States of the Union, and provinces of the Dominion. Much interest was developed in the exhibition of the Hastings achromatic objective, one of the notable gifts of mathematical and mechanical science to astronomy. It promotes accuracy of definition twenty-three per cent, and eliminates spherical aberration. In Section B, Prof. Thomas Gray, of the Rose Polytechnic Institute, Terre Haute, gave an experimental demonstration of methods of electrical measurement. Dr. George F. Barker, of the University of Pennsylvania, reviewed recent improvements in electrical storage batteries. He showed the immense advance in efficiency gained in the newest batteries based on the Planté model. In Section C, Mr. Charles E. Monroe, of Newport, R. I., gave the results of investigation into the explosiveness of celluloids. He had found the opaque variety insensitive to a shock of detonation at ordinary temperatures, while translucent celluloids were readily exploded by this means. Mr. O. Chanute, of Chicago, who has made the subject a specialty, gave an account of the best methods for preserving timber. After discussing the question of weights and measures, Section C passed a resolution urging colleges of pharmacy and medicine to adopt the metric system. Before Section E, the Society of American Geologists held a session, at which Prof. James D. Dana, of Yale, took occasion, in the light of new geological discoveries, to revise certain of his former teachings respecting areas of continental progress. Among his suggestions in nomenclature was that Ontarian be substituted for Silurian in local geological phraseology. In Section E, Rev. H. C. Hovey, of Bridgeport, Conn., described the newly explored pits of remarkable depth in the Mammoth Cave of Kentucky; the whole series of pits being connected by a magnificent hall several hundred feet in length. Mr. R. T. Hill, of the State Geological Survey of Texas, read several excellent papers on the general features of Texan geology, on the Eagle Flats of the mountainous region of Texas, the ancient volcanoes and Staked Plains of the State. In Section F a good many papers of value were read —all, however, technical in character. Prof. C. V. Riley, entomologist to the United States Department of Agriculture at Washington, contributed a paper on the best methods of subduing injurious insects by intentional importation of their natural enemies. Much interest

was developed in Toronto in entomology through the large attendance of entomologists from all sections of the country. An Entomological Club was formed, and Washington is to be its first meeting-place, but no date for meeting was named at Toronto. Mr. T. J. Burrill, of Champaign, Ill., read an interesting paper on the fermentation of ensilage. Section H was more than usually strong this year—the leading officers of the Bureau of Ethnology being present in force. The antiquity of man was discussed from opposed points of view by Mr. W J McGee, of Washington, and Dr. C. C. Abbott, of Trenton, N. J. Mr. W. H. Holmes, of Washington, contributed an interesting paper on the evolution of ornament, as illustrated in the ceramic and textile art of the North American Indians. Mr. W. J. Hoffman, also of Washington, described the secret societies of the Ojibwas, which enjoy as elaborate a ritual of initiation, and as sharply defined gradations of rank, as any modern order among the pale-faces. Rev. Dr. Bryce, of Winnipeg, Manitoba, depicted the Winnipeg mound region, the most northerly district where mounds have been discovered on the North American continent.

In Section I, Mrs. N. S. Kedzie read a sensible, thorough-going paper on scientific cookery. Prof. A. G. Warner's paper on luxury was an able and discriminating discussion of the difficult question, How much of income may be justly expended on luxuries? Prof. B. E. Fernow, the chief of the Forestry Division, United States Department of Agriculture, Washington, made a strong plea for the extension of governmental control to forests, irrigation, water-courses, and the like. His ground was that in these matters individual interests are often opposed to the general good, and that the state alone can represent national interests with comprehensiveness and continuity. At Prof. Fernow's suggestion the Association passed a resolution recommending to Congress an early and earnest consideration of a sound forestry policy.

While the press and people of Toronto promoted the success of the meeting by hearty and intelligent co-operation in its work, by cordial and multiplied hospitalities, the question naturally occurs, What did the Association do for Toronto in presenting science in such wise as to interest and instruct popular audiences? The first public lecture was delivered by Mr. C. K. Gilbert, Assistant Director United States Geological Survey, on the geology of Niagara River; it was both appropriate and timely, coming as it did on the eve of an excursion to the great cataract. Dr. H. Carrington Bolton gave the second lecture, an admirable illustrated account of a recent visit to Mount Sinai. Interest, however, was of course centered in the address of the retiring president, Major J. W. Powell, chief of the United States Geological Survey. In his unavoidable absence, the address was read for him. Its topic was the evolution of music, from dance to symphony. We regret to say that it disappointed the vast audience which had assembled to hear it. Major Powell has made important fields of exploration and research his own; had he chosen a theme which could have been illuminated by his special knowledge, we feel certain that he could not only have interested but charmed the thousands whom his fame drew together in Toronto. Section I, the Section of Economics and Statistics, affords, in a larger measure than any other, an opportunity for the presentation of questions having popular interest, and eliciting instructive discussion. An increased recognition of this fact at the hands of the Council of the Association seems to be desirable.

The next meeting of the Association is to be held in Indianapolis, and is to commence August 20th. Its officers will be Prof. George L. Goodale, Cambridge, Mass., president. Its vice-presidents: Section A, S. C. Chandler, Cam-

bridge, Mass.; B, Cleveland Abbe, Washington; C, R. B. Warder, Washington; D, James E. Denton, Hoboken, N. J.; E, John C. Branner, Little Rock, Ark.; F, C. S. Minot, Boston, Mass.; H, Frank Baker, Washington; I, Richards Dodge, Washington.

LITERARY NOTICES.

THE PHILOSOPHY OF NECESSITY; OR, LAW IN MIND AS IN MATTER. By CHARLES BRAY. Third edition. Longmans, Green & Co. 1 vol. 12mo. Pp. 407. Price, $1.75.

THE readers of George Eliot's "Life," as related in her letters and journals, will recall her intimacy with the Bray family. In Chapter II of that work Mr. Cross speaks of her acquaintance with and admiration for Charles Bray, mentions the book whose title is given above (which was first published in 1841), and adds that her association with the author and his family "no doubt hastened the change in her attitude toward the dogmas of the old religion." With Mr. and Mrs. Bray, and the latter's sister, there existed on the part of Miss Evans "a beautiful and consistent friendship, running like a thread through the woof of . . . thirty-eight years."

It would be an excellent thing if the reading public could be induced more often to turn back to the works of those who have carefully thought out the problems of existence, rather than to demand new expressions which are apt to be more crude and superficial. Did they but know it, they would not seldom find a greater degree of novelty in the old than in the recent. And the republication of books which have commanded attention, but which, though excellent, are in danger of being forgotten in the multitude of novelties, is a highly commendable enterprise.

Among such works of a past generation is "The Philosophy of Necessity," by Charles Bray. It aims to justify the doctrine of the uniformity of nature as construed by the necessitarians and utilitarians, of whom the Mills and Bentham are the type. The author treats the subject first on the side of moral and then of mental science. The best part is the first division, wherein there is a very able and valuable discussion of the origin, objects, and advantages of evil, pain being considered "as the necessary and most effectual guardian of that system of organization upon which happiness depends." Mr. Bray is no pessimist. On the contrary, he believes fully in the beneficial quality of pain, that evil is only a means to good, or good in the making. The limitations of human knowledge prevent us from seeing this clearly, but an hypothesis to that effect furnishes the only rational explanation of the existence of suffering in the world. The moral universe is governed by law, and its laws "are as stable as those of the physical world"; and, while "the causes of many evils must still remain unexplained," enough is known to warrant the faith that "further knowledge will make manifest the benevolent tendency of all creation, and bring home to every heart the all-cheering conviction that 'whatever is, is right.'"

THE GARDEN'S STORY; OR, PLEASURES AND TRIALS OF AN AMATEUR GARDENER. By GEORGE H. ELLWANGER. New York: D. Appleton & Co. Pp. 345. Price, $1.25.

