Beacon Lights of History, Volume 14 eBook

Beacon Lights of History, Volume 14 by John Lord

BOOKRAGS

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RICHARD WAGNER: MODERN MUSIC.

BY HENRY T. FINCK.

If the Dresden schoolboys who attended the *Kreuzschule* in the years 1823-1827 could have been told that one of them was destined to be the greatest opera composer of all times, and to influence the musicians of all countries throughout the second half of the nineteenth century, they would, no doubt, have been very much surprised. Nor is it likely that they could have guessed which of them was the chosen one. For Richard Wagner—or Richard Geyer, as he was then called, after his stepfather—was by no means a youthful prodigy, like Mozart or Liszt. It is related that Beethoven shed tears of displeasure over his first music lessons; nevertheless, it was obvious from the beginning that he had a special gift for music. Richard Wagner, on the other hand, apparently had none. When he was eight years old his stepfather, shortly before his death, heard him play on the piano two pieces from one of Weber's operas, which made him wonder if Richard might "perhaps" have talent for music. His piano teacher did not believe even in that "perhaps," but told him bluntly he would "never amount to anything" as a musician.

For poetry, however, young Richard had a decided inclination in his school years; and this was significant, inasmuch as it afterwards became his cardinal maxim that in an opera "the play's the thing," and the music merely a means of intensifying the emotional expression. Before his time the music, or rather the singing of florid tunes, had been "the thing," and the libretto merely a peg to hang these tunes on. In this respect, therefore, the child was father to the man. At the age of eleven he received a prize for the best poem on the death of a schoolmate. At thirteen he translated the first twelve books of Homer's Odyssey. He studied English for the sole purpose of being able to read Shakspeare. Then he projected a stupendous tragedy, in the course of which he killed off forty-two persons, many of whom had to be brought back as ghosts to enable him to finish the play.

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This extravagance also characterized his first efforts as a composer, when he at last turned to music, at the age of sixteen. One of his first tasks, when he had barely mastered the rudiments of composition, was to write an overture which he intended to be more complicated than Beethoven's Ninth Symphony. Heinrich Dorn, who recognized his talent amid all the bombast, conducted this piece at a concert. At the rehearsal the musicians were convulsed with laughter, and at the performance the audience was at first surprised and then disgusted at the persistence of the drum-player, who made himself heard loudly every fourth bar. Finally there was a general outburst of hilarity which taught the young man a needed lesson.

Undoubtedly the germs of his musical genius had been in Wagner's brain in his childhood,—for genius is not a thing that can be acquired. They had simply lain dormant, and it required a special influence to develop them. This influence was supplied by Weber and his operas. In 1815, two years after Wagner's birth, the King of Saxony founded a German opera in Dresden, where theretofore Italian opera had ruled alone. Weber was chosen as conductor, and thus it happened that Wagner's earliest and deepest impressions came from the composer of the "Freischuetz." In his autobiographic sketch Wagner writes: "Nothing gave me so much pleasure as the 'Freischuetz.' I often saw Weber pass by our house when he came from rehearsals. I always looked upon him with a holy awe." It was lucky for young Richard that his stepfather, Geyer, besides being a portrait-painter, an actor, and a playwright, was also one of Weber's tenors at the opera. This enabled the boy, in spite of the family's poverty, to hear many of the performances. In fact, Wagner, like Weber, owes a considerable part of his success as a writer for the stage to the fact that he belonged to a theatrical family, and thus gradually learned "how the wheels go round." Such practical experience is worth more than years of academic study.

While Wagner cordially acknowledged the fascination which Weber's music exerted on him in his boyhood, he was hardly fair to Weber in his later writings. In these he tries to prove that his own music-dramas are an outgrowth of Beethoven's Ninth Symphony. When Beethoven wrote that work, Wagner argues, he had come to the conclusion that purely instrumental music had reached a point beyond which it could not go alone, wherefore he called in the aid of poetry (sung by soloists and chorus), and thus intimated that the art-work of the future was the musical drama,—a combination of poetry and music.

This is a purely fantastic notion on Wagner's part. There is no evidence that Beethoven had any such purpose; he merely called in the aid of the human voice to secure variety of sound and expression. Poetry and music had been combined centuries before Beethoven in the opera and in lyric song.

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No, the roots of Wagner's music-dramas are not to be found in Beethoven, but in Weber. His "Freischuetz" and "Euryanthe" are the prototypes of Wagner's operas. The "Freischuetz" is the first masterwork, as Wagner's operas are the last, up to date, of the romantic school; and it embodies admirably two of the principal characteristics of that school: one, a delight in the demoniac, the supernatural—what the Germans call *gruseln*; the other, the use of certain instruments, alone or in combination, for the sake of securing peculiar emotional effects. In both these respects Wagner followed in Weber's footsteps. With the exception of "Rienzi" and "Die Meistersinger," all of his operas, from the "Flying Dutchman" to "Parsifal," embody supernatural, mythical, romantic elements; and in the use of novel tone colors for special emotional effects he opened a new wonder-world of sound, to which Weber, however, had given him the key.

"Lohengrin," the last one of what are usually called Wagner's "operas," as distinguished from his "music-dramas" (comprising the last seven of his works), betrays very strongly the influence of Weber's other masterwork, "Euryanthe." This opera, indeed, may also be called the direct precursor of Wagner's music-dramas. It contains eight "leading motives," which recur thirty times in course of the opera; and the dramatic recitatives are sometimes quite in the "Wagnerian" manner. But the most remarkable thing is that Weber uses language which practically sums up Wagner's idea of the music-drama. "'Euryanthe,'" he says, "is a purely dramatic work, which depends for its success solely on the co-operation of the united sister-arts, and is certain to lose its effect if deprived of their assistance."

When Wagner wrote his essay on "The Music of the Future" for the Parisians (1860) he remembered his obligations to the Dresden idol of his boyhood by calling attention to "the still very noticeable connection" of his early work, "Tannhaeuser," with "the operas of my predecessors, among whom I name especially Weber," He might have mentioned others,—Gluck, for instance, who curbed the vanity of the singers, and taught them that they were not "the whole show;" Marschner, whose grewsome "Hans Heiling" Wagner had in mind when he wrote his "Flying Dutchman;" Auber, whose "Masaniello," with its dumb heroine, taught Wagner the importance and expressiveness of pantomimic music, of which there are such eloquent examples in all his operas. During his three and a half years' sojourn in Paris, just at the opening of his career as an opera composer (1839-1842), he learned many things regarding operatic scenery, machinery, processions, and details, which he subsequently turned to good account. Even Meyerbeer, the ruler of the musical world in Paris at that time, was not without influence on him, though he had cause to disapprove of him because of his submission to the demands of the fashionable taste of the day, which contrasted so strongly with Wagner's own courageous defiance of everything inconsistent with his ideals of art. The result to-day—Meyerbeer's fall and Wagner's triumph—shows that courage, like honesty, is, in the long run, the best policy, and, like virtue, its own reward.

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It is important to bear in mind all these lessons that Wagner learned from his predecessors, as it helps to explain the enormous influence he exerted on his contemporaries. Wonderful as was the power and originality of his genius, even he could not have achieved such results had he not had truth on his side,—truth, as hinted at, in moments of inspiration, by many of his predecessors.

Wagner was most shamefully misrepresented by his enemies during his lifetime. A thousand times they wrote unblushingly that he despised and abused the great masters, whereas in truth no one ever spoke of them more enthusiastically than he, or was more eager to learn of them, though, to be sure, he was honest and courageous enough also to call attention to their shortcomings. In all his autobiographic writings there is not a more luminous passage than the following, in which he relates his experiences as conductor at the Riga Opera in 1838, when he was at work on “Rienzi":—

“The peculiar gnawing melancholy which habitually overpowered me when I conducted one of our ordinary operas was interrupted by an inexpressible, enthusiastic delight, when, here and there, during the performance of nobler works, I became conscious of the incomparable effects that can be produced by musico-dramatic combinations on the stage,—effects of a depth, sincerity, and direct realistic vivacity, such as no other art can produce. I felt quite elated and ennobled during the time that I was rehearsing Mehul’s enchanting ‘Joseph’ with my little opera company.” “Such impressions,” he continues, “like flashes of lightning” revealed to him “unsuspected possibilities.” It was by utilizing these “possibilities” and hints, and at the same time avoiding the errors and blemishes of his predecessors, that his superlative genius was enabled to create such unapproachable masterworks as “Siegfried” and “Tristan and Isolde.”

The way up to those peaks was, however, slow and toilsome. For years he groped in darkness, and light came but gradually. It has already been intimated that his genius was slow in developing. A brief review of his romantic career will bring out this and other interesting points.

At the time when Richard Wagner was born (May 22, 1813), Leipzig was in such a state of commotion on account of the war to liberate Germany from the Napoleonic yoke that the child’s baptism was deferred several months. To his schooldays reference has been made already, and we may therefore pass on to the time when he tried to make his living as an operatic conductor. Although he was then only twenty-one years old, he showed remarkable aptitude for this kind of work from the beginning, and it was through no fault of his that misfortune overtook every opera company with which he had anything to do. The bankruptcy, in 1836, of the manager of the Magdeburg Opera, affected him most disastrously, for it came at the moment when he had arranged for the first performance of an opera

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he had written, entitled, “Das Liebesverbot,” or “The Novice of Palermo,” and which therefore was given only once. Many years later an attempt was made to revive this juvenile work at Munich, but the project was abandoned because, as the famous Wagnerian tenor, Heinrich Vogl, informed the writer of this article, “Its arias and other numbers were such ludicrous and undisguised imitations of Donizetti and other popular composers of that time that we all burst out laughing, and kept up the merriment throughout the rehearsal.” This is of interest because it shows that Wagner, like that other great reformer, Gluck, began his career by writing fashionable operas in the Italian style. A still earlier opera of his, “The Fairies,”—the first one he completed,—was not produced till 1888, fifty-five years after it had been written, and five years after Wagner’s death. This has been performed a number of times in Munich, but it is so weak and uninteresting in itself that it required a splendid stage setting, and the “historic” curiosity of Wagner’s admirers to make it palatable. It is significant that already in these early works, Wagner wrote his own librettos,—a policy which he pursued to the end.

Koenigsberg was the next city where the opera company with which he was connected, failed. This was the more embarrassing to him, as he had in the meantime been so unwise as to marry a pretty actress, Minna Planer, who was destined, for a quarter of a century, to faithfully share his experiences,—chiefly disappointments. The pittance he got as conductor of these small German opera companies did not pay his expenses, all the less as he was fond of luxurious living, and, like most artists, the world over, foolishly squandered his money when he happened to have any.

At Riga, where Wagner next attempted to establish himself, the opera company again got into trouble, and his financial straits became such that, relying on his future ability to meet his obligations, he resolved to leave that part of the world altogether and seek his fortune in Paris. He knew that the Prussian Meyerbeer had won fame and fortune there,—why should not he have the same good luck? He had unbounded confidence in his own ability, and what increased his hopes of a Parisian success, was that he had already completed two acts of a grand historic opera, “Rienzi,” based on Bulwer’s novel, and written in the sensational and spectacular style of Meyerbeer. He supposed that all he had to do was to go to Paris, finish this opera, get it accepted through the influence of his countryman and colleague, Meyerbeer, and—wake up some morning famous and wealthy. He was not the first man who built castles in Spain.

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To-day a trip from Riga to Paris is a very simple affair. You get into a train, and in about twenty-four hours are at your goal. In 1839 there were no such conveniences. Wagner had to go to the Prussian seaport of Pillau, and there board a sailing vessel which took him to London in three weeks and a half. His journey, however, was a much more romantic affair than a railway trip would have been. In the first place, it was a real flight—from his creditors whom he had to evade. Next he had to dodge the Russian sentries, whose boxes were placed on the boundary line only a thousand yards apart. A friend discovered a way of accomplishing this feat, and Wagner presently found himself on the ship, with his wife and his enormous Newfoundland dog. In his trunk he had what he hoped would help him to begin a brilliant career in Paris: one opera completed,—"The Novice of Palermo;" two acts of another,—"Rienzi;" and in his head he had the plot and some of the musical themes for a third,—"The Flying Dutchman."

The sea voyage came just in time to give him local color for this weird nautical opera. Three times the vessel was tossed by violent storms, and once the captain was obliged to seek safety in a Norwegian harbor. The sailors told Wagner their version of the "Flying Dutchman" legend, and altogether these adventures were the very thing he wanted at the time, and aided him in making his opera realistic, both in its text and its music, which imitates the howling of the storm winds and "smells of the salt breezes."

So for once our young musician had a streak of luck. But it did not last long. He found Paris a very large city, and with very little use for him. He made the most diverse efforts to support himself, nearly always without success. Once it seemed as if his hopes were to be fulfilled. The Theatre de la Renaissance accepted his "Novice of Palermo;" but at the last moment there was the usual bankruptcy of the management,—the fourth that affected him! Then he wrote a Parisian Vaudeville, but it had to be given up because the actors declared it could not be executed. The Grand Opera, on which he had fixed his eye, was absolutely out of the question. He was brought to such straits that he offered to sing in the chorus of a small Boulevard theatre, but was rejected. His wife pawned her jewels; on several occasions it is said that she even went into the street to beg a few pennies for their supper. It was doubtless during these years of starvation that Wagner acquired those gastric troubles which in later years often prevented him from working more than an hour or two a day.

A few German friends occasionally gave a little pecuniary aid, but the only regular source of income was musical hackwork for the publisher Schlesinger, who gladly availed himself of Wagner's skill in having him make vocal scores of operas, or arrange popular melodies for the piano and other instruments. Wagner also wrote stories and essays for musical periodicals, for which he received fair remuneration; but his attempt to compose romances and become a parlor favorite failed. Nobody wanted his songs, and he finally offered them to the editor of a periodical in Germany for two dollars and a half to four dollars apiece. This may seem ludicrously pathetic; but then had not poor Schubert, a little more than a decade before this, sold much better songs for twenty cents each!

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Meyerbeer no doubt aided Wagner, but considering his very great influence in Paris, he achieved surprisingly little for him. The score of “Rienzi” had been completed in 1840, and in the spring of the next year, Wagner went to Meudon, near Paris, and there composed the music of “The Flying Dutchman,” in seven weeks, but neither of these operas seemed to have the least chance to appear on the boards of the Grand Opera. The best their author could do was to sell the libretto of “The Flying Dutchman” for one hundred dollars, reserving the right to set it to music himself.

The outcome of all these disappointments was that he finally lost hope so far as Paris was concerned, and sent his “Rienzi” to Dresden and his “Flying Dutchman” to Berlin. The “Novice of Palermo” he had given up entirely after the bankruptcy of the Renaissance Theatre, because, as he wrote, “I felt that I could no longer respect myself as its composer.” Meyerbeer had, at his request, kindly sent a note to the intendant of the Dresden Opera, in which he said, among other things, that he had found the selections from “Rienzi,” which Wagner had played for him, “highly imaginative and of great dramatic effect.” Tichatschek, the famous Dresden tenor, examined the score, and liked the title role; the chorus director, Fischer, also pleaded for the acceptance of the opera; and so at last Wagner got word in Paris that it would be produced in Dresden. As Berlin, too, retained the manuscript of his other opera, there was reason enough for him to end his Parisian sojourn and return to his native country. He went overland this time, and, to cite his own words, “For the first time I saw the Rhine; with tears in my eyes I, the poor artist, swore eternal allegiance to my German fatherland.”

It was fortunate in every way that he went to Dresden. His opera required many alterations and improvements, which he alone could make. He was permitted to superintend the rehearsals, which was, of course, a great advantage to the opera. The singers grew more and more enthusiastic over the music, and when the first public performance was given, on October 20, 1842, the audience also was delighted and remained to the very end, although the performance lasted six hours. The composer immediately applied the pruning-knife and reduced the duration to four hours and a half (from 6 to 10.30,—opera hours were early in those days); but the tenor, Tichatschek, declared with tears in his eyes, “I shall not permit any cuts in my part! It is too heavenly.”

Those were proud and happy days for Wagner. “I, who had hitherto been lonely, deserted, homeless,” he wrote, “suddenly found myself loved, admired, by many even regarded with wonderment.” “Rienzi” was repeated a number of times to overcrowded houses, though the prices had been put up. It was regarded as “a fabulous success,” and the management was eager to follow it up with another. So the score of “The Flying Dutchman”

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was demanded of Berlin (where they seemed in no hurry to use it), and at once put into rehearsal. It was produced in Dresden on January 2, 1843, only about ten weeks after “Rienzi,”—an almost unprecedented event in the life of an opera composer. Wagner conducted the second opera himself (also “Rienzi,” after the first few performances), and gave so much satisfaction that he was shortly afterwards appointed to the position of royal conductor (which he held about six years).

So far, all seemed well. But disappointments soon began to overshadow his seeming good luck. The first production of the “Flying Dutchman” can hardly be called a success. Wagner himself characterized the performance as being, in its main features, “a complete failure,” and the stage setting “incredibly awkward and wooden” (very different from what it is in Dresden to-day). *Mme*. Schroeder-Devrient was an admirable “Senta,” and received enthusiastic applause; but the opera itself puzzled the audience rather than pleased it.

The music-lovers of Dresden had expected another opera *a la* Meyerbeer, like “Rienzi,” with its arias and duos, its din and its dances, its pomps and processions, its scenic and musical splendors. Instead of that, they heard a work utterly unlike any opera ever before written; an opera without arias, duets, and dances, without any of the glitter that had theretofore entertained the public; an opera that simply related a legend in one breath, as it were,—like a dramatic ballad; an opera that indulged in weird chromatic scales, and harsh but expressive harmonies, with an unprecedented license. Here was the real Wagner, but even in this early and comparatively crude and simple phase, Wagner was too novel and revolutionary to be appreciated by his contemporaries; hence it is not to be wondered at that the “Flying Dutchman,” after four performances in Dresden, and a few in Cassel and Berlin, disappeared from the stage for ten years.

Although Wagner was now royal conductor, he did not succeed in securing a revival of this opera at Dresden. His next work, “Tannhaeuser,” was nevertheless promptly accepted. The score was completed on April 13, 1845, and six, months later (October 19), the first performance was given. Wagner had thrown himself with all his soul into the composition of this score. To a friend in Berlin he wrote: “This opera must be good, or else I never shall be able to do anything worth while.” The public at first seemed to agree with him. Seven performances were given before the end of the season, and it was resumed the following year; yet Wagner came to the conclusion that he had written the opera “for a few intimate friends, but not for the public,” to cite his own words. What the public had expected and desired was shown by its enthusiastic reception of “Rienzi,” and its colder treatment of the “Dutchman.” But “Tannhaeuser” was like the second opera; in fact, even “more so.” Wagner had outlived the time when he was willing to make concessions to current taste and fashion; thenceforth he went his own way, eager, indeed, for approval, but stubbornly refusing to win it by sacrificing his high art ideals.