THE author of this work is an "amateur" in the sense that he has a genuine love for the gardener's occupation; his knowledge of the subject and familiarity with plants and their relations with soil, situation, weather, climate, and purpose, are professional. His essay is practical in the sense that one may learn from it well how to manage a garden with the greatest success, what plants to put in it, where to put them, how to arrange them, and how to treat them. It is to an equal extent æsthetical, for it is permeated with the sense of the beautiful and of whatever is pleasing to a refined taste, and draws freely for illustration on the world's stores of poetry. Hence, whatever be the purpose of the reader who takes it up, he will find something respondent in it. The particular design of the volume is to direct attention to the importance of hardy flower-gardening as a means of outward adornment and a source of recreation; to present a simple outline of the art rather than a formal treatise or text-book of plants—"to stimulate a love for amateur gardening that may be carried out by all who are willing to bestow upon it that need of attention it so boun-

tifully repays." Having dwelt upon the plans for the garden as revolved in anticipation during the storms of March, the author gives "An Outline of the Garden," or a discussion of its general arrangement, the selection of plants, and the provision of stock. Among the first objects to be looked after are "the spring wild flowers," which have been too much neglected heretofore, but are beautiful, easily got, and (a great many of them) easily cultivated. From the attention given to the daffodil, we judge it to be a decided favorite with the author. In successive chapters are discussed "The Rock Garden," the "Summer Flowers," "Two Garden Favorites" (the lily and the rose), "Insect Visitors," "Hardy Shrubs and Climbers," flowers "In and Out of the Garden," "The Hardy Fernery," "Midsummer Flowers and Midsummer Voices," "Flowers and Fruits of Autumn," and the "Last Monk's-hood Spire," the variegated colors and the poetry of the closing season. Nearly all the plants referred to are such as may be successfully grown in the lower lake region, and have for the most part come under notice in the author's garden.

HISTORY OF HIGHER EDUCATION IN SOUTH CAROLINA, WITH A SKETCH OF THE FREE SCHOOL SYSTEM. By OGDEN MERIWETHER. Pp. 247.—EDUCATION IN GEORGIA. By CHARLES EDGEWORTH JONES. Pp. 154.—HISTORY OF EDUCATION IN FLORIDA. By GEORGE GARY BUSH. Pp. 54.—HIGHER EDUCATION IN WISCONSIN. By WILLIAM F. ALLEN and DAVID E. SPENCER. Pp. 68. Washington: Government Printing-Office.

THESE monographs constitute numbers 4, 5, 6, and 7 of the series of "Contributions to American Educational History," which the United States Bureau of Education is publishing, under the editorial supervision of Prof. Herbert B. Adams, in its "Circulars of Information." In the first paper of the group, South Carolina is shown to have been active at a very early period in promoting the mental development of its youth. Schools were founded and maintained by the State government and by private and charitable aid; and youth were sent to England to school, who on their return gave new impetus to the movement. The tardiness of the growth of colleges gave occasion for the development of a good system of academies, and training schools were brought within the reach of all. The first college was founded in 1785. At present, every religious denomination of any strength in the State is represented by its college, and attendance at most of the institutions is gradually increasing. In the main, they "follow the average college course, but, owing to want of funds, they can not offer many electives." The strongest and most famous institution is South Carolina College, which had as its president for fourteen years Thomas Cooper—a rash predecessor of Huxley and the evolutionists in the scientifico-religious discussion—and Francis Lieber as a professor for twenty years. Both of these eminent men were strong in political science, and under their influence the college gained a high reputation as a center for the study of that and correlated branches. The instruction of the negro population was well attended to during the earlier part of the history, and until, in 1834, an act was passed forbidding them to be taught. An entire change has come over the educational aspect since the war, of which due notice is taken in the history. Mr. Jones begins his sketch of "Education in Georgia" with notices of the schools that existed during the colonial epoch; then tells of the formation and conduct of academies after the Revolutionary War; and continues with a review of the elementary education afforded in the rural schools, an account of the "poor-school system," its rise, development, and decay; and a history of the beginnings of the general system of schools for whites, the application of which was interrupted by the war. The thread of the history is resumed after the war, and the present condition of the schools and colleges is described. Technological education has been made prominent, with results that are declared very satisfactory, at Emory College; the industrial department at Clark University is highly organized; and special emphasis is laid on the industrial education afforded at Atlanta University. Morris-Brown College, with two hundred and eleven pupils, is wholly under the charge of colored people. Mr. Bush's essay does not treat of the higher education alone in Florida, but sets forth in addition the growth and development of the school system of the State. It

particularly emphasizes the rapid advance made in all educational matters during the last decade. Since 1880, "each year has chronicled a steady advance, and the aggregate results will bear favorable comparison with the educational statistics of any other State. The superintendent has been able to report a gratifying progress in nearly every particular: in the growth of the schools in public favor; in the increased number of schools and school children; in improved buildings and enlarged funds; in a more intelligent and better instructed body of teachers; in a lengthened school year; and in a ratio of attendance which, if correctly reported, probably can not be surpassed in any of the older States." Messrs. Allen and Spencer's "Higher Education in Wisconsin" is the first of a series of monographs on the group of Northwestern States in the angle between the Ohio and the Mississippi Rivers. It gives only a general outline of the career of each of the colleges, mostly compiled from the sketches in their alumni records and similar publications. The larger share of space is given to the State University. The five private colleges are described as to the leading features and character of each and the scope and tendency of their work; and brief notices of three others are given. The execution of all these histories might be improved upon. Mr. Meriwether's on South Carolina shows the most painstaking, but it is considerably short of what such a work ought to be.

COMMERCIAL ORGANIC ANALYSIS. By ALFRED H. ALLEN. Second edition, revised and enlarged. Vol. III, Part I. ACID DERIVATIVES OF PHENOLS, AROMATIC ACIDS, TANNINS, DYES, AND COLORING MATTERS. Philadelphia: P. Blakiston, Son & Co. Pp. 431. Price, $4.50.

ANALYSTS will welcome the third installment of this comprehensive and carefully prepared work, which details the properties, methods of proximate analytical examination, and assaying of the various organic chemical substances employed in the arts, manufactures, and medicine. The material has so increased during revision that it will occupy at least double the space of the original two-volume edition. The part now issued consists of a chapter on aromatic acids, with an appendix descriptive of the tannins, and a chapter on dyes and coloring matters. The material relating to the latter subject is almost all new, coloring matters having been represented in the first edition only by sections on picric acid and basic anilin derivatives. In the present edition these substances are treated under the following ten divisions; nitro and nitroso coloring matters, aurin and its allies, phthaleins, azo coloring matters, rosanilin and its allies, safranines and indophenols, coloring matters from anthracene, sulphureted and unclassified coal-tar dyes, and coloring matters of natural origin. There remain to be treated in the second part of Vol. III, which will complete the work, organic bases, cyanogen compounds, albuminoids, etc.

STELLAR EVOLUTION AND ITS RELATIONS TO GEOLOGICAL TIME. By JAMES CROLL. New York: D. Appleton & Co. Pp. 118. Price, $1.

MR. CROLL in this book presents what he calls the "Impact Theory" of stellar evolution—a theory which, as applied to our sun, supposes that it was formed from a hot gaseous nebula, produced by the colliding of two dark stellar masses. The stars, being suns like our own, in all likelihood had a similar origin. He believes that this theory, which was proposed as a hypothesis some twenty years ago, has been strengthened by the astronomical and physical facts that have accumulated since that time. The hypothesis does not exclude the nebular theory, but rather includes it, and enlarges it by supposing what was in the world previous to the nebulæ. It assumes that previous to their formation there were stellar masses in motion; that the motion was in straight lines, and, as to each mass, without reference to the existence of any other; that two or more of these masses would casually collide; and that the collision would result in the breaking of them up, with the production of heat, and the rebounding of the fragments upon one another would end with the resolution of the whole into a nebula of inconceivably high temperature, whence the universe has been evolved, as supposed by Laplace's hypothesis. Here is an unlimited source for the energy possessed by the sun and solar system, to which the only conceivable alternative is gravitation. The latter is held to be inade-

quate to account for the amount and intensity of the energy. There are cited as supporting the impact theory, or as illustrating it, the meteorites, which may be residual portions of some of the original solid bodies; comets, for which a similar origin may be supposed; the motions of the stars, which are of greater velocity than can result from gravitation; the facility with which the theory will explain nearly every feature of the nebulæ; and binary stars, sudden outbursts of stars, and star clusters. An argument is based on the insufficiency of the gravitation theory to account for the heating of the primary nebula, while the "impact theory" furnishes at once a sufficient origin for it; and another, which is styled "a crucial test," on the requisitions of geological time as dependent on the antiquity of the sun's heat. It is mathematically demonstrable that, if gravitation be the only source from which the sun derived its heat, life on the globe can not date further back than twenty million years; and attempts have been made to measure the geological ages by this rule. Mr. Croll argues, from the evidences afforded by the amount of denudation that has occurred, and its calculated rate, and by biological development, that the processes which have taken place can not be subjected to such limitations. Further light is cast upon the theory by citations from the views, or consideration of questions suggested by them, of Prof. A. Winchell, Mr. Charles Morris, Sir William R. Grove, Sir Benjamin Brodie, Dr. T. Sterry Hunt, Mr. William Crookes, Prof. F. W. Clarke, and Dr. G. Johnstone Stoney, on the prenebular condition of matter.

DARWINISM: AN EXPLANATION OF THE THEORY OF NATURAL SELECTION, WITH SOME OF ITS APPLICATIONS. By ALFRED RUSSEL WALLACE. London and New York: Macmillan & Co. Pp. 494. Price, $1.75.

THIS work treats of the origin of species on the same general lines as were adopted by Darwin, but in the light of the discussions, objections, theories, and new discoveries that have been brought forth in the nearly thirty years which have elapsed since Darwin promulgated his great principle. The objections made to Darwin's theory in its earlier days were fundamental, and were directed against the principle itself. But Darwin "did his work so well that 'descent with modifications' is now universally accepted as the order of Nature in the organic world; and the rising generation of naturalists can hardly realize the novelty of this idea, or that their fathers considered it a scientific heresy to be condemned rather than seriously discussed." The objections now made to the theory apply solely to the particular means by which the change of species has been brought about. The objectors seek to minimize the agency of natural selection, and to subordinate it to laws of variation, of use and disuse, of intelligence and heredity. Mr. Wallace maintains the overwhelming importance of natural selection over all other agencies in the production of new species. He begins with illustrating the struggle for existence, which he considers one of the most important and universal, and yet least understood, forces of Nature. Next, variability is shown to be constant, universal, incessant, and frequent. It was a weakness in Mr. Darwin's argument that he based it so largely on the evidence of domesticated animals and plants. Mr. Wallace goes to Nature, and finds variation just as much the rule with species in the wild state, illustrating the fact with numerous citations and diagrams; and the objection that the preponderance of chances is immensely against the right variation or combination of variations occurring just when required, is blown away by showing that all forms of variation are all the time occurring. The argument is continued as to the relations of crosses, color, mimicry, heredity, and the geographical distribution of organisms. The objection based upon the failure to find evidences of the existence or former existence of a great number of the connecting links, which the theory of evolution supposes must have been developed, is answered by showing that the geological record of former forms is, and always will be, very imperfect, particularly with reference to animals and plants of the upland; and good reasons are given to show why it must be so. The views of Mr. Spencer, as set forth in his "Factors of Organic Evolution," and of Prof. Cope, Dr. Karl Semper, Prof. Geddes, and Prof. Weismann, are taken up, and claimed not materially to diminish the importance of natural selection, or to show that any of the laws or forces to which they

appeal can act otherwise than in strict subordination to it. In application to man, Mr. Wallace finds natural selection ample to the development of his physical structure, but failing to account for his moral and intellectual faculties.

THE ENGLISH SPARROW IN NORTH AMERICA, ESPECIALLY IN ITS RELATIONS TO AGRICULTURE. Prepared under the Direction of Dr. C. HART MERRIMAN, Ornithologist, by WALTER B. BARROWS, Assistant Ornithologist. Washington: Government Printing-Office. Pp. 405.

THIS monograph is published as "Bulletin No. 1" of the "Division of Economic Ornithology and Mammalogy" of the Department of Agriculture, and is designed to communicate the evidence from first hands respecting the character of the English sparrow, and its desirability or otherwise as a denizen of our own country. We have persecuted the hawk and the owl and the crow with guns and bounties and poison. Farmers' boys have lain in wait to shoot the robins and cat-birds that came to their cherry-trees. The ladies of the civilized world have thousands of agents in all countries, the United States included, hunting birds to obtain the wherewithal they may decorate their hats. One of our choicest amusements is to hunt for the mere sake of killing; and an amateur sportsman boasted the other day in a newspaper of having killed a thousand birds in a week, which, having no use for them, he gave to the farmers on whose land he poached. The first impulse on seeing a strange bird is to kill it. At last, after the birds had been exterminated in our large cities and made rare in the country at large, sparrows were introduced as a partial but certainly inadequate and unsatisfactory remedy for the mischief that had been done by rashly disturbing the balance of nature. As soon as they became numerous they were accused of driving useful birds away. There are unquestionably too many of them, and they multiply too fast; they are quarrelsome and tyrannical; and they are inefficient insect-destroyers as compared with the species we have allowed to be nearly exterminated. Whether or not they assist man in driving other birds away is a question of fact. The present report contains answers from thirty-three hundred persons in the country at large respecting the character and habits of the sparrow. The answers, mostly dated in 1886, represent all sorts of views, and are often contradictory. There is no means of estimating the relative value of the testimonies. The witnesses against the sparrow preponderate in numbers; but among those in its favor many are known to be accurate and intelligent observers. Mr. Nicholas Pike, who introduced them, an accomplished naturalist, is sure that they exterminated the measuring-worm from the trees of Brooklyn; and his testimony will be corroborated by all persons whose recollections run back far enough to compare the summer appearance of that city, with its trees bare as if a fire had swept through them, before the sparrows came, with the luxuriant foliage they obtained after the birds had worked a year or two upon them. There are many other testimonies to the destruction of insects by sparrows; but other birds are better at the business. Many equally intelligent and trustworthy witnesses, while admitting their quarrelsomeness, deny that the sparrows drive other birds away. Some of the States have recently passed laws to prevent the further destruction of song and plumage birds. Where these laws are enforced, the desirable birds are coming back, and the sparrows are not keeping them away. Man, not sparrows, is the enemy they have the most reason to dread.

THE JOURNAL OF MORPHOLOGY. Edited by C. O. WHITMAN, with the Co-operation of EDWARD PHELPS ALLIS, JR. Vol. II, No. 3, April, 1889. Boston: Ginn & Co. Pp. 250, with many Plates.

THE "Journal" has fixed a high mark, both in the quality of its articles and in the style of setting them forth, and adheres to it. The present number contains a study of the "Uterus and Embryo of the Rabbit and of Man," by Charles Sedgwick Minot; "The Anatomy and Development of the Lateral Line System in Amia Calva," by Mr. Allis; "The Organization of Atoms and Molecules," by Prof. A. E. Dolbear; "Some New Facts about the Hirudinea," by Mr. Whitman; and "Segmental Sense-Organs of Arthropods," by William Patten.

WHAT MOSES SAW AND HEARD; OR, THE IDEA OF GOD IN THE OLD TESTAMENT. By A. O. BUTLER. Chicago: R. R. Donnelley & Sons. Pp. 434.

IN this book a study is made of the character of the material surroundings in which the authors of the Old Testament were placed, and the nature of the impressions upon them which the Church regards as revelations from Deity, and which they describe as the voice of God speaking to them, or as appearances in a vision or a dream. It involves also an inquiry into their psychological condition. In the chapters on "The Bible as it is" and "The Publication of the Pentateuch," the author's conclusions respecting the origin and dates of the books agree in the main with those of the school of criticism represented by Kuenen. The inquiry is continued in chapters on "The Idea of God in Creation," "What Moses saw and heard," and "The Spirit of Inspiration." It is held that Moses saw the presence of God in the lightning or the fire, and heard his voice in the clouds; and the agency of God in the work of creation was the divine spiritual fire which the author of Genesis saw flashing in the clouds. Those who reject this construction may still find the interpretation of his expressions in the motion which God by his word, or by some power in himself, in the first instance communicated to matter. This suggests to the author the inquiry whether the writer of the first chapter of Genesis and the twentieth chapter of Exodus did not know that light was only a mode of motion.

AN INTRODUCTION TO THE LOCAL CONSTITUTIONAL HISTORY OF THE UNITED STATES. By GEORGE E. HOWARD. Vol. I. Development of the Township, Hundred, and Shire. Baltimore: Publication Agency of the Johns Hopkins University. Pp. 626.