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Here was true heroism, genuine manliness! Had he been willing to write more operas like “Rienzi,” he might have revelled in wealth (he loved wealth!) and basked in the sunshine of popularity, like Meyerbeer. But not one inch of concession did he make for the sake of the much-coveted riches and popular favor.

Yet was not his next work, “Lohengrin,” of a popular character? Popular to-day, yes; but in the days of his Dresden conductorship he could not even get it accepted for performance at his own opera-house! It was completed in August, 1847 (the last act having been written first and the second last), but although he remained in Dresden two years longer, all his efforts to get it staged failed, for various reasons. And when, at last, Liszt gave it for the first time, on August 28, 1850, at Weimar, whence it gradually made its way to other opera-houses, its reception everywhere showed that it was very far from being considered a “popular” work. The critics, especially, vied with one another in abusing this same “Lohengrin,” which at present is sung more frequently than any other opera; and they continued to abuse it until about twenty years ago. “An abyss of ennui,” “void of all melody,” “an insult to the very essence of music,” “a caricature of music,” “algebraic harmonies,” “no tangible ideas,” “not a dozen bars of melody,” “an opera without music,” “an incoherent mass of rubbish,”—are a few of the “critical” opinions passed on this opera, which is now regarded in all countries as a very wonderland of beautiful melodies and expressive harmonies.

The non-acceptance in Dresden of this glorious opera, concerning which Wagner wrote, “It is the best thing I have done so far,” was only one of many trials and disappointments which daily harassed him. He was over head and ears in debt, because, in his confidence in the immediate success of his operas, he had had them printed at once, at his own expense. The opera-houses were very slow in accepting them, and this left him in a sad predicament. There were, moreover, enemies everywhere,—ignorant, old-fashioned professionals, who objected to his way of interpreting the masters (though it was afterwards admitted that he was epoch-making as an interpreter of their deepest thoughts). All this galled him; and, furthermore, no attention whatever was paid to his pet plans for reforming the Dresden Opera, and theatrical matters in general.

In the state of mind brought about by this condition of affairs, it needed but a firebrand to start an explosion. This firebrand was supplied by the revolutionary uprising of 1849. Now, although Wagner had never really cared much for politics (to his friend Fischer he once wrote: “I do not consider true art possible until politics cease to exist"), he was foolish enough to believe that a general overturning of affairs would benefit art-matters, too, and facilitate his operatic reforms; so he became, as he himself admits, “a revolutionist in behalf of the theatre.” He actively assisted the insurgents, and the consequence was that, when the rebellion failed, he had to leave Dresden and seek safety in flight.

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Three of the leaders of the insurrection—Roeckel, Bakunin, and Heubner; personal friends of Wagner—were captured and imprisoned; he himself was so lucky as to escape to Weimar, where Franz Liszt took care of him. It so happened that Liszt, who had given up his career as concert pianist (though all the world was clamoring to hear him), and was conducting the Weimar Opera, had been preparing a performance of “Tannhaeuser,” to which Wagner would, under normal conditions, have been invited as a matter of course. He was now there, but as a political fugitive, wherefore it was not deemed advisable to have him attend the public performance; but he did secretly witness a rehearsal, and was delighted to find that Liszt’s genius had enabled him to penetrate into the innermost recesses of this music. It was impossible, however, for him to stay any longer. The Dresden police had issued a warrant for the arrest of “the royal Kapellmeister Richard Wagner,” who was to be “placed on trial for active participation in the riots which have taken place here.” No time was, therefore, to be lost. Late in the evening of May 18, Liszt’s noble patroness, the Princess Wittgenstein, received this note from him: “Can you give the bearer sixty thalers? Wagner is obliged to fly, and I cannot help him at this moment.”

Early the next morning Wagner, provided with a false pass, left Weimar and headed for Switzerland, which was to be his home for the greater part of the following twelve years of his exile from Germany. Had he been caught, like his friends, and, like them, imprisoned during these years, it is not likely that the world would now possess those seven monuments of his ripest genius, “Rheingold,” “Die Walkuere,” “Siegfried,” “Goetterdaemmerung,” “Tristan and Isolde,” “Die Meistersinger,” and “Parsifal.” Even as it was, the world has undoubtedly lost an immortal opera or two through his unfortunate participation in the rebellion. For during the first four years of his exile, he did not compose any music. He reasoned that he had written four good operas and nobody seemed to want them; why, therefore, should he compose any more?

At the same time, he realized that there were natural reasons why his operas were not understood. They were written in such a novel style, both vocal and instrumental, that the singers, players, and conductors found it difficult to perform them correctly, the consequence being that they did not specially impress the audiences, which, moreover, were bewildered by finding themselves listening to works so radically different from what they had been accustomed to in the opera-houses. In the hope of remedying this state of affairs Wagner devoted several years to writing essays, in which he explained his aims and ideals for the benefit both of performers and listeners. Little attention was, however, paid to these essays, and although they are valuable aesthetic treatises, most lovers of Wagner would gladly give them for the operas he might have written in the same time,—operas uniting the characteristics of “Lohengrin” and “The Valkyrie.”

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Wagner's letters to Liszt and other friends show that he suffered tortures, and was often brought to the verge of suicide by the thought that, as a political refugee, he was unable to go to Germany to superintend the production of his works. His one consolation was that, as he put it, through the friendship of Liszt his art had found a home at Weimar at the moment when he himself became homeless. Weimar became, as it were, a sort of preliminary Bayreuth, to which pilgrimages were made to hear Wagner's operas. Liszt not only produced the "Flying Dutchman," "Tannhaeuser," and "Lohengrin," but wrote eloquent essays on them, and in every possible way advanced the good cause. It has been justly said that by his efforts he accelerated the vogue of Wagner's operas fully ten years. He also helped him pecuniarily, and induced others to do the same. Never in the world's history has one artist done so much for another as Liszt did for Wagner during all the years of his exile in Switzerland.

Few persons would consider residence in Switzerland (the usual home in those days of political refugees) a special hardship; nor would Wagner have considered it in that light except for the solicitude he felt for the children of his brain. Otherwise he greatly enjoyed life in that glorious country, and the Alpine ozone nourished and stimulated his brain. Moreover, from the creative point of view, it was an actual advantage for him to be away from the opera-houses of the great capitals. In Switzerland, except for a short time when he was connected with the Zurich opera, he heard no operatic music except such as his own brain created. Undoubtedly this helps to account for the astounding originality of the music-dramas he wrote in Switzerland.

These music-dramas go as far beyond "Lohengrin" in certain directions as "Lohengrin" goes beyond the operas of Wagner's predecessors. It was a reckless thing to do, to make another such giant stride before the world had caught up with his first, and he had to suffer the consequences; but genius disregards prudence, and looks to the future alone. What he was now writing was what his enemies tauntingly called "the music of the future," because, as they said, nobody liked it at present; but what he himself called the "art work of the future," in which all the fine arts are inseparably united.

The biggest of his works, the "Nibelung Tetralogy," was conceived and for the most part written in Switzerland. Before leaving Dresden he had already written the poem of an opera which he called "Siegfried's Death." Returning to this in his exile he came to the conclusion, gradually, that the legend on which it is based, and which he had sketched out in prose at the beginning, contained the material for two, three, nay, four operas. Accordingly, he wrote the poems of these: first, "Goetterdaemmerung," then "Siegfried," "Die Walkuere," and "Rheingold." The music to these four dramas was, however, composed in the reverse order, in which they were to be performed.

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Wagner indulged in no illusions regarding these music-dramas. He knew that they were beyond the capacity of even the best royal opera-houses of that time, and that they could be performed only under exceptional conditions, such as he finally succeeded, after herculean efforts and many disappointments, in securing at Bayreuth in 1876. It is of great interest to note that the germs of a sort of “Bayreuth festival plan” can be found in his letters as early as 1850,—the year when “Lohengrin” had its first hearing. Thus a full quarter of a century elapsed between the conception of this festival plan and its execution. But Wagner had the patience of Job, as well as his capacity for suffering.

Amid privations of all sorts, he wrote the sublime music of these dramas, beginning with “Rheingold,” on Nov. 1, 1853,—the first time he had put new operatic melodies on paper since the completion of “Lohengrin,” in August, 1847. In his head, to be sure, he had been carrying much of the Nibelung music for some time, for he habitually created his leading melodies at the same time as the verse; and the four Nibelung poems were in print in 1853. On May 28, 1854, the score of “Rheingold” was completed, and four weeks later he began the sketches of “The Valkyrie,” the completed score of which was in his desk by the end of March, 1856.

In the meantime his poverty had compelled him, much against his wishes, to accept an offer from the London Philharmonic Society to conduct their concerts for a season (March to June, 1855). He had reason to bitterly regret this action. With the limited number of rehearsals at his command it was impossible for him to make the orchestra follow his intentions and reveal his greatness as a conductor. He was not allowed to make the programmes, and the directors, ignorant of the fact that they had engaged the greatest musical genius of the century, gave no Wagner concert, and put only a few short selections from his early operas on the programs. Thus his hopes of creating a desire for the hearing of his complete operas, which had been one of his motives in going to London, were frustrated. He was, moreover, constantly abused for doing things differently from Mendelssohn, and the leading critics referred to his best music as “senseless discord,” “inflated display of extravagance and noise,” and so on. Almost the only pleasant episode was the sympathy and interest of Queen Victoria, who had a long talk with him, and informed him that his music had enraptured her.

For all this trouble and loss of time (he found himself unable in London to do any satisfactory work on the uncompleted “Valkyrie” score), he received the munificent sum of $1,000,—considerably less than many Wagner singers to-day get for one evening’s work. Shortly before leaving London he wrote to a friend that he would bring home about 200 francs,—$40! For this he had wasted four months of precious time and endured endless “contrarieties and vulgar animosities,” to use his own words.

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Equally unsuccessful were his efforts, a few years later, to better himself financially by a series of concerts in Paris (1860). They resulted in a large deficit. Nor was he benefited by the performances of his “Tannhaeuser,” which were given at the grand opera in March, 1861, by order of Napoleon, at the request of the influential Princess Metternich. He had refused to interpolate a vulgar ballet in the second act for the benefit of the members of the aristocratic Jockey Club, who dined late and insisted on having a ballet on entering the opera-house. They took their revenge by creating such a disturbance every evening that after the third performance Wagner refused to allow any further repetitions, although the house on the third night had been completely sold out. He was to receive $50 for each performance. The result was $150, or less than 50 cents a day, for a year’s hard work and no end of worry in connection with the rehearsals.

How many men are there in the annals of art who would have refused, after all these disappointments and bitter lessons, to make *some* concessions? Wagner was writing a gigantic work, the Nibelung Tetralogy, which, he was convinced, would never yield a penny’s profit during his lifetime. Sometimes despair seized him. In one of his letters he exclaims: “Why should I, poor devil, burden and torture myself with such terrible tasks, if the present generation refuses to let me have even a workshop?” Yet the only deviation he made from his plan was that when he had reached the second act of the third of the Nibelung dramas, the poetic “Siegfried,” in June, 1857, he made up his mind to abandon the Tetralogy for the time being, and compose an opera which might be performed separately and once more bring him into contact with the stage.

This opera was “Tristan and Isolde;” but instead of being a concession, it turned out to be the most difficult and Wagnerian of all his works,—an opera with much emotion but little action, no processions or choruses such as “Lohengrin” still had, and, of course, no arias or tunes whatever. “Tristan and Isolde” was completed in 1859, and Wagner would have much preferred to have its performance in Paris commanded by Napoleon in place of “Tannhaeuser.” What the Jockey Club would have done in that case is inconceivable, for, compared with “Tristan,” “Tannhaeuser” is almost Meyerbeerian, if not Donizettian. No singers, moreover, could have been found in Paris able to interpret this work, with its new vocal style,—“speech-song,” as the Germans call it. Even Germany could do nothing, at first, with this opera. In Vienna, after fifty-four rehearsals, it was abandoned, in 1863, as “impossible,” and that city did not produce it till after Wagner’s death. Instead of bringing him into immediate contact with the stage, it was not heard *anywhere* till seven years after its completion.

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There was one more card for him to play. All his operas, so far, had been tragedies. What if he were to write a comic opera? Would not that be likely to get him access to the stage again, and help him financially? He had the plan for a comic opera; indeed, he had sketched it as early as 1845, at the same time as the plot of “Lohengrin.” Sixteen years it lay dormant in his brain. At last he wrote out the poem in Paris, immediately after the “Tannhaeuser” disaster there. Perhaps it would be more accurate to call “Die Meistersinger” a humorous opera; for while the story of the mediaeval knight who wins the goldsmith’s daughter has comic features, its chief characteristic is humor, with that undercurrent of seriousness that belongs to all masterpieces of humor. To a certain extent, it is a musical and poetic autobiography, the victorious young Knight Walter, who sings as he pleases, without regard to pedantic rules, representing Wagner himself and the “music of the future,” while the vain and malicious Beckmesser stands for the critics, and Hans Sachs for enlightened public opinion.

It was during the time that he wrote the gloriously melodious and spontaneous music to this poem that the most important event of his life happened. Work on the score was repeatedly interrupted by the necessity of making some money. Most of his concerts in German cities, undertaken for this purpose, did not yield him any profits. In Russia, however, he was very successful, and as he had the promise of a repetition of his success, he rented a fine villa at Penzing, near Vienna, and proceeded to enjoy life for a change. Who can blame him for this? As he said to a friend not long after this, “I am differently organized from others, have sensitive nerves, must have beauty, splendor, and light. Is it really such an outrageous thing if I lay claim to the little bit of luxury which I like,—I, who am preparing enjoyment for the world and for thousands?”

Unfortunately the second Russian project failed, through no fault of his own, and as he had borrowed money at usurious rates on his expected profits, he found himself compelled to fly once more from his creditors. After spending a short time in Switzerland, he went to Stuttgart, where he persuaded his friend Weissheimer to go with him into the Suabian Alps, where he intended to hide for half a year, until he could finish his “Meistersinger,” and with the score raise money for his creditors. The wagon had already been ordered for the next morning, May 3, 1864, and Wagner was packing his trunk, when a card was brought up to him with the inscription: “von Pfistenmeister, Secretaire aulique de S.M. le roi de Baviere,” and the message that the Baron came by order of the King of Bavaria, and was very anxious to see him.

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King Ludwig II. of Bavaria had declared, while he was still crown prince, that as soon as he became king he would show the world how highly he held the genius of Wagner in honor. He kept his word. One of his first acts was to despatch Baron von Pfistenmeister to search for Wagner, and not to return without him. He was to tell him that the king was his most ardent admirer; that he wanted him to come at once to Munich, to live there in comfort, at the king's expense, to complete his Nibelung operas, and produce them forthwith. Was it a wonder that when the Baron had left, Wagner, who was thus suddenly raised from the depth of despair (he had even meditated suicide) to the height of happiness, fell on Weissheimer's neck, and wept for joy.

Surely the brain of a Dumas could not have conceived a more romantic event than this sudden transformation of one who was a fugitive from debtor's prison into the favorite of a young and enthusiastic king. At last Wagner had an opportunity to bring forward his music-dramas. "Tristan and Isolde" was sung at the Munich Opera on June 10, 1865, with an excellent cast, and Hans von Buelow as conductor. "Die Meistersinger" followed on June 21,1868. Both these works were received with enthusiasm by the ever-growing band of Wagner-lovers. His plan of building a special theatre in Munich for the performance of his Nibelung operas could not be carried out, however, even with the king's aid; for his great influence with the king (he was rumored to be even his political and religious adviser, though this was not true), aroused so much hostile feeling that Wagner finally decided to have his Nibelung festival at the old secluded town of Bayreuth.

At the suggestion of the eminent pianist, Carl Taussig, Wagner societies were formed in the cities of Europe and America to raise funds for this festival and give Wagner a chance to establish a tradition by showing the world how his operas should be performed. With the aid of these and liberal contributions by his ever-devoted king, Wagner was able, after many trials, tribulations, and postponements, to bring out, at last, his great Tetralogy, on August 13, 14,16, and 17, of the year 1876. It was beyond comparison the most interesting and important event in the whole history of music. Wagner had personally visited the opera-houses throughout the land and selected the best singers. The audience included the Emperors of Germany and Brazil, King Ludwig, the Grand Dukes of Weimar and Baden, eminent composers like Liszt, Grieg, Saint-Saens, and many other notable persons. The impression made by the great work was the deeper because of the unusual circumstances: the theatre specially constructed after Wagner's novel plan; the amphitheatric seats; the concealed orchestra; the stereoscopic clearness and nearness of the stage scenes, *etc*.

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The necessity of charging very high rates ($225 for the four dramas) naturally prevented the audiences from being large, and the result was that Wagner had a deficit of $37,000 on his hands as the reward for his genius and years of business worries. When, however, his last work, the sublime, semi-religious “Parsifal,” was produced in 1882, there was a balance in his favor. He was then in his sixty-ninth year, and the exertion of producing this final masterpiece was too great for him. To recuperate, he went to Venice, where he died on Feb. 13, 1882. King Ludwig sent a special train to convey his body to Bayreuth, where it was buried in the garden behind his villa Wahnfried.

Since Wagner’s death the Bayreuth festivals have been kept up with ever-increasing success, under the guidance of his widow Cosima, the daughter of Liszt (whom he married in 1870, four years after the death of his first wife), and their son, Siegfried, who has in recent years also won some success as an opera composer. The performances at Bayreuth are no longer what they were during Wagner’s lifetime,—models for all the world; but they are still of unique interest. In truth, headquarters like Bayreuth are no longer needed, for all the German cities now vie with one another in their efforts to interpret the Wagner operas according to the composer’s intentions; and his influence on other musicians, which began with the performance of “Lohengrin” under Liszt, in 1850, is to-day greater than ever,—more powerful, perhaps, than that ever exerted by any other master.

But while an eminent German critic wrote not long ago that “the music-drama of Wagner constitutes modern opera,” it would be a huge mistake to make Wagnerism synonymous with modern music in general. Apart from the opera, there are several other very powerful currents, and while most of them can be traced to the first half of the nineteenth century, they are none the less modern. Their principal sources are Beethoven, Schubert, and Chopin, to whom we must add, in the second half of the century, Liszt.