THIS work forms an extra volume of the "Johns Hopkins University Studies in Historical and Political Science." In it a subject is treated which, although it has been a very important feature in the development of the American colonies and the organization of our States, has received but little systematic attention. It is only recently, in fact, that the matter of local governmental organizations has been formally considered by historians and political students. But, since Freeman began publishing his historical studies, the theory of an English local constitution, coeval in origin with that of the race, has become familiar; and, as the investigation has been extended, such a constitution has been found to have been a characteristic feature of Aryan civilization. Nowhere has local self-government played a more important part than in the development of our own American institutions, and it has become common with publicists to assign to it the origin of some of the most precious features of our system of government. As the author of this work remarks, in describing the New England town-meeting, "it is difficult to see, without the township, how the Englishman could have triumphed over the Frenchman in the struggle for the control of the continent; it is no less difficult to understand how, without it, the English race in America could have grown into an independent nation." The development of the various forms which local government has assumed in the United States is traced back to its beginning, and the modifications they have undergone are followed. Their origin lies far back in the history of the race. In this light are described the evolution of the township, hundred, and shire or county, with their various aspects, their divisions, and their combinations. The book is intended simply as a general introduction to the study of the subject, and leaves room for special treatment in different localities. But it points out "a rich field in which many laborers may find profitable employment," and which it would be well to have carefully cultivated.

Numbers Universalized, by *David M. Sensenig* (Appletons' Mathematical Series: D. Appleton & Co.), is intended as an advanced elementary algebra, which will be made part first of a higher algebra soon to be completed. It is thus bound separately in order to meet the wants of such schools as have arranged a higher course in algebra than is outlined and treated in the author's first book, "Numbers Symbolized," and yet have not time enough devoted to this branch to complete a full course in higher algebra. It is especially adapted to schools preparing students for college, and to advanced classes

in high and normal schools. While too great simplicity in treatment has been avoided, care has been taken to preserve the logical sequence of thought and to prevent the discussions from becoming unnecessarily abstruse and difficult. Examples have been selected with special reference to variety in combination and methods of reduction.

In his *Graduated Course of Natural Science* (Macmillan) Mr. *Benjamin Loewy* endeavors to place the fundamental facts of physics and chemistry upon a purely experimental basis. The principal subjects usually embraced by a school course in these branches are arranged in a progressive manner, "so that the pupil may be able to proceed gradually from that which is known, simple, and easy, to that which is unknown, complex, and difficult; from that which is near and within a young learner's perception, to what is more recondite." It is also a part of the plan to give no instruction but that which is conveyed through experiments and the immediate consequences of the phenomena observed, as deduced by a chain of simple reasoning. The present volume (Part I) of one hundred and fifty-one pages comprises the first year's course for elementary schools and the junior classes of technical schools and colleges.

The First *Report* of Mr. *John C. Smock* (Charles Van Benthuysen & Sons, Albany), *On the Iron Mines and Iron-Ore Districts in the State of New York*, is based in part on the answers by managers of mines to letters of inquiry addressed to them, and partly on a personal survey of the mining district. Nearly all the mines were visited, and notes of their geographical situation and geological relations were obtained. The answers to letters of inquiry furnished valuable data, especially in the relations of the mines to the iron-mining and iron-manufacturing industries of the country. Short notices of the older mines and of some of the abandoned mine localities have been incorporated in the report. The paper is published as "Bulletin" No. 7 of the New York State Museum of Natural History.

The *Report*, by Dr. *George M. Dawson*, *on an Exploration in the Yukon District, Northwestern Territory, and adjacent Northern Portion of British Columbia*, gives the results of an expedition made in 1887, in the vast and hitherto almost unknown region in the extreme Northwest of British America. The tract in question is bounded on the south by the sixtieth parallel, forming the northern line of British Columbia, on the west by Alaska, on the east by the Rocky Mountains and the one hundred and thirty-sixth meridian, and on the north by the Arctic Ocean. It derives its name from its lying within the drainage-basin of the Yukon River. It has an area of about one hundred and ninety-two thousand square miles, or nearly equal to that of France, greater than that of the United Kingdom by seventy-one thousand square miles, ten times that of Nova Scotia, and nearly three times that of the New England States. The report is accompanied by a map of the district and northern British Columbia, in three sheets.

Geonomy and Cosmonomia (J. B. Lippincott Company) presents theories on the origin of ocean currents and the growth of worlds and cause of gravitation, by *J. Stanley Grimes*, who is also the author of theories in mental physiology that have been favorably mentioned by such authorities as Dr. McCosh, the Rev. Joseph Cook, and the late Dr. G. M. Beard, and of a new view of the nebular system. In *Geonomy* he sets forth that the continents originated in the sinking of the ocean basins beneath weights of sediment, accompanied by compensatory upheavals, and were shaped by six pairs of elliptical oceanic currents, the sedimentary deposits of which caused the sinkings. In *Cosmonomia* the condensation of ether is presented as the cause of the growth of worlds and of gravitation.

Mr. *H. H. Johnston's History of a Slave* presents a dark aspect of affairs in Arabo-savage Africa. The author, who has acquired fame as an explorer, and particularly as the leader of an expedition for ascending Mount Kilimanjaro, has attempted in it to give a realistic sketch of life in the western Soudan. The story is the outcome of some of his own experiences, and is especially based on what he has seen and heard when traveling in North Africa, in the Niger Delta, and on the Cross River. It does not describe any particular series of events as they actually occurred, but combines isolated incidents such as are not unknown in the country into a connected, consecutive

story—or, to use the words of the author, he has pieced together the accounts given him by negro slaves in the Barbary states and in western equatorial Africa. Some of the incidents have been actually witnessed by him during some one of his journeys. The persons and places named are of real existence, as are also the languages quoted. The story is illustrated by forty-seven full-page pictures, from original drawings by the author—true delineations of African life and scenery, most of which have been done in Africa from actuality. No concoctor of fiction could invent a more tragic story than this one of a real life which is still happening every day.

The eighth issue of the *Annual Index to Periodicals* (W. M. Griswold, Bangor, Maine) is brought down to July, 1889. It contains the lists of titles of articles and authors, in the notation peculiar to Mr. Griswold's indexes, for twenty-five American and foreign periodicals.

Under the title of *The Two Great Retreats of History*, Ginn & Co. publish in a single volume, where they can be read comparatively, Grote's account of the Retreat of the Ten Thousand Greeks, taken from his history of Greece entire, except for a few verbal changes; and an abridgment of Count Ségur's narrative of Napoleon's retreat from Russia. The book is designed for school use, and is furnished with maps, an introduction to each section, and explanatory notes by "D. H. M."

The *Popular History of California*, by *Lucia Norman*, is published by the Bancroft Company, San Francisco, in a revised and enlarged second edition. The first edition, published in 1873, was well received. The "enlargements" bring the story down to the present time. The history of this State presents a considerable variety of incident. It includes periods of discovery and of colonization by the Spaniards; of the prominence of the missions; of the Mexican War and the conquest of the country by the United States; of the discovery of gold and the gold-hunting excitement; of filibustering and vigilance committees; and of agricultural and horticultural development, in which, rather than in gold, California seems destined to find the true source of its wealth.

Three language-studies of different character, each having its peculiar value, are published by Ginn & Co. The *Practical Latin Composition* of Mr. *William C. Collar* sets forth a method of teaching which has been satisfactorily tried by the author after breaking with the traditional method, and which rests on the principle that the exercise should be based upon the very words of some Latin author. These words furnish him a living model, in which he must find all his material—order, words, idioms, and constructions—and in which he must observe all the points wherein the structure varies from that of his own tongue. He is expected to familiarize himself first with the Latin passage and the details and peculiarities of its construction, and then to execute his exercise, reproducing the words and constructions, but with many changes of form, and in altered combinations; and to refer to the original only for correction and verification.

Next in the group is the *Pages choisis des Mémoires du Duc de Saint-Simon*, in preparing which Mr. *A. N. Van Daell* has been actuated by the belief that the study of a foreign language ought to bring students in contact with the master-minds of foreign nations. Too few of such works are accessible to ordinary students. Among the desirable ones is that of Saint-Simon, which "is one of the landmarks of French literature. "The selection of such a book as this for class use presupposes a certain degree of maturity on the part of the student. The editor has taken no other liberties with the text than to omit, "as the occasion required," unsuitable expressions or sentences. Notes—all in French—are furnished, explaining difficult expressions and making various points more clear.

The third of Ginn & Co.'s linguistic publications is the translation of the Anglo-Saxon poems, *Elene*, *Judith*, *Athelstan*, and *Byrhtnoth*, by *James M. Garnett*. The translations were made in the course of class work, are critical, and are based on carefully revised editions. "Elene" relates to the search for the true cross by the Empress Helena; "Judith" is a version of the Hebrew legend; and "Athelstan" and "Byrhtnoth" relate to battles in Anglo-Saxon history.