The symphonies of Haydn and Mozart are like toy-houses compared with the massive architecture of Beethoven’s. He not only elaborated the forms, but varied the rhythms, broadened the melody, and deepened the expression of orchestral music. In his works, too, are to be found the germs of romanticism, which others, notably Mendelssohn and Schumann, developed so fascinatingly in their best works. Most of Mendelssohn’s compositions have had their day; but Schumann is still a force in modern music and will long remain so.

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Brahms, the musical Browning, is, musically speaking, a son of Schumann and a grandson of Beethoven. While even Brahms did not escape the influence of Wagner, nor that of the romanticists Schubert and Chopin, still, in his essence, he represents reaction against modern romanticism and an atavistic return to the spirit of Beethoven. He has been, for decades, the idol of Wagner's enemies; yet, in truth, there was no occasion for opposing these two men, since they worked in entirely different fields. Brahms wrote no operas, while Wagner wrote little but operas. The real antagonist of Brahms is Liszt, who also worked only for the concert hall and who represents poetic or pictorial music (programme music), while Brahms stands for absolute music, or music *per se*, without any poetic affiliations.

While Schubert in his youth also came under the influence of his great contemporary, Beethoven, he soon emancipated himself completely from him, even in the symphony, in which, as Schumann pointed out, he opened up "an entirely new world" of melody, color, and emotion. His orchestration is more varied, euphonious, and enchanting than Beethoven's, and in this direction he did for the symphony what Weber did for the opera. By using the brass instruments pianissimo, for color instead of for loudness, he opened a path in which later masters, including Wagner, eagerly followed him. Schubert was also the first composer who revealed the exquisite beauty and the great emotional power of the freest modulation from key to key. His poetic impromptus for piano became the model for Mendelssohn's "Songs without Words," and the multitudinous forms of modern short pieces, while his melodious, dainty, graceful valses were the forerunners of the exquisite dance-music which subsequently made Vienna famous, and which reached its climax in Johann Strauss the younger, universally known as "the waltz king."

In all these respects, Schubert was epoch-making; and if the beautiful details he suggested to his successors up to the present day could be taken out of their works there would be some surprising blanks. Especially also is this true in the realm of lyric song, for, as everybody knows, he practically created the art song as we know and love it. The greatest of his immediate successors, Schumann and Franz, cheerfully admitted that they could never have written such songs as they gave the world but for Schubert, and the same confession might be made by the latest of the great songwriters, Grieg, Richard Strauss, and our American MacDowell. Schubert's best songs have never been equalled. They belong in the realm of modern music quite as much as Wagner's music-dramas and Liszt's symphonic poems.

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Chopin is another composer who, although he died in 1849 (Schubert died in 1828), is as modern as the masters just named. He was as boldly original as Schubert, and as great a magician in the art of arousing deep emotion by means of novel, unexpected modulations. As an originator of new harmonic progressions he has had only three equals,—Bach, Schubert, and Wagner. Harmonies as ultra-modern as those of Wagner's "Parsifal" may be found in some of the mazurkas of Chopin. He was, as Rubinstein called him, "the soul of the pianoforte." No one before or after him knew how to make that instrument speak so eloquently. By ingeniously scattering the notes of a chord over the keyboard while holding down the pedal, he practically gave the player three or four hands, and greatly enlarged the harmonic and coloristic possibilities of the pianoforte. Liszt, Rubinstein, Paderewski, and others have gone farther still in the same direction, but he showed the way, and most of his pieces are as delightful and as modern now as they were on the day when they were written. He wrote a few sonatas, but the majority of his works are short pieces such as are characteristic of the modern romantic school.

Before Chopin modernized pianoforte music the world's greatest composers had been Italians, Germans, and Frenchmen. Chopin's father was a Frenchman, but his mother was a native of Poland, and he was born in that country. While his music has the French qualities of elegance and clearness (which every one admires in the works of Gounod, Bizet, Massenet, and other Parisian masters), in its essence it is Polish—a fact of special significance, for from this time on other nations than the three mentioned—-especially the Slavic and Scandinavian—begin to play a prominent role in music. In this brief sketch only the greatest names can be considered,—such names as Rubinstein, Tschaikowsky, Dvorak, Grieg.

Rubinstein was not only one of the greatest pianists, but one of the most spontaneous and fertile melodists of all times. His frequently careless workmanship and his foolish, savage hostility to the dominant Wagner movement prevented him from enjoying the fruits of his rare genius. He felt that, had it not been for the all-absorbing Wagner, he himself might have been as popular as Mendelssohn. Although a Russian, there is little local color in his music, for the enchanting exotic melodic intervals in his "Persian" songs are Oriental in general, rather than Russian in particular. Similar exotic intervals may be found in the "Aida" of Verdi, a pure Italian. Rubinstein, like Mendelssohn and Meyerbeer, was a Hebrew. His day will yet come, for his Dramatic and Ocean symphonies are among the grandest orchestral works in existence.

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His countryman, Tschaikowsky, also was neglected during his lifetime; but since his death he has become, especially in London, almost as popular as Wagner; and deservedly so, for he was a genius of the highest type, less in his songs and pianoforte works than in his symphonies and symphonic poems, which include some of the most inspired pages in modern music. In some of his compositions there is a barbaric splendor which proclaims the Russian and delights those who like exotic novelty in music. Like all the Russians, Tschaikowsky was strongly influenced by Liszt; indeed, it may be said that in Russia Liszt was more potent in shaping the course of modern music than even Wagner.

Another Slavic composer, the Bohemian Dvorak, is of special interest to Americans not only because he is one of the greatest of modern orchestral writers (a colorist of rare charm), but because he presided for several years over Mrs. Thurber’s National Conservatory of Music in New York, and there wrote that truly melodious and deeply emotional work, “From the New World,” which has become almost as popular as Tschaikowsky’s “Pathetique.” His Bohemian rhythms have a unique charm.

Among the Scandinavian composers the greatest, by far, is Grieg, one of the most original melodists and harmonists of all times. His songs, in particular, are destined to immortality; they are among the very best written since Schubert. Of his pianoforte and chamber music, too, it can be said that everything is new, free from commonplace, and ultra-modern. He has written mostly short pieces, and for that reason has had to wait (like Chopin in his day) a long time for full recognition of his genius, the critics not having yet got over the foolish habit of measuring art-works with a yardstick. Like Chopin, moreover, Grieg has had the ill-fortune of having his most original and individual traits accredited to his nation and described as “national peculiarities.” His music does contain such peculiarities; but it is necessary to distinguish between what is Norwegian and what is Griegian. Grieg’s little pieces and songs are big with genius.

The Hungarian Liszt is another immortal master who, beside the fruits of his individual genius, contributed to the current of modern music some of those exotic national traits which distinguish it from that of earlier epochs when it was almost exclusively Italian, French, and German. His fifteen Hungarian rhapsodies constitute, however, only a small part of the invaluable legacy he has left the world. He was the most many-sided of all musicians,—the greatest of all pianists, and one of the best composers of oratorios, songs, orchestral, and pianoforte works,—everything, in short, except operas and chamber music. He was also the greatest of teachers and (with the exception of Wagner) the greatest of conductors; as such, he carried out both his own and Wagner’s new and revolutionary principles of interpretation, which have gradually made the orchestral conductor a personage of even greater importance, in concert hall and opera-house, than the prima donna, travelling, like her, from city to city, to delight lovers of music.

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One might have expected that the prince of pianists, being at the same time a composer, would do for the pianoforte what Bach had done for choral and organ music, Beethoven for the symphony, Schubert for the art song, and Wagner for the opera. But he could not, for Chopin had anticipated him. In only one direction was it possible to go beyond Chopin,—in that of making the piano capable of reproducing orchestral effects. This, Liszt achieved in his own works and his transcriptions. But, after all, the grandest pianoforte, while delightful as such, is but a poor substitute for an orchestra. Hence it was natural that Liszt should give up the pianoforte as his specialty and devote himself particularly to the orchestra.

In this domain he was destined to achieve reforms similar to those of Wagner in the opera. The “classical” symphony, like the old-fashioned opera, consists of detached numbers, or movements, that have no organic connection with one another. For the detached numbers of the opera Wagner substituted his “continuous melody;” and he provided an organic connection of all the parts by means of the “leading motives” or characteristic melodies and chords which recur whenever the situation calls for them. In the same spirit Liszt transformed the symphony into the symphonic poem, which is continuous and has a leading motive uniting all its parts.

There is another aspect to the symphonic poem, in which Liszt deviated from Wagner. In Wagner’s operas there is plenty of descriptive or pictorial music, but no program music, properly speaking; for even in such things as the Ride of the Valkyries, or the Magic Fire Scene, the music does not depend on a programme, but is explained by the scenery. In programme music, on the other hand, the scene or the poetic idea is simply explained in the programme, or else merely hinted at in the title of the piece. Crude attempts in this direction were made centuries ago, but programme music as an important branch of music is a modern phenomenon. Beethoven encouraged it by his “Pastoral Symphony,” and the French Berlioz did some very remarkable things in this line in his dramatic symphonies; but it remained for Liszt to hit the nail on the head in his symphonic poems. The French Saint-Saens followed him, rather than his countryman Berlioz; so did Tschaikowsky, Dvorak, and most modern composers, up to Richard Strauss, whose symphonic poems are the most widely discussed, praised, and abused compositions of our time.

To the great names contained in the preceding paragraphs another must be added,—-that of an Italian. By an odd coincidence, Verdi was born in the same year as Wagner, 1813. But what is far more remarkable is that at the close of their careers, so different otherwise, these two great composers met again—in their music, Verdi as a Wagnerian convert. Up to his fifty-eighth year Verdi had written two dozen operas, all made up of strings of arias in the old-fashioned

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way,—superb arias, many of them, especially in “Il Trovatore” and “Aida,” but still arias. Then he rested from his labors sixteen years; and when he appeared on the stage again, with his “Otello” and “Falstaff,” he had adopted Wagner’s maxims that arias are out of place in a music-drama; that “the play’s the thing,” and that the music should follow the text word for word.

Surely, this was the most remarkable of Wagner’s triumphs and conquests. He who had been denounced for decades as being unable to write properly for the voice was actually taken up as a model by the greatest composer of Italy, the land of song. Moreover, all the young composers of Italy have turned their backs on the traditions of Italian opera. The chief ambition of Mascagni, Leoncavallo, Puccini, and all the others has been to be called “the Italian Wagner;” and their operas are much more like Wagner’s than like Rossini’s and Donizetti’s, being free from arias and the vocal embroideries that formerly were the essence of Italian opera. The same is true of the operas written in recent decades in France, Germany, and other countries. Massenet, Saint-Saens, Humperdinck, Goldmark, Richard Strauss, Paderewski, and all the others have followed in Wagner’s footsteps.

Such, briefly told, is the story of Richard Wagner and Modern Music. The “music of the future” has become the music of the present. What the future will bring no one can tell. Croakers say, as they have always said, that the race of giants has died out. But who knew, fifty years ago, that Wagner and Liszt, or even their predecessors, Chopin and Schumann, and the song specialist, Robert Franz, were giants? We know it now, and future generations will know whether we have giants among us. Things of beauty that will be a joy forever have been created by men of genius now living in Europe; such men as the Norwegian Grieg, the Bohemian Dvorak, the French Saint-Saens and Massenet, the Hungarian Goldmark, the German Humperdinck and Richard Strauss, the Polish Paderewski. England has more good composers and listeners than it ever had before; and the same is true of America. We have no school of opera yet, but the best operettas of Victor Herbert and De Koven deserve mention by the side of those of the French. Offenbach, Lecocq, and Audran, the Viennese Strauss, Suppe, and Milloecker, the English Sullivan. The orchestral compositions of our John K. Paine are masterworks, and the songs and pianoforte pieces of MacDowell are equal to anything produced in Europe since Chopin and Franz. We have several other men of great promise, and altogether the outlook for America, as well as for Europe, is bright.

AUTHORITIES.

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The books, pamphlets, and newspaper articles on Wagner would fill a library. He has been more written about than any writers except Shakspere, Goethe, and Dante. He was also fond of writing about himself. His autobiography (extending only to 1865) has not yet been given to the public; but there are many autobiographic pages in the ten volumes of his literary works, which have been Englished by Ellis. Of great value are Wagner's letters to Liszt and to other friends. These were utilized for the first time in "Wagner and His Works," the most elaborate biography in the English language, by the author of the foregoing article. Shorter American and English books on Wagner have been written by Kobbe, Krehbiel, Henderson, Hueffer, Newman, &c. Of French writers Lavignac, Jullien, Mendes, Servieres, Schure, may be mentioned. Of great value are Kufferath's monographs on the Wagner operas and Liszt's analyses. In Germany the standard work of reference is the third edition of Glasenopp, in six volumes, four of which are now (1902) in print. Other German writers are Porges, Wolzogen, Pohl, Nohl, Tappert, Chamberlain, &c. The best histories of Modern Music in general are Langhaus's larger work and Riemann's "Geschichte der Musik seit Beethoven." The best general work for reference is "Great Composers and Their Works," edited by Professor Paine of Harvard. References to about 10,000 articles on Wagner may be found in Oesterlein's "Katalog Einer Richard Wagner Bibliothek," 3 vols.

JOHN RUSKIN.

1819-1900.

MODERN ART.

BY G. MERCER ADAM.

What John Ruskin has done in a prosaic, commercial, and Philistine age, in teaching the world to love and study the Beautiful, in opening to it the hidden mysteries and delights of art, and in inciting the passion for taking pleasure in and even possessing embodiments of it, that age owes to the great prose-poet and enthusiastic author of "Modern Painters." Neither before nor since his day has literature known such a passionate and luminous exponent of Nature's beauties, such an inculcator in men's minds of the art of observing her ways and methods, or one who has given the world such deep insight into what constitutes the true and the beautiful in art. For these things, and for opening new worlds of instruction and delight to his age in the realm of art, heightened by the charm of his marvellous prose, we can readily pardon Ruskin for his weaknesses and perverseness,—for his dogmatisms, his fervors, and ecstasies, his exaggerations of praise and blame, and even for the missionary propagation of his often unsound economic gospel, valuable though it may be in illustrating and enforcing morality in its aesthetic aspect. Despite his enemies, and all that the critics have said contradicting his theories, Ruskin was a surprise and a revelation to his time. In not a little of all that he said and did, it is true, we cannot concur; nor can we fail to see the

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errors he fell into through his want of reserve and his headlong haste to say and do the things he said and did; nevertheless, he was a great and inspiring teacher in things that appeal to our sense of the beautiful, and earnest in his zeal to raise men's intellectual and moral standard of life. Like most enthusiasts and geniuses, he had, now and then, his hours of reaction, waywardness, and gloom; but there was much that was noble and ennobling in the man, as well as rich and fructifying in his thought. Even in his social and moral exhortations, tinctured as they are with medievalism, and however much we may here again disagree with him, he had much that was uplifting and inspiring to say to his time,—a time that had great need of his apostolic counsellings and his fervent inculcations of morality, industry, religion, and humanity.

Throughout Mr. Ruskin's works—and they are amazingly manifold—a strong and intense purpose runs, given to the highest and noblest ends; and though their author at times wearies his reader by his diffuseness and his digressions, and to some is almost fanatical in his reverence for art, he is ever imaginative and eloquent, and has created for us a new, instructive, and uniquely fresh and thoughtful body of art-literature. The truth of infinite value he teaches is "realism,"—the doctrine that all truth and beauty are to be attained by a reverent and faithful study of nature, and not, as a reviewer expresses it, "by substituting vague forms, bred by imagination on the mists of feeling, in place of definite, substantial reality. The thorough acceptance of this doctrine would remould our life; and he who teaches its application, even to any single department of human activity, and with such power as Mr. Ruskin's, is a prophet for his generation." In all his various labors and aims, Mr. Ruskin set before himself a high, if somewhat quixotic, ideal of life, and with great earnestness did much, not only for the elevation of his fellow-men, but for the development of sound artistic taste and the enriching and spiritualizing of life by seeking to surround it at all times with the true and the beautiful, and with the old-time virtues of purity, manliness, and courage.

Among the "Beacon Lights" of the age there can be no question that Ruskin is worthy of an exalted place, since few men of our modern time, rich as it is in eminent thinkers and writers, has done more than he to illumine the many subjects with which he has so fascinatingly dealt,—and that not only in art and its cult of the Beautiful, but in ethics, education, and political economy. The energies, activities, and impulses he constantly put forth, as well as the high principles that ever guided him in his earnest endeavor to improve the intellectual and moral condition of his kind, mark his era as a great artistic epoch in the onward and upward progress of the race. By stimulus, suggestion, and inspiration he has powerfully influenced his time, though manifestly

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not a little of the seed he abundantly and hopefully scattered has fallen upon barren ground. Nevertheless, where the seed has fallen and germinated, the yield has been large: “his spirit has passed far wider than he ever knew or conceived; and his words, flung to the winds, have borne fruit a hundredfold in lands that he never thought of or designed to reach.” With what pride and gratitude should not the age regard him and his memory,—one who has quickened the sensibilities of men in looking upon nature; opened our dull eyes to its manifold beauties; made plain to the average intelligence what Art is and stands for; implanted in our souls worship of the beautiful; shown working-men how to use their tools in the highest interests of their craft, and taught maidens what and how to read as well as how and in what spirit to sew and cook. The world too often acknowledges its true teachers and prophets only when it begins to build them some belated tomb. “This, at any rate,” gratefully exclaims Frederic Harrison,[1] “we will not suffer to be done to John Ruskin.”

[Footnote 1: Written by Mr. F.H. on Professor Ruskin’s eightieth birthday (February 8, 1899).]

“We may all of us recall to-day with love and gratitude the enormous mass of stirring thoughts and melodious speech about a thousand things, divine and human, beautiful and good, which for a whole half-century the author of ‘Modern Painters’ has given to the world. They cover every phase of nature, every type of art, of history, society, economics, religion; the past and the future; all rules of human duty, whether personal or social, domestic or national.... He spake to us of trees, from the cedar of Lebanon unto the hyssop on the wall; he spake also of beasts, and of fowl, and of creeping things, and of fishes. He has put new beauty for us into the sky and the clouds and the rainbow, into the seas at rest or in storm, into the mountains and into the lakes, into the flowers and the grass, into crystals and gems, into the mightiest ruins of past ages, and into the humblest rose upon a cottage wall. He has done for the Alps and the cathedrals of Italy and France, for Venice and Florence, what Byron did for Greece. We look upon them all now with new and more searching eyes. Whole schools of art, entire ages of old workmanship, the very soul of the Middle Age, have been revealed with a new inspiration and transfigured in a more mysterious light. Poetry, Greek sculpture, mediaeval worship, commercial morality, the training of the young, the nobility of industry, the purity of the home,—a thousand things that make up the joy and soundness of human life have been irradiated by the flashing searchlight of one ardent soul: irradiated, let us say, as this dazzling ray shot round the horizon, glancing from heaven to earth, and touching the gloom with fire. We need not, even to-day, be tempted from truth, or pretend that the light is permanent or complete. It has long ceased to flash round the welkin, and its very scintillations have disturbed our true vision. But we remember still its dazzling power and its revelation of things that our eyes had not seen.

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“What we especially love to dwell on to-day is this: that in all this unrivalled volume of printed thoughts, in this encyclopaedic range of topic by this most voluminous and most versatile of modern writers [may we not say of all English writers?] there is not one line that is base, or coarse, or frivolous; not a sentence that was framed in envy, malice, wantonness, or cruelty; not one piece that was written to win money, or popularity, or promotion; not a line composed for any selfish end or in any trivial mood. Think what we may of this enormous library of print, we know that every word of it was put forth of set purpose without any hidden aim, utterly without fear, and wholly without guile; to make the world a little better, to guide, inspire, and teach men, come what might, scoff as they would, turn from him as they chose, though they left him alone, a broken old man crying in the wilderness, with none to hear or to care. They might think it all utterly vain; we may think much of it was in vain: but it was always the very heart’s blood of a rare genius and a noble soul.”

Before entering, somewhat in detail, into Ruskin’s vast and varied labors, let us briefly outline the scope and character of the work which gave the art critic and prophet of his time his chief fame. The personal incidents in his life need not detain us at the outset, as they are not specially eventful, and may be more fully gathered from the excellent “Life” of Ruskin, by his friend and some-time secretary, W.G. Collingwood, or from the delightfully interesting reminiscences by the master himself in his autobiographic “Praeterita,” published near the close of his long, arduous, and fruitful career. John Ruskin was born in London on the 8th of February, 1819. He was of Scotch ancestry, his father being a prosperous wine merchant in London, who acquired considerable wealth in trade, which the son in time inherited, and nobly used in his many private benevolences and philanthropic enterprises. The comfortable circumstances in which he was born, coupled with his father’s own love of pictures and books, were helpful in giving encouragement and direction to the young student’s studies and tastes. His mother, a deeply religious woman, was, moreover, influential in implanting the serious element in Ruskin’s character and life, and in familiarizing him with the Bible, whose noble English, in King James’ version, manifestly entered early into the youth’s ardent, prophetic soul, and, as a writer, had much to do in forming his magnificent prose style. Ruskin was in early years—indeed, far on in his manhood—in delicate health, and consequently he was educated privately till he passed to Christ Church College, Oxford, where, at the age of twenty, he won the Newdigate prize for verse, and graduated in 1842. His taste for art was manifested at an early age, and after passing from the university he studied painting under J.D. Harding and Copley Fielding; but his masters, as he tells us in “Praeterita,” were Rubens and Rembrandt.

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At the outset of his career Ruskin, as is well known, was led to take up a defence of J.M.W. Turner (1775-1851) and the contemporary school of English landscape-painting against the foreign trammels, which had fastened themselves upon modern art, and especially to prove the superiority of modern landscape-painters over the old masters. This revolutionary opinion, though at first it was hotly contested, established the new critic’s position as a writer on art, and the defence, or exposition rather, grew into the famous work called “Modern Painters” (5 vols., 1843-60). This elaborate work deals with general aesthetic principles, and, notwithstanding its occasional extravagances, alike of praise and censure, its charm is irresistible, presenting us with its brilliant and original author’s ideas of beauty, to which he freshly and powerfully awakened the world, while enshrining throughout the work the most enchanting word-poems on mountain, leaf, cloud, and sea, which, it is not too much to say, will live forever in English literature. In the second volume Mr. Ruskin takes up the Italian painters, and discusses at length the merits of their respective schools; in the others, as well as in the work as a whole, we have a body of principles which should govern high art-work, as well as new ideas as to what should constitute the equipment of the painter, and that not only as regards the technique of his art, but in the effect to be produced on the onlooker in viewing the skilled work of one who, above all accomplishments, should be lovingly and intimately in contact with nature.

From the study of painting Mr. Ruskin passed for a time to that of architecture. In this department we have from his pen “The Seven Lamps of Architecture” (1849) and “The Stones of Venice” (1851-53). In these two complementary works their author sets forth as in an impressive sermon the new and admonitory lesson that architecture is the exponent of the national characteristics of a people,—the higher and nobler sort exemplifying the religious life and moral virtue in a nation, the debased variety, on the other hand, expressing the ignoble qualities of national vice and shame. The text of “The Stones” is Venice, and the design of the volumes, in the author’s words, is to show that the Gothic architecture of Venice “had arisen out of, and indicated, a state of pure domestic faith and national virtue;” while its renaissance architecture “had arisen out of and indicated a state of concealed national infidelity and domestic corruption.” The earlier work, “The Seven Lamps,”—the Lamp of Sacrifice, of Truth, Power, Beauty, Life, Memory, Obedience,—looks upon architecture “as the revealing medium or lamp through which flame a people’s passions,—the embodiment of their polity, life, history, and religious faith in temple and palace, mart and home.” Akin to these two eloquent works, in which their author thoughtfully sets forth the civic virtues and moral tone, as well as the debased characteristics, by which architecture is produced at certain eras in a people’s life, is the earlier volume on “The Poetry of Architecture” (1837), which discusses the relation between architecture and its setting of landscape or other environment, illustrated by examples drawn from regions he had visited,—the English Lakeland, France, Switzerland, Spain, and northern Italy.

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After these works followed lectures on drawing, perspective, decoration, and manufacture, with later theories (crotchets, some have impiously called them) on political economy, Pre-Raphaelitism, *et cetera*, with a flood of opinions on social, ethical, and art subjects, enriched by rare intellectual gifts and much religious fervor. Ruskin's whole writings form a body of literature unique of its kind, pervaded with great charm of literary style, and inspired by a high moral purpose. Ruskin's excursions into non-aesthetic fields, and the strange jumble of Christian communism to which, late in life, he gave vehement expression, it must be honestly admitted, have detracted much from his early fame. In everything he wrote the Ruskinian spirit comes strongly out, colored with an amiable egotism and enforced by great assurance of conviction. The moral purpose he had in view, and the charm and elevated tone of his writings, lead us to forget the wholly ideal state of society he sought to introduce, while we are won to the man by the passion of his noble enthusiasms.

Like Carlyle and Emerson, Ruskin was by his parents intended for the ministry; but for the ministry he had himself no inclination. The broadening out early of his mind and the freeing of his thought on doctrinal subjects, which took him far from the narrow evangelicalism of his youth, made the ministry of the church repugnant to him, though he was always a deeply religious man and a force ever making for righteousness. At the same time, he numbered many divines among his most cherished friends, and he frequently, and with admitted edification, was to be found in chapel and church. Meanwhile he continued busily to educate himself for whatever profession he might choose or drift into, supplemented by such fitful periods of schooling as his delicate health permitted, as well as by many jaunts with his parents to the English lakes and other parts of the kingdom, and by frequent tours on the Continent, especially in Italy and Switzerland. Before he arrived at his teens, young Ruskin had composed much, both in prose and verse, and he early manifested an aptitude for drawing, as well as a decided taste for art, which, it is said, was in some measure incited by the gift, from a partner of his father, of a copy of the poet Rogers' "Italy," with engravings by Turner. Nor, early in manhood, did he escape a youth's fond dream of love, for as a worshipper of beauty, and an enthusiast of the "Wizard of the North," we find him drawn tenderly to a daughter of Lockhart, editor of the "Quarterly Review," a grandchild of his famous countryman, Sir Walter Scott. The affair, however, though encouraged by his parents, who longed to see their son settled in life, came to nought, chiefly owing to the young lover's weak physical frame and uncertain health. Later on, unhappily, he was caught in the toils of another Scottish lass, for whom, it is related, he had written "The King of the Golden River" (1841), and whose

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rare beauty had readily attracted him. With her, in 1848, he made an ill-assorted marriage, only to find, some years afterwards, his heart riven and a bitter ingredient dropped into his life’s chalice by a fatal defection on the wife’s part, she having become enamoured of the then rising young painter, Millais, whom Ruskin had trustingly invited to his house to paint her portrait. The sequel of the affair is a pitiful one, which Ruskin ever afterward hid deep in his heart, though at the time, finding that the woman was unable to live at the intellectual and spiritual altitude of her loyal husband, the latter, with a magnanimity beyond parallel, pardoned both Millais and the erring one, consented to a divorce, and actually stood by her at the altar as the faithless one took upon herself new vows unto a new husband. The estrangement and loss of a wife gave Ruskin afresh to Art,—his true and fondly cherished bride.

At this period, as we know, English painting was at a low ebb, mediocre and conventional, though with a show of artificial brilliance. Ruskin, with his scorn of the artificial and scholastic, threw himself into the work of overturning the established, complacent school of the time, and with splendid enthusiasm and an unfailing belief in himself and his ideas he undertook to reform what had been, and to raise current conceptions of art to a more exalted and lofty plane. We have seen what he had already achieved in his first dashing period of literary activity, in the production of the early volumes of “Modern Painters,” and in his “Seven Lamps” and “Stones of Venice.” While he was at work on the concluding volumes of the first and last of these great books there arose in England the somewhat fantastic movement in art, launched by the Pre-Raphaelite Brotherhood, which included such Ruskinites and other devotees of early Christian and mediaeval painting as Rossetti, Millais, Morris, Burne-Jones, and Holman Hunt. Towards this new school of symbolists and affectationists Ruskin was not at first drawn, since it seemed to him unduly idealistic, if not mystic, and smacked not a little, as he thought, of popery. Later, however, he saw good in it, as a breaking away from academic trammels; while he recognized the earnest enthusiasm of the little band of artists and artist-poets, as well as their technical dexterity and brilliance. With ready decision as well as with his accustomed zeal for art, Ruskin ended by defending and applauding the new innovators, particularly as their chief motive was the one the master had always strenuously pled for,—adherence to the simplicity of nature. Their scrupulous attention to detail, characteristic of the Pre-Raphaelites, later on bore good results, even after the Brotherhood fell apart, especially in William Morris’s application of their art-principles to household decoration and furnishings. But for the time the movement was loudly mocked and decried, and perhaps all the more because of Ruskin’s

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espousal of the fervid band, his letters of defence in the London “Times,” and his discussion in his booklet on “Pre-Raphaelitism.” Heedless of the outcry, Ruskin pursued his own self-confident course, and by the year 1860 he had completed his “Modern Painters,” and, in spite of objurgation and detraction, had won a great name for himself as a critic and expounder, while expanding himself over almost the whole world of art.

We have said that Pre-Raphaelitism, as a movement in art, was contemporaneously jeered at; while to-day, among superficial or inappreciative students of the period, seriously to mention it or any of its cultured brotherhood is to provoke a smile. Nevertheless, there was not a little high merit in the movement, which Ruskin was keen-eyed and friendly enough to recognize, while much that is worthy afterwards came out of it in the later work of the more notable of its members as well as in that of their unenrolled associates and the admirers of the Pre-Raphaelite method. What the movement owed to Ruskin is now frankly conceded, in the lesson the brotherhood took to heart from his counsellings,—to divest art of conventionality, and to work with scrupulous fidelity and sincerity of purpose. Nor was contemporary art alone the gainer by the movement; it also had its influence on poetry, though this has been obscured—-so far as any beneficial influence can be traced at all—by the tendency manifested in some of the more amorous poetic swains of the period, who professed to derive their inspiration from the Brotherhood, to identify themselves with what has been styled the “Fleshly School” of verse. Of the latter number, Swinburne, in his early “Poems and Ballads,” was perhaps the greatest sinner, though atoned for in part by the lyrical art and ardor of his verse, and much more by the higher qualities and scholarly characteristics of his later dramatic Work. Nor is Dante Rossetti himself, in some of his poems, free from the same taint, despite the fact of his interesting individuality as the chief inspirer and laborer among the Brotherhood. Yet the movement owed much to both his brush and his pen of other and nobler, because reverential, work, as those will admit who know “The Blessed Damozel,” “Sister Helen,” and his fine collection of sonnets, “The House of Life,” as well as his famous paintings, “The Girlhood of Mary Virgin,” and his Annunciation picture, “Ecce Ancilla Domini.” Of the product of other Pre-Raphaelites of note,—such as Ford Madox Brown, Millais, Morris, Woolner the sculptor, Coventry Patmore, and Holman Hunt,—much that is commendable as well as finely imaginative came from their hands, and justified Ruskin in his gallant advocacy of the movement, its founders, and their work.

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By this time, of which we have been writing, Ruskin had reached the early meridian of his powers, and, as we have hinted, had wrested from the unwilling many a juster recognition of his amazing industry and genius. To his fond and indulgent parents this was a great source of pride and satisfaction, and the practical evidence of it was the throng of visitors to the family seats of Herne Hill and Denmark Hill, in the then London suburbs, where Ruskin long had his home, and by the attentions and honor paid to their son by universities, academies, and public bodies, as well as by many eminent personages and the intellectual *elite* of the nation. Among those with whom the young celebrity was then ultimate and reckoned among his admiring correspondents were, besides Turner (who died in 1851) and the chief artists of the time, the Carlyles and the Brownings, Mary Russell Mitford, Charlotte Bronte, Harriet Beecher Stowe, Monckton Milnes (Lord Houghton), Charles Eliot Norton, Lady Trevelyan (Macaulay's sister), Whewell, Maurice, Kingsley, Dr. John Brown (author of “Rab and his Friends"), Tennyson, and Dean Milman. To these might be added many notable foreigners whom he either met with in his continental travels or who were attracted to him by a lively interest in his writings. In his home, thanks to a wealthy and indulgent father, he was surrounded with every comfort, short of luxury, if we except under the latter the large sums expended on the purchase of “Turners” and many famous foreign pictures, and a vast and increasing collection of favorite books and other treasures and curios.

Of the author's home-life we get many delightful reminiscences in “Praeterita,” with entertaining talks of his childhood days, his youthful companions, his toys and animate pets, his early playful adventures in authorship, and other garrulities with which, late in life when the work, as it remains, was incompletely put together, he beguiled the weariness and feebleness of old age. But we are anticipating, for we are writing of Ruskin when his hand was yet on the plough, and the plough was still in the furrow, and half a long life's arduous work was yet before him. At this era, no brain could well have been more active or fuller of philanthropies than his, for we approach the second period of his life's grand activities,—the era of a new departure in the interests that occupied him and the herculean tasks he set himself to do.

Before recording some of the achievements of this time and glancing at the inciting causes of the transition which marks the era we have now reached, let us note the demands made upon Mr. Ruskin's thought and labor by universities and public institutions, whose audiences desired to have him appear before them in person and address them upon topics in which he and they were interested. These appearances on the lecture platform were now numerous, since many throughout the kingdom were eager to see and know the man whose

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art criticisms, principles that govern the beautiful, and stimulating thought on all subjects, had made so deep an impression on the reflecting minds of the age. His earliest appearance on the rostrum was at Edinburgh, where he delivered four lectures before the Philosophical Institution, chiefly on landscape-painters and on Christian art, with a plea for the use of Gothic in domestic architecture. Subsequent appearances were at Manchester, where he spoke on the Political Economy of Art and the relation of art to manufactures; at the South Kensington Museum, London, which had just been opened; and later at Oxford, where further on in his career he became Slade Professor of Art in his own University. From the accounts of these public lectures we get opinions as to the personal appearance of Ruskin at the period which add to our knowledge of him from paintings, drawings, and photographs, though not a few of these accounts vary from those given us in books, chiefly sketched by his lady friends and correspondents. The more trusty of the contemporary pictures speak of him as having "light, sand-colored hair; his face more red than pale; the mouth well cut, with a good deal of decision in its curve, though somewhat wanting in sustained dignity and strength; an aquiline nose; his forehead by no means broad or massive, but the brows full and well bound together; the eye [says the observer from whom we are quoting] we could not see, in consequence of the shadows that fell upon his [Ruskin's] countenance from the lights overhead, but we are sure that the poetry and passion we looked for almost in vain in other features must be concentrated here." Miss Mitford speaks of him at this time as "eloquent and distinguished-looking, fair and slender, with a gentle playfulness, and a sort of pretty waywardness that was quite charming." Another, a visitor at his London home, characterizes him as "emotional and nervous, with a soft, genial eye, a mouth thin and severe, and a voice that, though rich and sweet, yet had a tendency to sink into a plaintive and hopeless tone." Later on in years we have this verbal portrait from a disciple of the great art-teacher, occurring in an inaugural address delivered before the Ruskin Society of Glasgow: "That spare, stooping figure, the rough-hewn, kindly face, with its mobile, sensitive mouth, and clear deep eyes, so sweet and honest in repose, so keen and earnest and eloquent in debate!"

When the fifth and last volume of "Modern Painters" was finally off his hands, Mr. Ruskin not only engaged, as we have seen, in occasional lecturing, but began (1861) to add a prolific series of *brochures*—many of them with quaint but significant titles—to his already stupendous mass of writing. Their subjects were not alone aesthetics, but now treated of ethical, social, and political questions, the prophetic declarations and earnest appeals of a man of wide and varied culture, deep thought, and large experience. The attempted alliance of political economy with art

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was a novel undertaking in that sixth lustrum of the past century, even by a man of Mr. Ruskin's eminence and fame in the world of letters. But Mr. Ruskin was a bold and earnest man, as well as a genius; and he had too much to tell his heedless, *laissez-faire* age to keep silent on themes, remote as they were from those he had hitherto taught, and of which he desired to deliver his soul, whatever ridicule it might provoke and however adverse the criticism levelled against him. His humanity and moral sense were outraged by the manner in which the mass of his countrymen lived, and trenchant was his castigation of this and eager as well as righteous his desire to amend their condition and elevate and inspire their minds. As an economist, it is true, there was not a little that was false as well as eccentric in what he preached; moreover, much of his counsel was directly socialistic in its trend, repugnant in large degree to his English readers and hearers; but all this was atoned for by the honesty and philanthropy of his motives, by his phenomenal fervor and eloquence, and by the literary beauty and charm of every page he wrote. Nevertheless, as in Carlyle—for in these depreciations the style of the seer of Chelsea was deeply upon him—the note of calamity and the wail of despair are too much in evidence in Ruskin's writings at this period, while, like Carlyle also, he was equally precipitate and impulsive in his attacks on things as they were. Yet in the economic condition just then of England, and in the circumstances environing the labor world, there was, possibly, justification for the rebukes and objurgations of onlookers of the type of both of these men, and very humanitarian as well as practically helpful were Ruskin's counsel and aid to labor and to all who sought to raise and expand their outlook and better their condition in life. Towards politics Ruskin was never drawn, but had he been more prosaic and less given to anathematizing, most valuable would have been his aid in legislation at this era of political and moral reform. But if political science, or science in any other of its branches or departments, did not come within his purview, great was the revolution he wrought in the working-man's surroundings, and immense the illumination he shed upon industry and on the spirit in which the laborer should think and work.