In *Oceania; Linguistic and Anthropological* (Melbourne and London), the Rev. D.

MacDonald, missionary at Havannah Harbor, New Hebrides, presents a study of Polynesian languages and mythology. Though such studies must be for the present chiefly tentative, it is hardly possible to speak too highly of their value as aids in the investigation of the origins and migrations of the human races. The author of this study makes a critical and comparative analysis of a number of Oceanic dialects, and deduces the conclusion, from certain identities among them, that they all sprang from one inflectional mother-tongue, and this was a branch of the Shemitic family.

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POPULAR MISCELLANY.

The Function of a University.—President D. S. Jordan has a warning in one of his recent papers against attaching too much significance to numbers in estimating the usefulness of a university. The kind of work that students are doing is the really important consideration. One student in quaternions, or in Germanic philology, or trained to carry a scientific investigation to an end, is worth more than a dozen in trigonometry, or stumbling over the elements in Whitney's Grammar, or learning to analyze flowers or identify the muscles of a cat. Great numbers may mean crowded class-rooms, overworked professors, and drudgery, instead of investigation, and the university a huge machine for lower education rather than a center for the discovery and dissemination of truth. "The highest function of the real university is that of instruction by investigation."

Death of the Rev. M. J. Berkeley.—The Rev. M. J. Berkeley, the distinguished English botanist, died July 30th, at Sibbertoft, near Market Harborough, in his eighty-seventh year. While his knowledge was very general, he was most eminent in cryptogamic botany, and particularly in the province of the fungi, in which he was a leading authority. He was born near Oundle in 1803. Having been graduated from Christ's College, Cambridge, he took orders as a clergyman, and occupied curacies in various places, adding to his income at times by taking pupils, and pursuing during his whole life the scientific researches that have given him fame. His earliest work was among the mollusca, but he soon turned his attention to botany, particularly to the study and classification of the cryptogams. Among his earlier researches were those into the nature of yeast and the vine mildew, the latter resulting in the discovery of the sulphur remedy. His descriptions of the British fungi in Dr. Hooker's "British Flora," published in 1836, constituted for more than twenty-five years the only text-book on the subject possessing any degree of completeness. The portions of Lindley's "Vegetable Kingdom" relating to fungi are also mainly Mr. Berkeley's work, and much of the matter relating to other orders of cryptogams was contributed by him. A more important and comprehensive work was his "Introduction to Cryptogamic Botany," published in 1857. He was associated with Lindley from an early period in the preparation of articles for the "Journal" of the Royal Horticultural Society relating to the influence of parasitical plants on growing crops and the application of vegetable physiology to purposes of cultivation. He was a valued contributor and kind of advisory editor to the "Gardener's Chronicle" from its establishment in 1841 to within a few years of his death; and in it he published a series of articles on vegetable pathology, which have not been collected. His researches on the potato disease made clear that it was caused by a fungus. Travelers became accustomed to submit to him for examination the fungi collected by them, and until within a year or two of his death he continued to publish descriptions of plants of this class from all parts of the world. He is credited by the "Athenæum" with having been among the first to recognize the necessity of studying the whole life-history of the plants before pronouncing a definite opinion as to their place in a natural scheme of classification; and to advocate and practice the culture of them for the observation of the transitions of their forms.

The Yellowstone Park Country.—According to Mr. Arnold Hague, geologist, the country across the Yellowstone Park plateau and the Absaroka Range presents a continuous mountain mass seventy-five miles in width, with an average elevation unsurpassed by any area of equal extent in the northern Rocky Mountains. It is exceptionally situated to collect the moisture-laden clouds which, coming from the southwest, precipitate immense quantities of snow and rain upon the cool table-land and neighboring mountains. The climate, in many respects, is quite unlike that of the adjacent country, the amount of snow and rainfall being higher, and the mean annual temperature lower. Rain-storms occur frequently throughout the summer, while snow is likely to fall at any time between September and May. Protected by the forests, the deep snows of winter lie upon the plateau well

into midsummer, while at still greater altitudes, in sheltered places, it remains throughout the year. By its topographical structure the park is designed by nature as a reservoir for receiving, storing, and distributing an exceptional water-supply, unexcelled by any area near the head-waters of the great rivers. The continental divide, separating the waters of the Atlantic from those of the Pacific, crosses the plateau from southeast to northwest. On both sides of this divide lie several bodies of water, which form so marked a feature in the scenery of the plateau that the region has been designated the lake country of the park. Yellowstone Lake presents a superficial area of 139 square miles, and a shore-line of nearly 100 miles. The discharge at the outlet was found in September, 1886, to be 1,525 cubic feet per second, or about 35,000,000 imperial gallons per hour. Dr. William Hallock estimates, from measurements, that the amount of water running into the park and leaving it by the five main drainage channels would be equivalent to a stream five feet deep, one hundred and ninety feet wide, with a current of three miles per hour, and that over an area of four thousand square miles the minimum discharge was equal to one cubic foot per second per square mile. For the preservation and regulation of this water-supply, the forest, which covers the mountains, valleys, and table-lands, and everywhere borders upon the lake-shores, is of inestimable value. Of the present park area about eighty-four per cent is forest-clad, mostly with coniferous trees.

The Glacier of Mount Tacoma.—Relating, in the "School of Mines Quarterly," an excursion to the great glacier of Mount Tacoma, Mr. Baily Willis describes the glacier, when the party came upon it from the bed of Carbon River, as rising, like a wall of ice, from thirty to fifty feet, across the path, while the river tumbled in little cascades from a low cave in the center. The upper surface of the wall, all its sharp ends having been melted off, was covered with a layer of rock and earth. "I think," says the author, "there can be no better illustration of the advance of a glacier to the point where the melting at its face balances the downward progress, than this worn, shrunken extremity, pressed on as it is by a vast accumulation of ice in the basin between Tacoma and Crescent Mountain. It pushes no great terminal moraine before it. It meets with no obstruction save the narrowness of the cañon; but here in the shadow of the cliffs the air-currents from the west bid it halt." The Crescent Mountain glacial system is fed by slopes which descend ten thousand feet in five miles from the Liberty Cap, Tacoma's northern summit. "Much too steep for snow to lie on, except on the highest shoulders where it packs to a depth of several hundred feet, the upper third of this tremendous height is bare black rock, on which the avalanches shatter into clouds of eddying smoke. The lower four miles are covered with a sheet of flashing ice, which pushes downward over the uneven surface, here carrying huge gleaming pinnacles aloft, there flowing in graceful curves like a river's current. Its western portion comes onward to the cliffs of Crescent Mountain, nearly three thousand feet high, and turning from them sweeps down into the gorge of Carbon River; the eastern part extends a long tongue into a meadow brilliant with flowers, whence White River plunges into its unexplored cañon. This meadow is but one end of a green valley that nestles strangely in this region of perpetual frost and sterile rocks, bounded on three sides by ice and snow, and on the fourth by forbidding precipices."

Origin of New Forest Growths.—Observations on the "new growth" of trees that appears after forest fires have been described by Prof. W. J. Beal, of the Michigan Forestry Commission. The stubs of most deciduous trees sprout after a fire, and are capable of preserving their vitality for a very long time. Slender oaks, resembling young sprouts, may be found in the forests attached to clumped roots of "grubs" of various sizes, that will show that the present growth is the first, second, third, or fourth sprout that has apparently come in succession from the same foundation. Of three little oaks which were found still having the remains of the seedling acorns attached by the stems of the cotyledons, one was five years old. Others, some four inches high and less than an eighth of an inch in diameter, were shown by the remains of the bud-rings to be from

four to ten years old. "It is not difficult to find white oaks under eighteen inches high that are twenty or more years old, and then this may be the second, third, or fourth sprout that has followed in succession, so that it is not improbable that in some of the cases seen the parent root or grub was from sixty to one hundred years old; and the whole now not an inch in diameter anywhere above the ground. Then what shall we say of the age of some grubs that weigh from thirty to fifty pounds each?" Pines and hemlocks will not grow from stumps, but the seeds have a vitality corresponding to that of the deciduous "grubs." In the cone they may be preserved with hardly impaired integrity for five or six years; and cones of *Pinus Banksiana* have been seen, unopened and apparently perfect, that were ten or fifteen years old. "I feel confident," Prof. Beal says, "that, in an hour or two spent in a certain favorable place, I could fully satisfy any intelligent person, unless he be unusually stubborn, that it is an easy matter to prove that new forests spring from seeds or the stumps of the old, and that, when the second growth is in some respects unlike the first, the change is accounted for in a rational manner."