Referring to Ruskin at this period of his career, and to his influence as a social and moral exhorter, Frederic Harrison, from whom we have already quoted, has an admirable passage on “Ruskin as Prophet,” [2] which, as it is presumably too little known, we take pleasure in embodying in these pages.

[Footnote 2: “Tennyson, Ruskin, Mill, and other Literary Estimates,” by Frederic Harrison; London and New York: Macmillan & Co. 1900.]

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“The influence of Ruskin,” says Mr. Harrison, “has been part of the great romantic, historical, catholic, and poetic revival of which Scott, Carlyle, Coleridge, Freeman, Newman, and Tennyson in our own country have been leading spirits within the last two generations in England. There is no need to compare him with any one of these as a source of original intellectual force. He owns Scott and Carlyle as his masters, and he might vehemently repudiate certain of the others altogether. His work has been to put this romantic, historical, and genuine sympathy inspired by Scott, Wordsworth, and Carlyle into a new understanding of the arts of form. The philosophic impulse assuredly was not his own. It is a compound of Scott, Carlyle, Dante, and the Bible. The compound is strange, for it makes him talk sometimes like a Puritan father, and sometimes like a Cistercian monk. At times he talks as Flora MacIvor talked to young Waverley; at other times like Thomas Carlyle inditing a Latter-day Pamphlet. But to transfuse into this modern generation of Englishmen this romantic, catholic, historical, and social sympathy as applied to the arts of form, needed gifts that neither Scott, nor Carlyle, nor Newman, nor Tennyson possessed—the eye, if not the hand, of a consummate landscape painter, a torrent of ready eloquence on every imaginable topic, a fierce and desperate courage that feared neither man nor devil, neither failure nor ridicule, and above all things an exquisite tenderness that is akin to St. Francis or St. Vincent de Paul....

“Here is a man who, laboring for fifty years, has scattered broadcast a thousand fine ideas to all who practise the arts, and all who care for art. He has roused in the cultured world an interest in things of art such as a legion of painters and ten royal academies could never have done. He has poured out a torrent of words, some right, some wrong, but such as have raised the level of art into a new world, which have adorned English literature for centuries, and have inspired the English race for generations; he has cast his bread upon the waste and muddy waters with a lavish hand, and has not waited to find it again, though it has been the seed of abundant harvest to others.”

Again, speaking of what Ruskin sought to accomplish in the regeneration of modern society, and the reformation of our social ideals, and of that “heroic piece of Quixotism” he founded, “the Guild of St. George,” Mr. Harrison remarks:—

“The first life of John Ruskin was the life of a consummate teacher of art and master of style; the second life was the life of priest and evangelist.... Here is the greatest living master [the passage was written while Mr. Ruskin was yet alive] of the English tongue, one of the most splendid lights of our noble literature, one to whom a dozen paths of ambition and power lay open, who had everything that could be offered by genius, fame, wealth, social popularity, and intense sensitiveness to all lovely things—and

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this man, after thirty years of untiring labor, devotes himself to train, teach, delight, and inspire a band of young men, girls, workmen, children,—all who choose to come around him. He lavishes the whole of his fortune on them; he brings to their door his treasures of art, science, literature, and poetry; he founds and endows museums; he offers these costly and precious collections to the people; he wears out his life in teaching them the elements of art, the elements of manufacture, the elements of science; he shows workmen how to work, girls how to draw, to sing, to play; he gives up to them his wealth, his genius, his peace, his whole life. He is not content with writing books in his study, with enjoying art at home or abroad; he must carry his message into the streets. He gives himself up—not to write beautiful thoughts: he seeks to build up a beautiful world.... When I see this author of ‘Modern Painters’ and the ‘Stones of Venice,’ the man who has exhausted almost all that Europe contains of the beautiful, who has thought and spoken of almost every phase of human life, and has entered so deeply into the highest mysteries of the greatest poets—when I see him surrounding himself in his old age with lads and lasses, schoolgirls and workmen, teaching them the elements of science and art, reading to them poems and tales, arranging for them games and holidays, ornaments and dresses, lavishing on these young people his genius and his wealth, his fame and his future—I confess my memory goes back instinctively to a fresco I saw in Italy years ago—was it Luini’s?—wherein the Master sat in a crowd of children and forbade them to be removed, saying that ’of such is the kingdom of heaven.’”

With this generous tribute to and appreciation of Ruskin, despite the economic vagaries into which the great critic and teacher of his time fell, we may more confidently approach the busy era of his later and self-sacrificing labors, and with less apology take space to deal—as compactly and intelligently as we can—with some of the more notable of the many books and *brochures* of the period. Difficult as would be the task, fortunately there is little need to epitomize these works, as many of them are better known, and perhaps more attentively read, than his earlier, bulkier, and more ambitious writings. A few of them lie outside the economic gospel of their apostolic author, and these we will first and briefly deal with. A number of them are instructive and inspiring lay sermons on the mystical union between nature and art, beauty and utility, and their reflex in the reverential homage for the beautiful and the worthy in the mind and character of the English-speaking race. The whole form a great body of fine and thoughtful work, which is as enchaining as its meaning is often profound. The best-known of these lay sermons is: “The Queen of the Air” (1869), a splendid blending of his fancy with the Greek nature-myths of cloud and storm, represented by Athena, goddess of the heavens,

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of the earth, and of the heart. The parable drawn is that “the air is given us for our life, the rain for our thirst and baptism, the fire for our warmth, the sun for our light, and the earth for our meat and rest.” Related to the work is “Ethics of the Dust” (1865), lectures to little housewives on mineralogy and crystallography, nature’s work in crystallization being the text for a diatribe against sordid living. “Sesame and Lilies,” which belongs also to this period of the writer’s work, consists of three addresses, delivered at Manchester and at Dublin, designed specially for young girls, and treating in the main of good and improving literature. The first of them, “Of Kings’ Treasuries,” deals with the treasures hidden in books, the writings of the world’s great men; its sequel, “Of Queens’ Gardens,” deals with the function and sphere of woman, and, by way of application, with the how and the what to read; the third lecture, on “The Mystery of Life and its Arts,” is a discursive but inspiring consideration of what life is and how most successfully to battle with it in the way of our work and of our appointed duty. All three lectures, observes a commentator, “tell men and women of the ideals they should set before them; how to read and to build character under the inspiration of the nobility of the past, fitting one’s self for such great society; how to develop noble womanhood; how to bear one’s self toward the wonder of life, toward one’s work in the world, and toward one’s duty to others.”

Other lectures and *brochures* of or about this period are “Hortus Inclusus” (The Enclosed Garden), being “Messages from the Wood to the Garden sent in happy days to two sister ladies,” residing at Coniston, and collected in 1887; “Arrows of the Chace,” letters on various subjects to newspapers, gathered and edited in 1880; “The Two Paths,” lectures on art and its application to Decoration and Manufacture (1859); “Ariadne Florentina” (1873), a monograph on Italian wood and metal engraving; “Aratra Pentelici” (1872), on the elements and principles of sculpture; and “The Eagle’s Nest” (1872), on the relation of natural science to art. Still pursuing his delightful methods of interpreting nature and teaching the world instructive lessons, even from the common things of mother earth, we have a series of three eloquent discourses, entitled (1) “Proserpina,” studies of Alpine and other wayside flowers, dwelling on the mystery of growth in plants and the tender beauty of their form; (2) “Deucalion,” a sort of glorified geological text-book, treating of stones and their life-history, and showing the wearing effect upon them of waves and the action of water; and (3) “Love’s Meinie” (1873), a rapture about birds and their feathered plumage, delivered at Eton and at Oxford. This trilogy, dealing with botany, geology, and ornithology, was presented to his audiences with illustrative drawings, representing the flora met with in his travels or found in the neighborhood of his new home in the Lancashire

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lakes, with sketches of regions, including the characteristics of the soil, in which he had been reared, and talks of the note and habit of all birds that were wont to warble over him their morning song. “The Pleasures of England,” the “Harbours of England,” and the “Art of England” further treat of his loved native land, the first of these being talks on the pleasures of learning, of faith, and of deed, illustrated by examples drawn from early English history, and the last treating of representative modern English artists, chiefly of the Pre-Raphaelite school. “The Laws of Fesole” (1878) deals with the principles of Florentine draughtsmanship; “St. Mark’s Rest,” with the art and architecture of Venice; and “Val d’Arno,” with early Tuscan art, interspersed with the author’s accustomed ethical reflections. “Mornings in Florence,” intended for the use of visitors to the art galleries of the beautiful city on the Arno, deals in the true artist-spirit with its famous examples of Christian art, giving prominence here also to the ethical side of the city’s history. “In Montibus Sanctis,” and “Coeli Enarrant,” the one comprising studies of mountain form, and the other of cloud form and their visible causes, though separately published, are only reprints of the author’s larger and nobler embodiment of his views on art, in “Modern Painters.” “The King of the Golden River,” of which we have previously spoken, is a fairy tale of much beauty, which he wrote for the “Fair Maid of Perth” whom he married, and who separated herself from him on the plea of “incompatibility.” Playful as is the style of the story, it is not without a moral, on what constitutes true wealth and happiness. “The Crown of Wild Olive” (1866) consists of lectures on work, traffic, and war; the latter lecture, delivered at the Royal Artillery Institution at Woolwich, was also separately published under the title of “The Future of England.” The two former, being addressed to working-men, laborers, and traders, discuss economic problems, and set forth tentatively their author’s antagonized political ethics, with which, in drawing this essay to a close, we now venture to deal.

After the magnificent work done by Ruskin in art up to his fortieth year, that he should turn, for practically the remainder of his life, to the seemingly vain and profitless task of a social reformer and regenerator of modern society, has to most men been a riddle too elusive and enigmatic to solve. And yet, in his earlier career, had he not himself prepared us for just such a departure as he took in the sixties, for in art was he not equally revolutionary and iconoclastic, as well as personally self-willed, passionate, and impulsive? Moreover, had not Mother Nature endowed him with the gifts of a seer and made him chivalrous as well as intensely sympathetic, while his early training inclined him to be serious, and even ascetic? Nor were the rebuffs he met with throughout his career calculated at this stage to make him court the applause

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of his fellow-men or be mindful of the world's censure or approval. Nor can one well quarrel with what he had now to say on many a subject, visionary and enthusiast as he always was, and given over to mediaeval views and preachments, and to abounding moral and ethical exhortation. Like Carlyle's, his voice was that of one crying in the wilderness, and yet in the industrial and social condition of Britain at the era there was need of just such appeals for regeneration and reform as Ruskin strenuously uttered, accompanied by indignant rebukes of grossness, vulgarity, and meanness, as manifested in masses of the people. If in his strivings after amelioration he was too denunciatory as well as too radical, we must remember the temper and manner of the man, and recognize how difficult it was in him, or in any iconoclast who scorned modern science as Ruskin scorned it, to reconcile the age of steam and industrial machinery, which he spurned and would have none of, with the views he held of Christianity, morals, and faith. His views on political economy, which he treated neither as an art nor a science, might be perverse and wrong-headed, and his method of adapting prophetic and apostolic principles to the practice of every-day life utterly impracticable; but the virtues he counselled the nation to manifest, and the graces he enjoined of truthfulness, justice, temperance, bravery, and obedience, were qualities needed to be cultivated in his time, with a fuller recognition of and firmer trust in God and His right of sway in the world He had created.

What Ruskin's economic views were, and what his relations to the industrial and social problems of his time, most readers of our author know, are mainly to be found in "Fors Clavigera," a series of letters to working-men, covering the years 1871-84, and in his early essays on political economy, "Unto this Last" (1860), and "Munera Pulveris" (1863). "Unto this Last" appeared in its original form in the pages of the "Cornhill Magazine," then edited by Thackeray, and our author speaks confidently of it as embodying his maturest and worthiest thoughts on social science. The work, which will be found the key to Ruskin's economic gospel, embraces four essays, treating successively of the responsibilities and duties of those called to fill all offices of national trust and service; of the true sources of a nation's riches; of the right distribution of such riches; and of what is meant by the economic terms,—value, wealth, price, and produce. Under these several heads, Ruskin expresses his conviction that co-operation and government are in all things the law of life, while the deadly things are competition and anarchy. Whatever errors the book[3] contains—and the author's unconscious arrogance and dogmatism made him blind to them—his views were set forth with his accustomed vigor and eloquence, and in the honest belief that he was more than fundamentally right. It was for such helpful work as this,

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and what he accomplished in the kindred volume, “Munera Pulveris,” which first appeared in “Fraser’s Magazine,” that Ruskin for the time dropped his revelations in art to let a new world of thought into the “dismal science” of political economy, confound its old-time instructors, and gird at the evils of the age,—the greed, selfishness, and petty bargaining spirit of industrial and commercial life. Nor in conducting such a crusade as this was Ruskin abandoning his old and less controverted gospel of art. He was but carrying into new and barren fields the high ideals he had hitherto counselled his age to emulate and heed, and in his sympathy with labor seeking to bring into its world the comeliness of beauty and the cheer of prosperity, comfort, and happiness. In “Time and Tide” (1867), and more at length in “Fors Clavigera,” Ruskin reiterates his message to labor, to get rid of ever-environing misery by realizing what are the true sources of happiness,—pleasure in sincere and honest work, inspired by intelligence, culture, religion, and right living. What he desires for the working-man he desires also for his family, and consequently he urges parents to train their sons and daughters to see and love the beautiful, to cultivate their higher instincts, and call forth and feed their souls. In all this there is much helpful, tonic thought, which the church or the nation, roused to zeal and earnest activity, might fittingly teach, and so advance the material weal of the people, extend the area of public enlightenment and morality, and herald the dawn of a new and higher civilization.

[Footnote 3: Alluding to the quaint title under which these “Cornhill” essays afterwards appeared,—a title that hints at the gist of the work,—Mr. Ruskin’s biographer tells us that the motto was taken from Christ’s parable of the husbandman and the laborers: “Friend, I do thee no wrong. Didst thou not agree with me for a penny? Take that thine is, and go thy way. I will give UNTO THIS LAST even as unto thee.”—Matt. xx. 14.]

Other aspects of Mr. Ruskin’s economic gospel are, unfortunately, not so sane and beneficent. His altruism knows no bounds, as his philanthropy and zeal have but few restraints. After the fashion of his mentor, Carlyle, he is carried away by his humanitarianism and his unreserved acceptance of the doctrine of the equality and brotherhood of man. Hence come his economic heresies in regard to rent and interest, and capital and usury, his denunciations of the division of labor, his Tolstoian impoverishment of himself for the benefit of his fellow-man, and his dictum that the wealth of the nation should be its own, and not accrue to the individual. Hence, also, the wholly ideal state of society he attempted to realize in his communal Guild of St. George, with its rigid government and restraints upon the personal liberty of its members. Ideally beautiful, admittedly, was the plan and scheme of the little state, with

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its disciplinings, exactions, and devout selective creed. But the age is a practical, unimaginative one, and whatever compacts men make, even for their highest welfare, there are, it is to be feared, few so loyal, tractable, and docile as to place themselves for long under such tutoring and one-patterned, fashioning forms of co-operative living. Into whatever millennial state Ruskin sought to usher his little band of English followers and disciples, one must speak appreciatively of his motives in projecting the scheme, and of the money and labor he personally lavished upon the Utopian project. Reverently also must one speak of the catholic creed to which its members were asked to subscribe: namely, to trust in God, recognize the nobleness of human nature, labor faithfully with one's might, be loyal to one's common country, its laws, and its monarch's or ruler's orders, so far as they are consistent with the higher law of God; while exacting obedience, and a pledge that one will not deceive, either for gain or other motive; will not rob; will not hurt any living creature nor destroy any beautiful thing; and will honor one's own body by proper care for it, for the joy and peace of life. All this is very exemplary and beautiful, and not over-hard to live up to, though the working-men of Sheffield in time wearied of the organization, and the Guild and its noble ideals is now, we believe, but a memory, if we except the art museum and library of the Order taken over and still maintained by the town.

More practical, may we not say, than this imitation of the Florentine *arti* of the Middle Ages was the Working Men's College, founded in London in the fifties by that other earnest Christian Socialist, F.D. Maurice, in which Ruskin lectured gratuitously, took charge of the drawing classes, and hied off to the country with its members to sketch from nature and otherwise instruct and entertain them. Yet good in many respects came of the Guild of St. George, in the impulse it gave to the revival of the then dormant industries, such as the hand-spinning of linen, hand-weaving of carpets and woollen fabrics, lace-making, wood-carving, and metal-working, besides the stimulus it gave, with the infusion of higher ideals of workmanship, to the decorative arts, and the improvement in the sightliness of factories, and in the homes and surroundings of labor. Here Ruskin's philanthropy and reform zeal showed themselves most worthily in the financial aid he gave in the pulling down, in crowded districts of the British metropolis, of poor tenements, and the building up in their place of clean, attractive, and wholesome habitations. In such benevolences and well-doings, and in this life of renunciation and self-sacrifice, Ruskin spent himself, and made serious inroads into his bodily health and strength, as well as scattered the fortune—about a million dollars—left him by his now deceased father. But this was the manner and character of Ruskin, and this the mode of expressing his love

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for his fellow-man, which in myriad ways showed itself throughout a long and strenuous career of devotion to high ideals, and of practical, tender help in all good works. In all his philanthropies he was true to his own preachings and counsellings, spending and being spent in the spirit of his Divine Master, his whole soul aglow with reverence and adoration and tender with a profound moral emotion. Besides his rare endowments as a lover of the beautiful, he had that other precious gift, of golden speech, which threw a mantle of loveliness over every book he wrote and perpetual lustre over the domain of letters.

Ruskin's declining years, while hallowed by suffering, were cheered by many tender attentions and unexpected kindnesses, and by the recognition, by many notable public bodies and eminent contemporaries, of his long life of great service and devotion to his kind. In our modern age, from which, in his loved Coniston home, he passed from life Jan. 20, 1900, no one more reverently than he has looked deeper into the mystery of life, thought more concernedly of its problems, shed more passionately and eloquently about him love for the beautiful, or practically and helpfully done more—layman only though he was—for religion and humanity. At his death the nation paid honor to his memory by offering his remains a resting-place in the great fane of England's illustrious dead, Westminster Abbey; but Ruskin had himself otherwise ordered the disposal of his body. "Bury me," he said, "at Coniston." And there, on the fifth day after his falling softly asleep, amid a concourse of loving friends, the earthly tenement of the great art critic and lover of righteousness was laid to rest, his grave strewn with myriad wreaths, garlands, and crosses of beautiful, bright flowers.

Here, after his long, strenuous, militant career, do we leave this inspiring teacher and "consecrated priest of the Ideal," his gentle soul finding rest and peace after the myriad troubles and tumults of life. Still now is the once active, fertile, stimulating mind of the man who so effectively roused his generation from its complacent smugness and indifference in its appreciation of the beautiful, and with ardent boldness challenged established beliefs in art and defied the conventionality and authority of his time. His has been a powerful force in innumerable departments of human thought, and epoch-making the influence he has exerted in giving to the world new ideals of the beautiful and in shaping modern opinion and taste in art. How great is the work he has done, and what a library of stimulating, inspiring books he has left us, comparatively few realize, as they little realize what the age owes to him for his noble activities in well-doing and his many and impressive lessons and influence. In a commonplace, commercial time, how stimulating as well as ardent have been his appeals for sensitiveness of perception in regard to art, and of the tone and spirit in which it ought to be

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viewed and valued! And with what tender, reverent feeling has he not opened our hearts to compassion and to consideration for the welfare of our fellow-man, and how potent have been his counsellings pointing to the true and abiding sources of pleasure in life! Long must his formative opinions and influence extend, and in the minds of all who think and reflect abiding must be the charm as well as the power of his imaginative, glowing thought. That he met with opposition and hostility in his day was but the price to be paid for the disturbing, correcting, disciplining, yet inspiring part he played in the work he so impulsively set himself to do. One smiles now at the epithets of scorn and contumely once hurled at him, at the man who, little understood as he has been, has done so much to uplift and purify the thought of his time and do battle with the forces opposed to reform and arrayed against those of light and truth. And how great were the weapons with which he was armed, and how varied as well as marvellous the talents he brought into play in the onslaught upon shallowness, convention, and ignorance! Truly, he has done much for his time, and great has been the gain Modern Art has won from his inspiring lessons and thought. The coming of such a man, and at the time that was his, one cannot help reflecting, was one of the providences of an overruling Power, and adequately to estimate his influence and work, and the tone and temper in which he wrought, we have but to consider what the age would have been, in countless departments of thought and activity, had the century now passed possessed no John Ruskin.

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HERBERT SPENCER.

1820-

THE EVOLUTIONARY PHILOSOPHY.

BY MAYO W. HAZELTINE.

Herbert Spencer occupies a unique place in the history of human thought, because he has been the first to attempt the construction of a philosophical system in harmony with the theory of Evolution and with the results of modern science. To his contemporaries he is known almost exclusively as the author of the colossal work which he has chosen to call the "Synthetic Philosophy." Concerning his personality very little information has been published, and it is doubtful whether he will deem it worth while to leave behind him the materials for a detailed biography. About his private life we know even less than we know about that of Kant. The very few facts obtainable may be summed up in a score of sentences.

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I.

Herbert Spencer was born on April 27, 1820, at Derby, in England, and was an only surviving child. His father was a schoolmaster in the town named, and secretary of a philosophical society. From him the son seems to have imbibed the love of natural science and the faculty of observation conspicuous in his work. The father was particularly interested in entomology, and Spencer himself used to collect, describe, and draw insects when a boy. At the age of thirteen he was sent to study with an uncle, Rev. Thomas Spencer, a liberal clergyman and a scholar, with whom he remained three years, carrying on the study of natural history, which he had begun in childhood. He now devoted himself to mathematics, evincing a singular capacity for working out original problems. At this time, too, he became familiar with physical and chemical investigations, and already exhibited a strong tendency to experimental inquiry and original research. His aversion to linguistic studies put a university career out of the question. At the age of seventeen he entered the office of Sir Charles Fox and began work as a civil engineer, but about eight years afterward he gave up this profession, and devoted the whole of his time to scientific experiments and studies, and to contributions on philosophical questions to various periodicals. As early as 1842, in a series of letters to the Nonconformist newspaper on “The Proper Sphere of Government,” he propounded a belief in human progress based on the modifiability of human nature through adaptation to its social surroundings, and he asserted the tendency of these social arrangements to assume of themselves a condition of stable equilibrium. From 1848 to 1853 he was sub-editor of the Economist newspaper, and in his first important work, “Social Statics,” published in 1850, he developed the ethical and sociological ideas which had been set forth in his published letters. The truth that all organic development is a change from a state of homogeneity to a state of heterogeneity is regarded by Spencer as the organizing principle of his subsequent beliefs. It was gradually expounded and applied by him in a series of articles contributed to the “North British,” the “British Quarterly,” the “Westminster,” and other reviews. In these essays, and especially in the volume of “Principles of Psychology,” published in 1855, the doctrine of Evolution began to take definite form, and to be applied to various departments of inquiry. It was not until four years later—a fact to be carefully borne in mind by those who would estimate correctly the relation of Spencer to Darwin—that the publication of the latter’s “Origin of Species” afforded a wide basis of scientific truth for what had hitherto been matter of speculation, and demonstrated the important part played by natural selection in the development of organisms. As early as March, 1860, Spencer issued a prospectus, in which he set forth the general aim and scope of

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a series of works which were to be issued in periodical parts, and would, collectively, constitute a system of philosophy. In 1862 appeared the “First Principles,” and in 1867 the “Principles of Biology.” In 1872 the “Principles of Psychology” was published; the first part of the “Principles of Ethics” in 1879; and his “Principles of Sociology” in three volumes, begun in 1876, was completed in 1896. In the preface to the third volume of the last-named work the author explains that the fourth volume originally contemplated, which was to deal with the linguistic, intellectual, moral, and aesthetic phenomena, would have to remain unwritten by reason of the author’s age and infirmities. The astounding extent of Herbert Spencer’s labors becomes, indeed, the more marvellous when one considers that impaired health has for many years incapacitated him for persistent application. Owing partly to his ill health, and partly to the absorbing nature of his occupation, his life has been a retired one, and in the ordinary sense of the term, uneventful. He has never married, and, although the high opinion of his writings formed by contemporaries has led to many academic honors being pressed upon him at home and abroad, these have all been declined. It only remains to mention that in 1882 he visited the United States, where the importance of his speculations had been early recognized, and that his home is now in Brighton, England.

II.

In Mr. Spencer’s latest book, “Facts and Comments,” a little light is thrown on the author’s habits, opinions, and predilections. Referring to the athleticism to which so much attention is paid just now in English and American universities, he points out how erroneous it is to identify muscular strength with constitutional strength. Not only is there error in assuming that increase of muscular power and increase of general vigor necessarily go together, but there is error in assuming that the reverse connection cannot hold. As a matter of fact, the abnormal powers acquired by gymnasts may be at the cost of constitutional deterioration. In a paper on “Party Government” the author maintains that what we boast of as political freedom consists in the ability to choose a despot, or a group of oligarchs, and, after long misbehavior has produced dissatisfaction, to choose another despot or group of oligarchs: having meanwhile been made subject to laws, some of which are repugnant. Abolish the existing conventional usages, with respect to party fealty,—let each member of parliament feel that he may express by his vote his adverse belief respecting a government measure, without endangering the government’s stability,—and the whole vicious system of party government would disappear. In a paper on “Patriotism,” Mr. Spencer says that to him the cry “Our country, right or wrong,” seems detestable. The love of country, he adds, is not fostered in him by remembering

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that when, after England's Prime Minister had declared that Englishmen were bound in honor to the Khedive to reconquer the Soudan, they, after the reconquest, forthwith began to administer it in the name of the Queen and the Khedive, thereby practically annexing it; and when, after promising through the mouths of two colonial Ministers not to interfere in the internal affairs of the Transvaal, the British Government proceeded to insist on certain electoral arrangements, and made resistance the excuse for a desolating war. As to the transparent pretence that the Boers commenced the war, Mr. Spencer reminds us that in the far West of the United States, where every man carries his life in his hands and the usages of fighting are well understood, it is held that he is the real aggressor who first moves his hand toward his weapon. The application to the South African contest is obvious. In an essay on "Style," Mr. Spencer tells us that his own diction has been, from the beginning, unpremeditated. It has never occurred to him to take any author as a model. Neither has he at any time examined the writing of this or that author with a view of observing its peculiarities. The thought of style, considered as an end in itself, has rarely, if ever, been present with him, his sole purpose being to express ideas as clearly as possible, and, when the occasion called for it, with as much force as might be. He has observed, however, he says, that some difference has been made in his style by the practice of dictation. Up to 1860 his books and review articles were written with his own hand. Since then they have all been dictated. He thinks that there is foundation for the prevailing belief that dictation is apt to cause diffuseness. The remark was once made to him, it seems, by two good judges—George Henry Lewes and George Eliot—that the style of "Social Statics" is better than the style of his later volumes; Mr. Spencer would ascribe the contrast to the deteriorating effect of dictation. A recent experience has strengthened him in this conclusion. When lately revising "First Principles," which originally was dictated, the cutting out of superfluous words, clauses, sentences, and sometimes paragraphs, had the effect of abridging the work by about one-tenth. Touching the style of other writers, Mr. Spencer points out the defects in some passages quoted from Matthew Arnold and Froude. He says that he is repelled by the ponderous, involved structure of Milton's prose, and he dissents from the applause of Ruskin's style on the ground that it is too self-conscious, and implies too much thought of effect. On the other hand, he has always been attracted by the finished naturalness of Thackeray.

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A word should here be said about the misconception of Mr. Spencer’s position with reference to the fundamental postulate of religions,—a misconception which used to be more current than it is now. He cannot fairly be described as a materialist. He is no more a materialist than he is a theist. He is, in the strictest sense of the word, an agnostic. He was the most conspicuous example of the *thing* before Huxley invented the *word*. The misconception was shared by no less a man than the late Benjamin Jowett, the well-known master of Balliol College, Oxford, who, in one of his published “Letters,” says: “I sometimes think that we platonists and idealists are not half so industrious as those repulsive people who only ‘believe what they can hold in their hand,’ Bain, H. Spencer, *etc*., who are the very Tuppers of philosophy.” It is hard to see how the law of evolution and other generalizations of an abstract kind with which Mr. Spencer’s name is associated can be held in anybody’s hands. Letting that pass, however, Mr. Spencer has himself suggested that, since the system of synthetic philosophy begins with a division entitled the “Unknowable,” having for its purpose to show that all material phenomena are manifestations of a Power which transcends our knowledge,—that “force as we know it can be regarded only as a Conditioned effect of the Unconditioned Cause”—there has been thereby afforded sufficiently decided proof of belief in something which cannot be held in the hands. It is, indeed, absurd to apply the epithet “materialist” to a man who has written in “The Principles of Psychology”: “Hence, though of the two it seems easier to translate so-called matter into so-called spirit than to translate so-called spirit into so-called matter (which latter is, indeed, wholly impossible), yet no translation can carry us beyond our symbols.”

III.

Any exposition of the “Synthetic Philosophy” must, of course, begin with the volume entitled “First Principles.” In the first part of this preliminary work the author carries a step further the doctrine of the Unknowable put into shape by Hamilton and Mansel. He points out the various directions in which science leads to the same conclusion, and shows that in their united belief in an Absolute that transcends not only human knowledge but human conception lies the only possible reconciliation of science and religion. In the second part of the same book Mr. Spencer undertakes to formulate the laws of the Knowable. That is to say, he essays to state the ultimate principles discernible throughout all manifestations of the Absolute,—those highest generalizations now being disclosed by science, such, for example, as “the Conservation of Force,” which are severally true, not of one class of phenomena, but of *all* classes of phenomena, and which are thus the keys to all classes of phenomena.

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The conclusions reached in “First Principles” may be thus summed up: over and over again in the five hundred pages devoted to their formulation, it is shown in various ways that the deepest truths we can reach are simply statements of the widest uniformities in our experiences of the relations of Matter, Motion, and Force; and that Matter, Motion, and Force are but symbols of the Unknown reality. A Power of which the nature remains forever inconceivable, and to which no limits in Time and Space can be imagined, works in us certain effects. These effects have certain likenesses of kind, the most general of which we class together under the names of Matter, Motion, and Force; and between these effects there are likenesses of connection, the most constant of which we class as laws of the highest certainty. Analysis reduces these several kinds of effects to one kind of effect; and these several kinds of uniformity to one kind of uniformity. The highest achievement of Science is the interpretation of all orders of phenomena as differently conditioned manifestations of this one kind of effect, under differently conditioned modes of this one kind of uniformity. When science has done this, however, it has done nothing more than systematize our experiences, and has in no degree extended the limits of our experiences. We can say no more than before whether the uniformities are as absolutely necessary as they have become to our thought relatively necessary. The utmost possibility for us is an interpretation of the process of things, as it presents itself to our limited consciousness; but how this process is related to the actual process we are unable to conceive, much less to know.

Similarly we are admonished to remember that, while the connection between the phenomenal order and the ontological order is forever inscrutable, so is the connection between the conditioned forms of being and the unconditioned form of being forever inscrutable. The interpretation of all phenomena in terms of Matter, Motion, and Force is nothing more than the reduction of our complex symbols of thought to the simplest symbols; and when the equation has been brought to its lowest terms, the symbols remain symbols still. Hence the reasonings contained in “First Principles” afford no support to either of the antagonist hypotheses respecting the ultimate nature of things. Their implications are no more materialistic than they are spiritualistic, and no more spiritualistic than they are materialistic. The establishment of correlation and equivalence between the forces of the outer and the inner worlds serves to assimilate either to the other, according as we set out with one or the other. He who rightly interprets the doctrine propounded in “First Principles” will see that neither the forces of the outer, nor the forces of the inner, world can be taken as ultimate. He will see that, though the relation of subject and object renders necessary to us the antithetical conceptions of Spirit and Matter, the one is no less than the other to be regarded as but a sign of the Unknown Reality which underlies both.

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In logical order the formulation of “First Principles” should have been followed by the application of them to Inorganic Nature. This great division of Mr. Spencer’s subject is passed over, however; partly because, even without it, the scheme is too extensive to be carried out in the lifetime of one man; and partly because the interpretation of Organic Nature, after the proposed method, is of more immediate importance. Before noting how Mr. Spencer applies his fundamental principles to the interpretation of the phenomena of life, it may be well to put before the reader’s eye the “formula of evolution” in the author’s own language: “Evolution is an integration of matter and concomitant dissipation of motion; during which the matter passes from an indefinite, incoherent homogeneity to a definite, coherent heterogeneity; and during which the retained motion undergoes a parallel transformation.” This law of evolution is equally applicable to all orders of phenomena,—“astronomic, geologic, biologic, psychologic, sociologic, *etc*.,”—since these are all component parts of one cosmos, though disguised from one another by conventional groupings. It is obvious that, so long as evolution is merely established by induction, it belongs, not to philosophy, but to science. To belong to philosophy it must be deduced from the persistence of force. Mr. Spencer holds that this can be done. For any finite aggregate, being unequally exposed to surrounding forces, will become more diverse in structure, every differentiated part will become the parent of further differences; at the same time, dissimilar units in the aggregate tend to separate, and those which are similar, to cluster together ("segregation"); and this subdivision and dissipation of forces, so long as there are any forces unbalanced by opposite forces, must end at last in rest; the penultimate stage of this process “in which the extremest multiformity and most complex moving equilibrium are established,” being the highest conceivable state. The various derivative laws of phenomenal changes are thus deducible from the persistence of force. It remains to apply them to inorganic, organic, and superorganic existences. The detailed treatment of inorganic evolution is omitted, as we have said, from Spencer’s plan, and he proceeds to interpret “the phenomena of life, mind, and society in terms of Matter, Motion, and Force.”

IV.

The first volume of the “Principles of Biology” consists of three parts, the first of which sets forth the data of biology, including those general truths of physics and chemistry with which rational biology must start. The second part is allotted to the inductions of biology, or, in other words, to a statement of the leading generalizations which naturalists, physiologists, and comparative anatomists have established. The third and final part of the first volume of the “Principles of Biology” deals with the speculation commonly known as “the development hypothesis,” and considers its *a priori* and *a posteriori* evidences.

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The inductive evidences for the evolutionary hypothesis, as contra-distinguished from the special-creation hypothesis, are dealt with in four chapters. The “Arguments from Classification” are these: Organisms fall into groups within groups; and this is the arrangement which we see results from evolution where it is known to take place. Of these groups within groups, the great or primary ones are the most unlike, the sub-groups are less unlike, the sub-sub-group still less unlike, and so on; and this, too, is a characteristic of groups demonstrably produced by evolution. Moreover, indefiniteness of equivalence among the groups is common to those which we know have been evolved, and to those supposed in the volume before us to have been evolved. There is the further significant fact that divergent groups are allied through their lowest rather than their highest members. Of the “Arguments from Embryology,” the first is that, when developing embryos are traced from their common starting-point, and their divergencies and re-divergencies are symbolized by a genealogical tree, there is manifest a general parallelism between the arrangement of its primary, secondary, and tertiary branches, and the arrangement of the divisions and subdivisions of Mr. Spencer’s classifications. Nor do the minor deviations from this general parallelism, which look like difficulties, fail on closer observation to furnish additional evidence; since those traits of a common ancestry which embryology reveals are, if modifications have resulted from changed conditions, liable to be disguised in different ways and degrees, in different lines of descendants. Mr. Spencer next considers the “Arguments from Morphology.” Apart from those kinships among organisms disclosed by their developmental changes, the kinships which their adult forms show are profoundly significant. The unities of type found under such different externals are inexplicable, except as results of community of descent, with non-community of modification. Again, each organism analyzed apart shows, in the likenesses obscured by unlikenesses of its component parts, a peculiarity which can be ascribed only to the formation of a more heterogeneous organism out of a more homogeneous one. And, once more, the existence of rudimentary organs, homologous with organs that are developed in allied animals or plants, while it admits of no other rational interpretation, is satisfactorily interpreted by the hypothesis of evolution. Last of the inductive evidences are the “Arguments from Distribution.” While the facts of distribution in space are unaccountable as results of designed adaptation of organisms to their habitats, they are accountable as results of the competition of species, and the spread of the more fit into the habitats of the less fit, followed by the changes which new conditions induce. Though the facts of distribution in time are so fragmentary that no positive conclusion can be drawn, yet all of them

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are reconcilable with the hypothesis of evolution, and some of them yield strong support,—especially the near relationship existing between the living and extinct types in each great geographical area. Thus of these four categories of evidence, each furnishes several arguments which point to the same conclusion. This coincidence would give to the induction a very high degree of probability, even were it not enforced by deduction. As a matter of fact, the conclusion deductively reached is in harmony with the inductive conclusion. Mr. Spencer has deductively shown that, by its lineage and its kindred, the evolution-hypothesis is as closely allied with the proved truths of modern science as is the antagonist hypothesis, that of special creation, with the proved errors of ancient ignorance. He has shown that, instead of being a mere pseud-idea, it admits of elaboration into a definite conception, so showing its legitimacy as an hypothesis. Instead of positing a purely fictitious process, the process which it alleges proves to be one actually going on around us. To which may be added that the evolution-hypothesis presents no radical incongruities from a moral point of view. On the other hand, the special-creation hypothesis is shown to be not even a thinkable hypothesis, and, while thus intellectually illusive, to have moral implications irreconcilable with the professed beliefs of those who hold it.