The Oyster-Garden of Arcachon.—The great oyster-garden at Arcachon, France, is a basin on the Bay of Biscay, connected with the Atlantic only by a very narrow opening, and is sixty-eight miles in circumference and protected from winds by the pine-clad heights that surround it. The waters are salt enough and yet not too strong, the bottom is of the gravelly sand favorable to oyster-breeding, and the rise and fall of the tide are such that the basin is completely covered at high tide and the beds are largely uncovered at low water. The oyster has always been an inhabitant of this spot. The stock had become nearly exhausted forty years ago, but has been recruited by individual enterprise under the encouragement of the Government. There are now 12,500 acres of oyster-beds in the basin. Several thousand men and women are employed to attend them, and the average annual sale of oysters by the principal firm is over 200,000,000. As the majority are not sold under two years old, and these only for relaying, it is computed that there are usually 500,000,000 oysters of various ages upon these beds. The beds having been artificially made, the whole process of oyster-breeding can be witnessed there. They are laid out in parks, each park embracing twenty or more beds, and between the parks, as between the sections of the beds, are water-ways for the passage of boats. The beds are made of sand and gravel, upon foundations of wooden piles, and raised above the level of the basin bottom, but not to such an extent as to expose them at other than low tides. A barrier of "switches" or nets protects the beds from fishes. Sets of earthenware tiles are arranged for the reception of the young oysters or "spat," coated with mortar, so that anything fixing itself to them may be scraped off easily. Sometimes each of these tiles will be covered by five hundred or six hundred young oysters. They develop rapidly, and in about a month take the form of real miniature oysters. Then they need more room, and are thinned by scraping, to be placed wider apart on other tiles, or to be transferred to their final beds, or to wire-bottomed trays.

A Navajo Tanner.—Dr. Shufeldt has succeeded in witnessing the complete process of tanning a buckskin by a Navajo Indian. He had difficulty in inducing the tanner to bring his work where it could all be performed before his eyes, because of a superstition that the hide must be removed on the spot where the animal is slain, or the hunter will lose his eye-sight before the next moon. The present hunter, however, perhaps tried to avoid this doom by beginning some of the preliminaries of his work before removing the animal. The skin was taken off with great dexterity in manipulation, and laid in a hole dug in the ground and filled with spring-water till the next morning. It was then taken out, washed, cleansed with a knife, and dipped in clean water. The tools for shaving off the hair were obtained from the animal itself, being parts of the bones of the fore-leg. The skull of the deer, which had been kept through the night in the ashes of a low camp-fire, was split, and the brains were taken out. They were then manipulated in a basin of tepid water for the removal of splinters of bone, and left to sim-

mer for an hour. When the water, not so hot but that the hand could be held comfortably in it, had become of a muddy color, the tanner took out the brains and rubbed them in the palms of his hands till they were dissolved into a pasty mass. The skin was hung upon a tree and wrung and twisted into a hard coil, and kept in that position for nearly an hour. It had then apparently shrunk to two thirds of its size, and had to be pulled into shape again. This done, it was spread out, hair side up, and thoroughly rubbed with the brain solution. The effect of this was to give it softness and pliancy. The skin, folded into a kind of ball, was wrapped in a buffalo-robe, and exposed for a few minutes to the sun, for the purpose, as the Indian said, of letting "the brains go well into him." It was then unwrapped and spread out to dry. On the next morning it had shrunken again to one third of its original size, was hard, appeared almost brittle, and was half-transparent. It was then soaked in cold or tepid water, washed and rinsed, wrung and "twisted and retwisted upon itself"; again stretched and manipulated into shape, pulled this way and pulled that, worked at the edges to get them limp and pliant, and at the ears and the skin of the legs. "But during all this time an interesting change was coming over it: the heat of an August sun was rapidly drying it, it was fast coming to be of a velvet-like softness throughout, and, attaining its original size, it was changing to a uniform pale clay-color. The hair side was smooth, while the inside was roughish. Indeed, in a few moments more it was buckskin." Then, with the aid of a wooden awl, the tanner stretched the skin of the neck transversely with great force, cut his mark on either side near the ear, and the fabric was finished and spread out for its final drying.

Architecture.—Discussing the question, What style of architecture should we follow? Mr. William Simpson observes that we should follow no style to copy it, or as the ultimate object to be reached, but may use any style with the intention of developing new forms from it. A new style, if we want one—and every people and every age should have its own—can not be evolved out of the inner consciousness of any man or any number of men, but is possible only by practical working. It can only be produced by a course of development requiring time, during which the requirements of the period and the building materials should be the dominating factors. This will produce the constructive forms by a natural process. Then follows the æsthetic or decorative function, in which the artist should be a designer and not a copier. Some style, however, should be taken from which to start. All previous styles have been developments from pre-existing ones. Such has been the condition in the past, and by accepting this we would not be ignoring the experience of what has taken place. The process of adaptation should be begun by weeding out all shams. Let all forms which are not suited to the present wants and conditions be rejected. The same should be done with all constructive forms that are not natural, or which would be bad building if produced with the material employed. No structural form should be added to a building which is not required, and with no other object than that of "architectural effect." This has been a prolific cause of shams. Such things as pinnacles, turrets, towers, and all sorts of useless excrescences have come into existence under this supposed necessity. All decoration which is founded on, or the representation of, previous constructive forms, should be rigidly avoided; and originality in design should be understood as the aim of all decorators.

A Problem in Human Character.—A very paradoxical character is described in the autobiography of Solom Maimon, "vagabond Talmudist," and one of the most learned men and sharpest casuists of the Hebrew race. He appears there, according to the summary of a reviewer of the work, as a "skeptical rabbi, a great Talmudist who despised the Talmud, an omnivorous reader of all such science as in the last century a Polish Jew could get hold of, a genuine idler in literature, who, although he could dash off a considerable spell of work in a short time, had no work in him, had no method in him, and always preferred slipshod effort to steady industry; a man whom want and misery had reduced into spasmodic fits of intemperance, which rather grew upon him toward the end." With all this

he spent a half-year of his life as a regular professional beggar — adopting apparently all the habits and feelings of a beggar. "None the less he was a man of remarkable acquirements, being a learned Talmudist, for those times at least a considerable mathematician, and having in middle life mastered Latin, German, French, and English, besides the various Eastern dialects of which his Hebrew knowledge was the foundation. He had evidently a very great turn for physics as well as for mathematics, and a wonderful capacity for the acquisition of languages without the slightest communication with those who could speak them, so that he knew a language fairly well of which he could not properly pronounce a single sentence." He so criticised Kant's greatest work as to excite the admiration of the author. In character "he was candid, grateful, generous, and full of kindly feelings. But he was conceited, irreverent, passionate, intolerant of the influence of others, and never really at ease among the class for which his knowledge fitted him. His study of the Talmud . . . thoroughly unfitted him for feeling the least respect for the element of authority in religion." The questions are suggested whether Maimon's vagabond tastes stimulated his intellectual restlessness, or his intellectual restlessness stimulated his vagabond tastes; whether he would have been as keen if he had been a home-stayer and steady worker, or whether it was his taste for wandering and his unsettled habits that really made his intelligence so bright. Much might be said on both sides of these questions; but the probability is, that Maimon would have been stronger and more useful, though, perhaps, less diversified and brilliant, if he had led a regular life.

An Anti-Lightning Cage.—Besides the orthodox or "gather-up-and-carry-away" system of protection against lightning there is another system suggested by Clerk Maxwell—the "bird-cage" or "meat-safe" principle. "In a banker's strong room," says Prof. Lodge, "you are absolutely safe. Even if it were struck, nothing could get at you. In a bird-cage, or in armor, you are moderately safe. . . . A sufficiently strong and closely meshed cage or netting all over a house will undoubtedly make all inside perfectly safe—only, if that is all the defense, you must not step outside, or touch the netting while outside, for fear of a shock. . . . An earth-connection is necessary as well." A wire netting all over the house, a good earth-connection at several points, and a plentiful supply of barbed wire stuck all over the roof, constitute an admirable system of defense. Points to the sky are recognized as correct; but there should be "more of them, any number of them, rows of them, like barbed wire—not necessarily at all prominent—along ridges and eaves. For a single point has not a very great discharging capacity; and, if you want to neutralize a thunder-cloud, three points are not so effective as three thousand. No need, however, for great spikes and ugly tridents, so painful to the architect. Let the lightning come to you, do not go to meet it. Protect all your ridges and pinnacles—not only the highest—and you will be far safer than if you built yourself a factory-chimney to support your conductor upon."