Passing from the evidence that Evolution has taken place to the question—How has it taken place?—Mr. Spencer finds in known agencies and known processes adequate causes of its phenomena. In astronomic, geologic, and meteorologic changes, ever in progress, ever combining in new and more involved ways, we have a set of inorganic factors to which all organisms are exposed; and in the varying and complicated actions of organisms on one another we have a set of organic factors that alter with increasing rapidity. Thus, speaking generally, all members of the Earth's flora and fauna experience perpetual rearrangements of external forces. Each organic aggregate, whether considered individually or as a continuously existing species, is modified afresh by each fresh distribution of external forces. To its pre-existing differentiations new differentiations are added; and thus that lapse to a more heterogeneous state, which would have a fixed limit were the circumstances fixed, has its limits perpetually removed by the perpetual change of the circumstances. These modifications upon modifications, which result in evolution, structurally considered, are the accompaniments of those functional alterations continually required to re-equilibrate inner with outer actions. That moving equilibrium of inner actions corresponding with outer actions, which constitutes the life of an organism, must either be overthrown by a change in the outer actions or must undergo perturbations that cannot end until there is a readjusted balance of functions and correlative

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adaptation of structures. But where the external changes are either such as are fatal when experienced by the individuals, or such as act on the individuals in ways that do not affect the equilibrium of their functions, then the readjustment results through the effects produced on the species as a whole: there is indirect equilibration. By the preservation in successive generations of those whose moving equilibria are less at variance with the requirements, there is produced a changed equilibrium completely in harmony with the requirements.

Even were this the whole of the evidence assignable for the belief that organisms have been gradually evolved, Mr. Spencer holds that the belief would have a warrant higher than is possessed by many beliefs which are regarded as established. As a matter of fact, however, the evidence is far from exhausted. At the outset of the first volume of "Principles of Biology," it was remarked by the author that the phenomena presented by the organic world as a whole cannot be properly dealt with apart from the phenomena presented by each organism in the course of its growth, development, and decay. The interpretation of either class of phenomena implies interpretation of the other, since the two are in reality parts of one process. Hence the validity of any hypothesis respecting the one class of phenomena may be tested by its congruity with phenomena of the other class. In the second volume of "The Principles of Biology," Mr. Spencer passes to the more special phenomena of development, as displayed in the structures and functions of individual organisms. If the hypothesis that plants and animals have been progressively evolved be true, it must furnish us with keys to these special phenomena. Mr. Spencer finds that the hypothesis does this, and by doing it gives numberless additional vouchers for its truth. It is impossible for us here to review, even in outline, the extensive field traversed in the second volume of "Principles of Biology." We would not omit, however, to direct attention to the interesting conclusion reached by Mr. Spencer toward the close of the volume with regard to the future of the human race considered from the viewpoint of the possible pressure of population upon subsistence. He points out that in man all the equilibrations between constitution and conditions, between the structure of society and the nature of its members, between fertility and mortality, advance simultaneously towards a common climax. In approaching an equilibrium between his nature and the ever-varying circumstances of his inorganic environment, and in approaching an equilibrium between his nature and all the requirements of the social state, man is at the same time approaching that lowest limit of fertility at which the equilibrium of population is maintained by the addition of as many infants as there are subtractions by death.

V.

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Next in logical order and in order of publication come the two volumes collectively entitled “The Principles of Psychology.” In these volumes an attempt is made to trace objectively the evolution of mind from reflex action through instinct to reason, memory, feeling, and will, from the interaction of the nervous system with its environment. Subjectively, mental states are analyzed, and it is contended that all of them—including those primary scientific ideas, the perceptions of matter, motion, space, and time, assumed in the “First Principles”—can be analyzed into a primitive element of consciousness, something which can be defined only as analogous to a nervous shock. These perceptions have now become innate in the individual. They may be called—as Kant called space and time—forms of intuition; but they have been acquired empirically by the race, through the persistence of the corresponding phenomena in the environment, and from the accumulated experiences of each individual being transmitted in the form of modified structure to his descendants. This principle of heredity is one of the laws by which individuals are connected with one another into an organic whole; and we thus pass to what Spencer calls superorganic evolution, implying the co-ordinated actions of many individuals, and giving rise to the science of sociology.

It is this science which Mr. Spencer undertakes to expound in the three volumes entitled the “Principles of Sociology.” The first of these volumes presents a statement of the several sets of factors entering into social phenomena. These factors are, first, human ideas and feelings considered in their necessary order of evolution; secondly, surrounding natural conditions; and, thirdly, those ever-complicating conditions to which society itself gives origin. Under the caption “The Inductions of Sociology,” are set forth the general facts, structural and functional, gathered from a survey of societies and their changes; in other words, the empirical generalizations that are arrived at by comparing different societies, or successive stages of the same societies. The author then examines the evolution of governments, general and local, as this is determined by natural causes; their several types and metamorphosis; their increasing complexity and specialization, and the progressive limitation of their functions. From political the author turns to ecclesiastical organization. He traces the differentiation of religious government from secular; its successive complications and the multiplication of sects; the growth and continued modification of religious ideas, as caused by advancing knowledge and changing moral character; and the gradual reconciliation of these ideas with the truths of abstract science. A good deal of space is devoted to what the author calls ceremonial organization, by which he means that third kind of government which, having a common root with the others, and slowly becoming separate from and supplementary to them, serves to regulate the minor actions of life. Finally, Mr. Spencer discusses industrial organization; that is to say, the development of productive and distributive agencies, considered in its necessary causes, comprehending not only the progressive division of labor and the increasing complexity of each industrial agency, but also the successive forms of industrial government as passing through like phases with political government.

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Many pages would be requisite adequately to describe the result of the inquiries prosecuted by Mr. Spencer during some twenty years, and embodied in the three volumes entitled “Principles of Sociology.” The ultimate conclusions reached, however, may be summed up in a few paragraphs. It is the author’s final conviction that, if the process of evolution, which, unceasing throughout past time, has brought life to its present height, continues throughout the future, as we cannot but anticipate, then, amid all the rhythmical changes in each society, amid all the lives and deaths of nations, amid all the supplantings of race by race, there will go on that adaptation of human nature to the social state which began when savages first gathered together into hordes for mutual defence,—an adaptation finally complete. Mr. Spencer foresees that many will think this a wild imagination. Though everywhere around them are creatures with structures and instincts which have been gradually so moulded as to subserve their own welfares and the welfares of their species, yet the immense majority ignore the implication that human beings, too, have been undergoing in the past, and will undergo in the future, progressive adjustments to the lives imposed on them by circumstances. There are a few, nevertheless, who think it rational to conclude that what has happened with all lower forms must happen with the highest forms,—a few who infer that among types of men those most fitted for making a well-working society will hereafter, as heretofore, from time to time, emerge and spread at the expense of types less fitted, until a fully fitted type has arisen.

It is, at the same time, conceded that the view thus suggested cannot be accepted without qualification. If we carry our thoughts as far forward as palaeolithic implements carry them back, we are introduced, not to an absolute optimism, but to a relative optimism. The cosmic process brings about retrogression, as well as progression, where the conditions favor it. Only amid an infinity of modifications, adjusted to an infinity of changes of circumstances, do there now and then occur some which constitute an advance: other changes, meanwhile, caused in other organisms, usually not constituting forward steps in organization, and often constituting steps backward. Evolution does not imply a latent tendency to improve everywhere in operation. There is no uniform ascent from lower to higher, but only an occasional production of a form, which, in virtue of greater fitness for more complex conditions, becomes capable of a longer life of a more varied kind. And, while such higher type begins to dominate over lower types, and to spread at their expense, the lower types survive in habitats or modes of life that are not usurped, or are thrust into inferior habitats or modes of life in which they retrogress.

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Mr. Spencer's examination of "The Principles of Sociology" has led him to the belief that what holds with organic types must hold also with types of society. Social evolution throughout the future, like social evolution throughout the past, must, while producing, step after step, higher societies, leave outstanding many lower. Varieties of men adapted here to inclement regions, there to regions that are barren, and elsewhere to regions unfitted, by ruggedness of surface or insalubrity, for supporting large populations, will, in all probability, continue to form small communities of simple structures. Moreover, during future competitions among the higher races, there will probably be left, in the less desirable regions, minor nations formed of men inferior to the highest; at the same time that the highest overspread all the great areas which are desirable in climate and fertility. But while the entire assemblage of societies thus fulfils the law of evolution by increase of heterogeneity,—while within each of them contrasts of structure, caused by differences of environments and entailed occupations, cause unlikenesses implying further heterogeneity, we may infer that the primary process of evolution—integration—which, up to the present time, has been displayed in the formation of larger and larger nations, will eventually reach a still higher stage, and bring yet greater benefits. As when small tribes were welded into great tribes, the head chief stopped inter-tribal warfare; as, when small feudal governments became subject to a king, feudal wars were prevented by him,—so, in time to come, a federation of the highest nations, exercising supreme authority (already foreshadowed by occasional agreements among "the Powers"), may, by forbidding wars between any of its constituent nations, put an end to the re-barbarization which is continually undoing civilization.

When, eventually, this peace-maintaining federation has been formed, Mr. Spencer looks for effectual progress towards that equilibrium between constitution and conditions,—between inner faculties and outer requirements,—implied by the final stage of human evolution. Adaptation to the social state, now perpetually hindered by anti-social conflict, may then go on unhindered; and all the great societies, in other respects differing, may become similar in those cardinal traits which result from complete self-ownership of the unit, and from exercise over him of nothing more than passive influence by the aggregate. On the one hand, by continual repression of aggressive instincts and by continual exercise of feelings which prompt ministration to public welfare, and, on the other hand, by the lapse of restraints gradually becoming less necessary, there will be produced, in Mr. Spencer's forecast, a kind of man so constituted that, while fulfilling his own desires, he will fulfil also the social needs. Already, small groups of men, shielded by circumstances from external antagonisms, have been

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moulded into forms of moral nature so superior to our own that the account of their goodness almost savors of romance; and it is reasonable to infer that what has even now happened on a small scale may, under kindred conditions, ultimately happen on a large scale. Prolonged studies, showing among other things the need for certain qualifications above indicated, but also revealing facts like that just named, have not caused our author to recede from the belief expressed nearly fifty years ago that "the ultimate man will be one whose private requirements coincide with public ones. He will be that manner of man who, in spontaneously fulfilling his own nature, incidentally performs the functions of a social unit; and yet is only enabled so to fulfil his own nature by all others doing the like."

Before taking leave of the "Principles of Sociology," we should caution the reader against a misconception that might seem, at first sight, to find some warrant in the following remark of a sympathetic reviewer: "Like Aristotle, he [Mr. Spencer] has had to delegate large portions of his work to be done for him by others." As our author has himself pointed out in "Facts and Comments," the reviewer's reference will be rightly interpreted by those who know that the work delegated by Aristotle to others was simply the *collection* of materials for his Natural History, not the classification of those materials, much less the drawing of inductions from them. As not one reader in ten knows this, however, wrong impressions are likely to be made by the reviewer's remark. Mr. Spencer's name being especially associated with the "Synthetic Philosophy," the sentence quoted will suggest to many the thought that large portions of that work were written by deputy. This, of course, the reviewer did not mean to say. The work to which he referred is entitled "Descriptive Sociology, or groups of sociological facts, classified and arranged by Herbert Spencer, compiled and abstracted by David Duncan, Richard Scheppig and James Collier," eight parts of which have thus far appeared. Knowing that he should be unable to read all the works of travel and history containing the facts he should need when dealing with the science of society, Mr. Spencer engaged these gentlemen—first one, then two, then three—to read up for him and arrange the extracts they made in a manner prescribed. With much material he had himself accumulated in the course of many years, our author incorporated a much larger amount of material derived from the compilations just mentioned when writing the "Principles of Sociology."

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It is the two volumes entitled the “Principles of Ethics” to which we shall lastly invite attention. The six parts of which this work is composed were published in an irregular manner. Part I., presenting the data of ethics, was issued in 1879; Part IV., a treatise on “Justice,” in 1891; Parts II. and III., which set forth respectively the inductions of ethics and the ethics of individual life, and which, along with Part I., form the first volume, were issued in 1892; Parts V. and VI., which treat respectively of negative beneficence and positive beneficence, were issued in 1893, and, along with Part IV., constitute the second volume. With regard to the “Principles of Ethics,” considered as a whole, it should be noted that the author was prompted to prepare the work, notwithstanding the ill health by which he was incessantly interrupted, by the conviction that the establishment of rules of conduct on a scientific basis is a pressing need. Now that moral injunctions are losing the authority given by their supposed sacred origin, the secularization of morals is becoming imperative. Those who reject the current creed appear to assume that the controlling agency conferred by it may safely be thrown aside. On the other hand, those who defend the current creed allege that, in the absence of the guidance it yields, no guidance can exist, divine commandments being, in their opinion, the only possible guides. Dissenting from both of these beliefs, Mr. Spencer has had for his primary purpose in the two volumes under review to show that, apart from any supposed supernatural basis, the principles of ethics have a natural basis. In these two volumes this natural basis is set forth, and its corollaries are elaborated. If the conclusions to which the general law of evolution introduces us are not in all cases as definite as might be wished, yet our author submits that they are more definite than those to which we are introduced by the current creed. Complete definiteness is not, of course, to be expected. Right regulation of the actions of so complex a being as man, living under conditions so complex as those presented by a society, evidently forms a subject-matter unlikely to admit of specific statements throughout its entire range.

The principal inductions drawn from the data collected in the first of these volumes may be set forth in a few sentences. Multitudinous proofs are brought forward of the fact that the ethical sentiment prevailing in different societies, and in the same society under different conditions, are sometimes diametrically opposed. In Europe and in the United States to have committed a murder disgraces for all time a man’s memory, and disgraces for generations all who are related to him. By the Pathans, however, a contrary sentiment is displayed. One who had killed a Mellah (priest) and failed to find refuge from the avengers, said at length: “I can but be a martyr; I will go and kill a Sahib.” He was hanged

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after shooting a sergeant, perfectly satisfied "at having expiated his offence." The prevailing ethical sentiment in England is such that a man who should allow himself to be taken possession of and made an unresisting slave would be regarded with scorn; but the people of Drekete, a slave-district of Fiji, "said it was their duty to become food and sacrifices for the chiefs," and that "they were honored by being considered adequate to such a noble task." Less extreme, though akin in nature, is the contrast between the feelings which the history of Englishmen has recorded within a few centuries. In Elizabeth's time, Sir John Hawkins initiated the slave-trade, and, in commemoration of the achievement, was allowed to put in his coat-of-arms: "a demi-moor proper, bound with a cord,"—the honorableness of his action being thus assumed by himself, and recognized by Queen and public. At the present day, on the other hand, the making slaves of men, called by Wesley "the sum of all villanies," is regarded in England with detestation; and for many years the British government maintained a fleet to suppress the slave-trade. Again, peoples who have emerged from the primitive family-and-clan organization, hold that one who is guilty of a crime must himself bear the punishment, and it is thought extreme injustice that the punishment should fall upon any one else. The remote ancestors of the English people thought and felt differently, as do still the Australians, whose "first great principle with regard to punishment is that all the relatives of a culprit, in the event of his not being found, are implicated in his guilt: the brothers of the criminal conceive themselves to be quite as guilty as he is." Then, too, among civilized peoples the individualities of women are so far recognized that the life and liberty of a wife are not supposed to be bound up with those of her husband; and she now, having obtained a right to exclusive possession of property, contends for complete independence, domestic and political. It is, or was, otherwise in Fiji. The wives of the Fijian chiefs consider it a sacred duty to suffer strangulation on the deaths of their husbands. A woman who had been rescued by an Englishman "escaped during the night, and, swimming across the river, and presenting herself to her own people, insisted upon the completion of the sacrifice which she had in a moment of weakness reluctantly consented to forego." Another foreign observer tells of a Fijian woman who loaded her rescuer "with abuse, and ever afterwards manifested the most deadly hatred towards him." In England and on the Continent the religious prohibition of theft and the legal punishment of it are joined with a strong social reprobation, so that the offence of a thief is never condoned. In Beloochistan, on the other hand, quite contrary ideas and feelings are current. There "a favorite couplet is to the effect that the Biloch who steals and murders, secures Heaven to seven generations of ancestors."

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In England and the United States reprobation of untruthfulness is strongly expressed, alike by the gentleman and the laborer. In many parts of the world it is not so. In Blantyre, for example, according to MacDonald, “to be called a liar is rather a compliment.” Once more: English sentiment is such that the mere suspicion of incontinence on the part of a woman is enough to blight her life; but there are peoples whose sentiments entail no such effect, and, in some cases, a reverse effect is produced: “Unchastity is, with the Wetyaks, a virtue.” It seems, then, that in respect of all the leading divisions of human conduct, different races of men, and the same races at different stages, entertain opposite beliefs, and display opposite feelings.

In Mr. Spencer’s opinion, the evidence here brought to a focus ought to dissipate once for all the belief in a moral sense, as commonly entertained. A long experience of mankind, however, prevents him from indulging in such an expectation. Among men at large, lifelong convictions are not to be destroyed either by conclusive arguments or multitudinous facts. Only to those who are not by creed or cherished theory committed to the hypothesis of a supernaturally created human species will the evidence above summed up prove that the human mind has no originally implanted conscience. Mr. Spencer himself at one time espoused the doctrine of the intuitive moralists, but it has gradually become clear to him that the qualifications required practically obliterate the doctrine as enunciated by them. It has become clear to him, in other words, that if among civilized folk the current belief is that a man who robs and does not repent will be eternally damned, while an accepted proverb among the Bilochs is, that “God will not favor a man who does not steal and rob,” it is impossible to hold that men have in common an innate perception of right and wrong.