A Giant Earthworm.—An earthworm which, in some examples, reaches the length of six feet, is described by Prof. Baldwin Spencer, in the "Transactions of the Royal Society of Victoria," as existing in Gippsland, Australia. It is the *Megascolides australis*, one of a group peculiar to Australia, of which five species are known. When found at all it is somewhat abundant, and lives principally on the sloping sides of creeks. At times it is found beneath fallen logs, and may be turned out of the ground by the plow. The worm itself does not appear to leave a "casting" at the mouth of its burrow, but often lives in ground riddled by the holes of the land-crab, which forms a "casting." Hence, contradictory statements have been made about the worm's having a "casting." The presence of the worm underground may be recognized by a very distinct gurgling sound which is made by the animal retreating in its burrow when the ground is stamped upon by the foot. When once heard, this gurgling sound is unmistakable. By its rapid motion and its power of distending any part of its body at will, so as to make it fit very tightly in its hole, the worm contrives to make itself very hard to catch. It has a characteristic odor,

somewhat resembling that of creosote, which is very strong and unpleasant in the dead animal. The body, in decaying, passes into a fluid, which the natives of the district say is good for rheumatism. Fowls refuse to touch it, living or dead. When held in the hand the worm, in contracting its body, throws out jets of a milky fluid; and this fluid seems to be the substance which it uses for coating its burrows to make their walls moist and slippery. The worm moves in its burrow by swelling up one or the other end and pulling or pushing itself along from that. Outside of the burrow it does not attempt to get along. The burrows of the large worm measure from three quarters of an inch to an inch in diameter. In disused burrows are often found casts of the worms, and, more rarely, cocoons containing a single embryo. The cocoon is thin, and made of a leathery, tough material, with a very distinct stalk-like process at each end. It contains a milky fluid like that found in the body cavity of the worm.

Fishing in the Greek Islands.—Mr. J. Theodore Bent has been struck, in his visits among the islands of Greece, by the observation of many survivals of ancient ways in the customs of the people, and this very noticeably in the fishing. In fishing for "shell-fish," the fishermen use a long trident, with more prongs than Neptune's had, but otherwise like it, and which they call by the old name *καμαξ*. The fishermen of Hydra make bulwarks of netted osiers, like those which Ulysses made for his two-decked raft when he left Calypso's charmed island. The scaros is pursued in the way that Oppian sings of in his poem on fishing. Taking advantage of the affectionate character of the scaros and of the male's gallant devotion to the female, the fisherman fastens a female fish to his line. If the "bait" is dead, he imitates life by bobbing it up and down. The male scari rush up in shoals to rescue their female fellow, and are caught by a companion-fisher with a net. For tunny, nets are used having large openings and furnished with a thick string. A bay is chosen with a convenient promontory, from a post on which the nets are fastened, while the fishermen row out to a rock in the sea. Here they leave a man, and return to shore by a roundabout route, carrying a string with them by which they can pull in the net as soon as the man on the rock announces the arrival of the fish. The same method is described by Aristotle in his book on animals. If the market is overstocked with tunny, the fish are driven into a creek by throwing stones at them and the entrance is fastened up with brambles. The fishermen in Melos believe in an ogre called Vanis, a being with goat's feet and a human body—a satyr, in short—who dwells at the end of a promontory they have to pass in going out of their harbor. They always cast a bit of bread into the water as they go by, that Vanis may eat it and send them fish in return.

Studies at Wundt's Psychological Laboratory.—Wundt's psychological laboratory at Leipsic occupies four rooms in the university building. The number of students has gradually increased, and in 1887 was nineteen. The men work in groups, one acting as subject in the experiments, and another making observations. Wundt suggests subjects for research at the beginning of the semester, but he lets the students choose the direction in which they prefer to work, and encourages them to find independently problems and the methods of solving them. The experiments are classified by Dr. J. Mck. Cattell under four heads: 1. The Analysis and Measurement of Sensation. 2. The Duration of Mental Processes. 3. The Time Sense; and 4. Attention, Memory, and the Association of Ideas. Under the first head are included experiments in the least differences in weight, intensity, and tone of sound, illumination, and color that can be perceived —the whole being embraced under the term *psychophysics*. In the subjects under the second head, constituting psychometry— "the facts obtained when we learn how long it takes to perceive, to will, to remember, etc., are in themselves of the same interest to the psychologist, as the distances of the stars to the astronomer or atomic weights to the chemist"; they help in the analysis of complex mental phenomena, and in studying the nature of attention, volition, etc. Psychometrical experiment has brought perhaps the strongest testimony we have to the complete parallelism of physical and

mental phenomena; and "there is scarcely any doubt but that our determinations measure at once the rate of change in the brain and of change in consciousness." There is also a general interest in the study. "Time, like size, is relative. The time-sense, involving the time-relations of perceptions and our power of estimating intervals of time, is to a considerable extent a physiological fact due to inertia in the sense-organ. Stimuli must be separated by a certain interval of time in order that they may be recognized as distinct. The experiments under this head relate to the measurement of these intervals. The experiments in attention, memory, and the association of ideas are varied, and cover some matters included under the other heads. The highest degree of complexity and the lowest degree of intensity and interest which our consciousness can grasp; the number of things—lines, letters, etc.; the relative visibility of colors and legibility of letters of the alphabet; the intervals between maxima of intensity and sensation, or rhythm of sensation; the time it takes for an idea to suggest another; and many similar studies—are related to it.

Inebriate Asylums and their Work.—Dr. T. D. Crothers remarks, as a curious fact, that inebriety was recognized as a disease long before insanity was thought to be other than spiritual madness and a possession of the devil. The first inebriate asylum was opened at Binghamton, N. Y., under Dr. J. E. Turner, after eight years of effort. It was conducted with much success for a time, but went down in the hands of trustees. The Washingtonian Home of Boston, opened in 1857, is now treating about four hundred cases every year. The Kings County Home, of Brooklyn, was opened in 1867, and is crowded with patients. The Chicago Washington Home, opened in 1867, and the Franklin Home, Philadelphia, opened in 1872, are in successful operation. The first two institutions proceed on the theory of disease. The Chicago Home and the Philadelphia Home regard religion, education, and pledges as sufficient to restore the patients, and consider a short residence at the hospital better than long treatment. More than fifty hospitals for inebriates have been started in America, over thirty of which are in successful operation. The others have been changed into insane asylums, water-cures, etc. About twenty asylums for inebriates are open in England and Scotland. Others exist in Melbourne, New Zealand, Germany, and Switzerland, and new ones are projected in Norway, Sweden, and France. The value of the results of the asylum treatment has been estimated from the answers to letters of inquiry addressed to friends of patients several years after dismissal. Of one thousand patients at Binghamton, sixty-eight and a half per cent continued temperate after five years; of two thousand at the Boston Washingtonian Home, thirty-four per cent after from ten to eighteen years; of six hundred at the Kings County Home, thirty-four per cent after ten years. The most careful authorities in the United States are agreed that fully one third of all cases that come under treatment are permanently cured.

The Gnawers of the Selkirk Mountains.—The heaps of bowlders above the forest region in the Selkirk Mountains of British Columbia, says the Rev. W. S. Green, "form a refuge for a variety of mammals — the hoary marmot, measuring about three feet long, being the commonest and most useful from a commissariat point of view. This creature gives a loud, shrill whistle; so weird does it sound in these solitudes that it returns to one's ears as an inseparable memory of the Selkirk valleys. The serrellel is a strange beast; it too lives beneath the bowlder-heaps, and it has the most wonderful fancy for collecting flowers. One day, when we were ascending a glacier moraine, my cousin said to me, 'Some one has been here before.' I said, 'Impossible!' but was utterly puzzled by finding a bouquet of flowers plucked, with their stems lying neatly together, just as though some child had laid them down. Soon afterward we found similar bouquets at the burrows of these animals. What their particular object in collecting flowers is, it is difficult to understand; making hay for winter use I have seen suggested. Mountain rats, chipmunks, little chief hares, and other creatures are also common in these regions, rendering *caches* of provisions useless, unless tinned meats alone are hidden. My Alpine rope was nibbled into little bits in one night, and on

another occasion some beast gnawed a hole through the tent while we were asleep, and ate the bread which I was using for a pillow. A skin I hung up to dry on the tent-rope vanished, and the scampering of little feet up and down the outside of the tent commenced every night the moment we retired to rest."

A Country of Salt.—Everything in the country of the river Chaï, in Central Asia, is described by Gabriel Bouvalot as covered with salt. It is seen in the walls of the houses and on the banks of the rivers, and the water one drinks is very salt. Traveling saltpeter-makers go in summer from place to place wherever they can find materials to work upon. Their mode of operation is a rough-and-ready one. Holes in the earth serve as vats and boilers, and below these are placed ovens. Abundance of brushwood supplies material for the fires. The workers collect from the surface of the earth heaps of a compost of salt and animal manure. This is soaked for twenty-four hours in water, then filtered, and then boiled for twenty-four hours, cleansed, and placed in the sun, so that the water may evaporate. An ordinary workman can make about fifty pounds in a day, and this he sells at the rate of a penny a pound. The workers appear quite contented with their lot, and the industry is preserved in their families for generations.

NOTES.

SEVERAL "effigy mounds" in the Rock River Valley, Ill., have been described by T. H. Lewis. The "Rockford Turtle" is 184½ feet long and from three to five and a half feet high, and stands in the midst of the best part of Rockford. It is associated with a bird-mound, seven round mounds, and two embankments. An animal mound in Jo Daviess County is 216 feet long, with an average height of five and a half feet, has its fore-feet resting on an embankment, and is associated with twenty-three other mounds and two embankments. A bird effigy on the east side of Rock River some five miles below Rockford, and an animal 116½ feet long at Freeport, are described. Few of the Illinois effigy mounds are in good preservation.

A MARKED difference is observed by Dr. George M. Dawson, of the Geological Survey of Canada, as between the maritime Indians of the coast and the Indian tribes of southern British Columbia. While it is largely one of habit and mode of life, it is also almost everywhere coincident with radical differences in language. The natural tendency to diversity as between coast-inhabiting fishermen and roaming hunters is intensified and perpetuated by the barrier of the Coast Range. The diversity breaks down to some extent only on certain routes of trade between the coast and the interior.

THE distinction of the Legion of Honor has been conferred upon Prof. C. V. Riley by the French Government. The Minister of Agriculture, writing to Prof. Riley on the subject, said that in awarding the honor the Government had sought to reward the important services which he had rendered to agriculture generally of all countries, and particularly to France, by his labors and discoveries.

A CASE of poisoning by mackerel was recently established at a coroner's inquest in London. The deceased, who had eaten a part of the fish adjacent to the head, was attacked with gastritis and pneumonia, became delirious, and died; while his wife, who ate another part of the fish, suffered no inconvenience. The gills of the mackerel appearing to have undergone fermentation, the victim's illness was ascribed to his having eaten decomposed fish. Cases of this kind, which used to be regarded as unaccountable, are now considered due to the presence of ptomaines developed by decomposition.

A PECULIAR tendency in idiots to imperfections and disease in the teeth has been noticed by several physicians; and it has been studied by Madame Sollier in a hundred cases of idiots taken at random. The multiplicity and variety of the dental lesions were remarkable; and the conclusion has been drawn that idiocy, with or without epilepsy, predisposes to arrests of development and to anomalies of dentition. The effect rarely appears in the first teeth, however, but almost wholly in the second.

MR. CARRUTHERS, President of the Linnæan Society, has found that seven original and authentic portraits of Linnæus are in existence. The most widely known engravings are from the originals by Inlander and Roslin; and these give the most faithful representations of the features of the great naturalist.

AN instantaneous photographic apparatus is proposed to take the place of the judge at the winning-post in race-courses. Its value is seen in very close races, when the judges can not decide accurately, and in what are called "dead heats," when two or three horses appear to reach the winning-post at exactly the same time. The photograph will show one of the horses to be an inch or so ahead, and decide in his favor.

WORKS have been erected in London by Mr. William Webster for experiment upon an electrical treatment of sewage that has been devised by him. Electricity is to be applied directly, to resolve the matter into its chemical elements and secure a precipitation in the form of sludge.

A LARGE exhibition of prehistoric objects, representing public and private collections in Austria, is to be given in connection with the next Congress of German Anthropological Societies, which is to meet this year in Vienna.

THE oldest man in Great Britain is Hugh McLeod, crofter, of Ross-shire, Scotland, who was born in 1783, and is consequently in his one hundred and seventh year. He is still straight and good for a full day of wakefulness, and cuts his own peat and carries home his daily load of eighty-four pounds. He eats porridge and milk, potatoes, fish, and mutton when he can get it, has cultivated a fondness for tea, and is "very heavy" in chewing "thin twist." His father was a weaver, and he has been a carpenter and joiner. There are three other centenarians in the same parish.

MR. GOSCHEN has traced a connection between the use of the cigarette after dinner and a decline in the consumption of wine at table. The friends of the cigarette claim that it is convenient, is adapted to various kinds of employments, is cheap as compared with good cigars, and makes less demand than a pipe upon the manly powers. Its opponents hold that it is adulterated with deleterious ingredients which provoke the head and throat, and stimulate the desire to drink; that it blunts the delicacy of the taste and encourages promiscuous drinking; and that it leads to the spending of much money—all in addition to the harm there may be in smoking at all.

THE Kina Balu, or "Chinese Widow," the great mountain of Borneo, rises thirteen thousand seven hundred feet from a low undulating country, at about twenty-five miles from the west coast of the island, and is regarded with a kind of religious awe by the natives. Its slopes abound with pitcher-plants and *Nepenthes* generally. It has been partially ascended by the travelers Lobb, Low, and St. John; and its real summit was reached, according to Mr. R. T. Pritchett, last year by Mr. Whitehead. This traveler has spent several years of hard work in exploring, and has brought back many before unknown varieties of birds.

FIVE cases of ruptured tympanum, described by Dr. W. R. H. Stewart, admonish us to be careful how we treat the ear. One was of a boy whose ear had been boxed by his teacher; another, of a woman who had received a blow in a scuffle with her husband; a third, of a man sixty years old, who had suffered from deafness and an offensive discharge ever since having been struck when a boy. In the fourth case, a laborer had been made deaf and partly lost the sense of taste in consequence of a blow on the side of the head. The last case was that of a woman who had accidentally perforated her tympanum while picking her ear with a hairpin. Pains and deafness were common to all these cases. All were improved, and most of them were cured, by treatment.

SYMPTOMS of poisoning were recently developed in the case of some persons in Berne, Switzerland, who had eaten of the mushroom *Morchella esculenta*. On investigation a highly poisonous substance was found in the sample—identical with that which had been eaten—resembling the ptomaines, and like them, probably, a result of partial decomposition. The warning is against stale fungi.

ARSENIC has been detected in a sample of matches obtained in Jena, Germany, which are characterized by the heads having a black covering with a metallic luster, and containing much lead, partly present as red lead. The quantity of arsenic was so small as to be detected only by the most delicate tests.

OBITUARY NOTES.

DR. C. JESSEN, naturalist, formerly professor at Greifswald, and more recently at Berlin, has lately died, in his sixty-ninth year.

PROF. ELIAS LOOMIS, LL. D., of the Munson chair of Natural Philosophy and Astronomy in Yale University, died August 15th, in his seventy-ninth year. He was graduated from Yale College in 1830, and three years later became a tutor there. He and Prof. A. C. Twining, of West Point, together began the first observations made in this country to determine the altitude of shooting-stars. In 1835 he discovered Halley's comet on its return by means of his own computations of the elements of its orbit. He was the author of text-books covering the whole range of mathematical subjects; of popular treatises on natural philosophy, astronomy, and meteorology; and of many contributions to scientific journals.

DR. JOHN PERCY, a distinguished English metallurgist, died June 20th, aged about seventy-two years. He was appointed Professor of Metallurgy in the School of Mines in 1851, and held the office till 1879. He began his great work on metallurgy in 1861, and continued it in 1864, 1870, and 1880. He received the Bessemer medal of the Iron and Steel Institute for his researches in metallurgy, particularly in iron and steel, in 1877. He was elected a Fellow of the Royal Society in 1847, and President of the Iron and Steel Institute in 1886. He was also distinguished for labors in practical ventilation.

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