At the same time, while the inductions drawn by Mr. Spencer from the data of ethics show that the moral-sense doctrine in its original form is not true, they also show that it adumbrates a truth, and a much higher truth. For the facts cited, chapter after chapter, unite in proving that the sentiments and ideas current in each society become adjusted to the kinds of activity predominating in it. A life of constant external enmity generates a code in which aggression, conquest, revenge, are inculcated, while peaceful occupations are reprobated. Conversely, a life of settled internal amity generates a code inculcating the virtues conducing to harmonious co-operation,—justice, honesty, veracity, regard for others’ claims. The implication is that, if the life of internal amity continues unbroken from generation to generation, there must result not only the appropriate code, but the appropriate emotional nature,—a moral sense adapted to the moral requirements. Men so conditioned will acquire to the degree needful for complete guidance that innate conscience which the

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intuitive moralists erroneously supposed to be possessed by mankind at large. There needs but a continuance of absolute peace externally and a rigorous insistence on non-aggression internally, to insure the moulding of men into a form naturally characterized by all the virtues. This general induction is re-enforced by especial induction. Now as displaying this high trait of nature, now as displaying that, Mr. Spencer has instanced various uncivilized peoples who, inferior to us in other respects, are morally superior to us. He has also pointed out that such peoples are, one and all, free from inter-tribal antagonisms. The peoples showing this connection between external and internal peacefulness on the one hand, and superior morality on the other, are of various races. In the Indian Hills are found some who are by origin Mongolian, Kelarian, Dravidian; in the forests of Malacca, Burma, and in secluded parts of China exist such tribes of yet other bloods; in the East Indian archipelago are some belonging to the Papuan stock; in Japan there are the amiable Ainos, who have no traditions of internecine strife; and in North Mexico exists yet another such people unrelated to the rest, the Pueblos. Our author holds that no more conclusive proof could be wished than that supplied by these isolated groups of men, who, widely remote in locality and differing in race, are alike in the two respects that circumstances have long exempted them from war, and that they are now organically good. May we not reasonably infer, asks Mr. Spencer, in conclusion, that the state reached by these small, uncultured tribes may be reached by the great cultured nations, when the life of internal amity shall be unqualified by the life of external enmity?

We bring to an end our review of the “Synthetic Philosophy” by pointing out that the ethical doctrine constituting the culmination of the system which is set forth in the “Principles of Ethics” is fundamentally a corrected and elaborated version of the doctrine propounded in “Social Statics” issued as long ago as 1850. The correspondence between the two works is shown not only by the coincidence of their constructive divisions, but also by the agreement of their cardinal ideas. As in the one, so in the other, Man, in common with lower creatures, is held to be capable of indefinite change by adaptation to conditions. In both he is regarded as undergoing transformation from a nature appropriate to his aboriginal wild life, to a nature appropriate to a settled civilized life; and in both this transformation is described as a moulding into a form fitted for harmonious co-operation. In both works, too, this moulding is said to be effected by the repression of certain primitive traits no longer needed, and the development of needful traits. As in the first work, so in this last, the great factor in the progressive modification is shown to be sympathy. It was contended in “Social Statics,” as it is contended in the “Principles of Ethics,”

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that harmonious social co-operation implies that limitation of individual freedom which results from sympathetic regard for the freedoms of others; and that the law of equal freedom is the law in conformity to which equitable individual conduct and equitable social arrangements co-exist. Mr. Spencer's theory in 1850 was, as his theory still is, that the mental products of Sympathy which constitute what is called "the moral sense," arise as fast as men are disciplined into social life; and that along with them arise intellectual perceptions of right human relations, which become clearer as the form of social life becomes better. Further, in the earlier work it was inferred, as it is inferred in the latest, that there is being effected a conciliation of individual natures with social requirements; so that there will eventually be achieved the greatest individuation, along with the greatest mutual dependence,—an equilibrium of such kind that each, in fulfilling the wants of his own life, will aid in fulfilling the wants of all other lives. We observe, finally, that, in the first work, there were drawn essentially the same corollaries respecting the rights of individuals and their relations to the State that are drawn in the "Principles of Ethics."

A word may be said in conclusion about the difference between the relation of Mr. Spencer on the one hand and Darwin on the other to the thought of the Nineteenth Century. The fact is not to be lost sight of that the principles of the Evolutionary, or, as Mr. Spencer prefers to term it, the Synthetic, philosophy were formulated before the publication of the "Origin of Species." What the ultimately general acceptance of the theory propounded in Darwin's work did for Mr. Spencer was precisely this: it greatly strengthened the biological evidence for the evolutionary hypothesis. That hypothesis was upheld, however, by evidence drawn not merely from biology, but from many other sources. Moreover, while the Darwinian theory of natural selection, supplemented as it was by the adoption of the Lamarkian factors,—the effect of use and disuse and the assumed transmissibility of acquired character,—merely attempted to explain the mode in which the changes in organic life have taken place upon the earth, the evolutionary hypothesis put forth by Mr. Spencer professed to be applicable to the whole sphere of the knowable. It is further to be borne in mind that Mr. Spencer has devoted a large part of his life to tracing in detail the applications of his fundamental principles to social, political, religious, and ethical phenomena. Darwin, on the other hand, strictly confined himself to the biological field, and left to disciples the task of indicating the bearing of the Darwinian theory upon sociology, theology, and morals.

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CHARLES ROBERT DARWIN.

1809-1882;

HIS PLACE IN MODERN SCIENCE.

BY MAYO W. HAZELTINE.

There is no doubt that, by the judgment of a large majority of scientists, the place of pre-eminence in the history of science during the nineteenth century should be assigned to Charles Robert Darwin. The theory associated with his name deserves to be called epoch-making. The Darwinian hypothesis, indeed, should not be confounded with the cosmic theory of Evolution which was formulated earlier and independently by Herbert Spencer, and supported by many arguments drawn from sources outside the field of natural history. The specific merit of the Darwinian hypothesis is that it furnishes a rational and almost universally accepted explanation of the mode in which changes have taken place in the development of organic life upon the earth. With the possible cosmical applications of his theory Darwin did not concern himself, though the bearing of his hypothesis upon wider problems was at once discerned, and has been set forth by Spencer and others. Before stating, however, the conclusions at which Darwin arrived in his "Origin of Species," the "Descent of Man," and other writings, and before indicating the extent to which these conclusions have been adopted, we should say a word about his interesting, amiable, and exemplary personality. Concerning his private life, there is no lack of information. He himself wrote an autobiographical sketch which has been amplified by his son Francis Darwin, and supplemented with numerous extracts from his correspondence.

I.

Charles Robert Darwin was born at Shrewsbury, Feb. 12, 1809. His mother was a daughter of Josiah Wedgwood, the well-known Staffordshire potter, and his father, Dr. Robert Waring Darwin, was a son of Erasmus Darwin, celebrated in the eighteenth century as a physician, a naturalist, and a poet. It is a curious fact that in some of his speculations Erasmus Darwin anticipated the views touching the evolution of organic life subsequently announced by Lamarck, and ultimately incorporated by Charles Darwin in the theory that bears his name. The only taste kindred to natural history which Dr.

Darwin possessed in common with his father and his son was a love of plants. The garden of his house in Shrewsbury, where Charles Darwin spent his boyhood, was filled with ornamental trees and shrubs, as well as fruit-trees.

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When Charles Darwin was about eight years old, he was sent to a day-school, and it seems that even at this time his taste for natural history, and especially for collecting shells and minerals, was well developed. In the summer of 1818 he entered Dr. Butler's great school in Shrewsbury, well known to the amateur makers of Latin verse by the volume entitled "Sabrinae Corolla." He expressed the opinion in later life that nothing could have been worse for the development of his mind than this school, as it was strictly classical, nothing else being taught except a little ancient biography and history. During his whole life he was singularly incapable of mastering any language. With respect to science, he continued collecting minerals with much zeal, and after reading White's "Selborne" he took much pleasure in watching the habits of birds. Towards the close of his school life he became deeply interested in chemistry, and was allowed to assist his elder brother in some laboratory experiments. In October, 1825, he proceeded to Edinburgh University, where he stayed for two years. He found the lectures intolerably dull, with the exception of those on chemistry. Curiously enough, while walking one day with a fellow-undergraduate, the latter burst forth in high admiration of Lamarck and his views on evolution. So far as Darwin could afterwards judge, no impression was made upon his own mind. He had previously read his grandfather's "Zooenomia," in which similar views had been propounded, but no discernible effect had been produced upon him. Nevertheless, it is probable enough that the hearing rather early in life such views maintained and praised may have favored his upholding them under a different form in the "Origin of Species."

While at Edinburgh, Darwin was a member of the Plinian Society, and read a couple of papers on some observations in natural history. After two sessions had been spent at Edinburgh, Darwin's father perceived that the young man did not like the thought of being a physician, and proposed that he should become a clergyman. In pursuance of this proposal, he went to the University of Cambridge in 1828, and three years later took a B.A. degree. In his autobiography the opinion is expressed that at Cambridge his time was wasted. It was there, however, that he became intimately acquainted with Professor Henslow, a man of remarkable acquirements in botany, entomology, chemistry, mineralogy, and geology. During his last year at Cambridge Darwin read with care and interest Humboldt's "Personal Narrative," and Sir John Herschel's "Introduction to the Study of Natural Philosophy." These books influenced him profoundly, arousing in him a burning desire to make even the most humble contribution to the structure of natural science. At Henslow's suggestion he began the study of biology, and in 1831 accompanied Professor Sedgwick in the latter's investigations amongst the older rocks in North Wales.

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It was Professor Henslow who secured for young Darwin the appointment of naturalist to the voyage of the "Beagle." This voyage lasted from Dec. 27, 1831, to Oct. 2, 1836. The incidents of this voyage will be found set forth in Darwin's "Public Journeys." The observations made by him in geology, natural history, and botany gave him a place of considerable distinction among scientific men. In 1844 he published a series of observations on the volcanic islands visited during the voyage of the "Beagle," and two years later "Geological Observations on South America." These two books, together with a volume entitled "Coral Reefs," required four and a half years' steady work. In October, 1846, he began the studies embodied in "Cirripedia" (barnacles). The outcome of these studies was published in two thick volumes. The time came when Darwin doubted whether the work was worth the consumption of the time employed, but probably it proved of use to him when he had to discuss in the "Origin of Species" the principles of a natural classification. From September, 1854, and during the four ensuing years, Darwin devoted himself to observing and experimenting in relation to the transmutation of species, and in arranging a huge pile of notes upon the subject. As early as October, 1838, it had occurred to him as probable, or at least possible, that amid the struggle for existence which everywhere goes on in the animal world, favorable variations would tend to be preserved, and unfavorable ones to be destroyed. The result would be the formation of new species.

It was not until June, 1842, however, that Darwin allowed himself the satisfaction of writing a very brief abstract of his theory in thirty-five pages. This was enlarged two years later into one of 230 pages. Early in 1856, Sir Charles Lyell, the well-known geologist, advised him to write out his views upon the subject fully, and Darwin began to do so on a scale three or four times as extensive as that which was afterwards followed in his "Origin of Species." He got through about half the work on this scale. His plans were overthrown, owing to the curious circumstance that, in the summer of 1858, Mr. Alfred E. Wallace, who was then in the Malay archipelago, sent him an essay "On the Tendency of Varieties to depart indefinitely from the Original Type." It turned out upon perusal that this essay contained exactly the same theory as that which Darwin was engaged in elaborating. Mr. Wallace expressed the wish that, if Darwin thought well of the essay, he should send it to Lyell. It was Sir Charles Lyell and Sir Joseph Hooker who insisted that Darwin should allow an abstract from his manuscript, together with a letter to Prof. Asa Gray, dated Sept. 5, 1857, to be published at the same time with Wallace's essay. Darwin was unwilling to take this course, being then unacquainted with Mr. Wallace's generous disposition. As a matter of fact, the joint productions excited very little attention, and the only published notice of them asserted that what was new in them was false, and that what was true was old. From the indifference evinced to the papers which first propounded the theory of natural selection, Darwin drew the inference that it is necessary for any new view to be explained at considerable length in order to obtain the public ear.

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In September, 1858, Darwin, at the earnest advice of Lyell and Hooker, set to work to prepare a volume on the transmutation of species. The book cost him more than thirteen months' hard labor. It was published in November, 1859, under the title of "Origin of Species." This, which Darwin justly regarded as the chief work of his life, was from the first highly successful. The first edition was sold on the day of publication, and the book was presently translated into almost every European tongue. Darwin himself attributed the success of the "Origin" in large part to his having previously written two condensed sketches, and to his having finally made an abstract of a much larger manuscript, which itself was an abstract. By this winnowing process he had been enabled to select the more striking facts and conclusions. As to the current assertion that the "Origin" succeeded because the subject was in the air, or because men's minds were prepared for it, Darwin was disposed to doubt whether this was strictly true. In previous years he had occasionally sounded not a few naturalists, and had never come across a single one who seemed to doubt about the permanence of species. Probably men's minds were prepared in this sense, that innumerable well-verified facts were stored away in the memories of naturalists, ready to take their proper places as soon as any theory which would account for them should be strongly supported. Darwin himself thought that he gained much by a delay in publishing, from about 1839, when the "Darwinian" theory was clearly conceived, to 1859; and that he lost nothing, because he cared very little whether men attributed most originality to him or to Wallace.

Darwin's "Variation of Animals and Plants under Domestication" was begun in 1860, but was not published till 1868. The book was a big one, and cost him four years and two months' hard labor. It gives in the first volume all his personal observations, and an immense number of facts, collected from various sources, about domestic productions, animal and vegetable. In the second volume the causes and laws of variation, inheritance, *etc*., are discussed. Towards the end of the work is propounded the hypothesis of Pangenesis, which has been generally rejected, and which the author himself looked upon as unverified, although by it a remarkable number of isolated facts could be connected together and rendered intelligible.

The "Descent of Man" was published in February, 1871. Touching this work, Darwin has told us that, as soon as he had become (in 1837 or 1838) convinced that species were mutable productions, he could not avoid the belief that man must come under the same law. Accordingly, he collected notes on the subject for his own satisfaction, and not for a long time with any intention of publishing. In the "Origin of Species," the derivation of any particular species is never discussed; but in order that no honorable man should accuse him of concealing

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his views, Darwin had thought it best to add that by that work, "light would be thrown on the origin of man and his history." It would have impeded the acceptance of the theory of natural selection if Darwin had paraded, without giving any evidence, his conviction with respect to man's origin. When he found, however, that many naturalists accepted his doctrine of the evolution of species, it seemed to him advisable to work up such notes as he possessed, and to publish a special treatise on the origin of man. He was the more glad to do so, as it gave him an opportunity of discussing at length sexual selection, a subject which had always interested him.

Darwin's book on the "Expression of Emotion in Men and Animals" was published in the autumn of 1872. This had been intended to form a chapter on the subject in the "Descent of Man," but as soon as Darwin began to put his notes together he saw that it would require a separate treatise. In July, 1875, appeared the book on "Insectivorous Plants." The fact that a plant should secrete, when properly excited, a fluid containing an acid and ferment closely analogous to the digestive fluid of an animal, was certainly a remarkable discovery. In the autumn of 1876 appeared "The Effects of Cross and Self Fertilization," a work in which are described the endless and wonderful contrivances for the transportation of pollen from one plant to another of the same species. About the same time was brought out an enlarged edition of the "Fertilization of Orchids," originally published in 1862. Among the minor works issued during the later years of Darwin's life may be mentioned particularly the little book on "The Formation of Vegetable Mould through the Action of Worms." This was the outgrowth of a short paper read before the Geological Society more than fourteen years before.

In order to appreciate the enormous amount of research accomplished by Charles Darwin, it is needful to keep in mind the conditions of ill-health under which almost continually he worked. For nearly forty years he never knew one day of the health of ordinary men. His life was one long struggle against the weariness and drain of sickness. During his last ten years there were signs of amendment in several particulars, but a loss of physical vigor was apparent. Writing to a friend in 1881, he complained that he no longer had the heart or strength to begin any prolonged investigations. In February and March, 1882, he frequently experienced attacks of pain in the region of the heart, attended with irregularity of the pulse. On April 18 he fainted, and was brought back to consciousness with great difficulty. He seemed to recognize the approach of death, and said, "I am not the least afraid to die." On the afternoon of Wednesday, April 19, he passed away. On April 26 he was interred in Westminster Abbey. The funeral was attended by representatives of France, Germany, Italy, Spain, and Russia, and by delegates of the universities and learned societies of which he had been a member. Among the pall-bearers were Sir John Lubbock, Sir Joseph Hooker, Professor Huxley, Mr. A.R. Wallace, Mr. James Russell Lowell, the Duke of Argyll, and the Duke of Devonshire. The grave is appropriately placed in the north aisle of the nave, only a few feet from the last resting-place of Sir Isaac Newton.

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II.

An outline of Darwin's personality would not be complete without a glance at some of his mental characteristics, and at his attitude toward religion. Of his intellectual powers, he himself speaks with extraordinary modesty in his autobiography. He points out that he always experienced much difficulty in expressing himself clearly and concisely, but he opines that this very difficulty may have had the compensating advantage of forcing him to think long and intently about every sentence, and thus enabling him to detect errors in reasoning and in his own observations, or in those of others. He disclaimed the possession of any great quickness of apprehension or wit, such as distinguished Huxley. He protested, also, that his power to follow a long and purely abstract train of thought was very limited, for which reason he felt certain that he never could have succeeded with metaphysics or mathematics. His memory, too, he described as extensive, but hazy. So poor in one sense was it that he never could remember for more than a few days a single date or a line of poetry. On the other hand, he did not accept as well founded the charge made by some of his critics that, while he was a good observer, he had no power of reasoning. This, he thought, could not be true, because the "Origin of Species" is one long argument from the beginning to the end, and has convinced many able men. No one, he submits, could have written it without possessing some power of reasoning. He was willing to assert that "I have a fair share of invention, and of common sense or judgment, such as every fairly successful lawyer or doctor must have, but not, I believe, in any higher degree." He adds humbly that perhaps he was "superior to the common run of men in noticing things which easily escape attention, and in observing them carefully."

Writing in the last year of his life, he expressed the opinion that in two or three respects his mind had changed during the preceding twenty or thirty years. Up to the age of thirty or beyond it poetry of many kinds gave him great pleasure. Formerly, too, pictures had given him considerable, and music very great, delight. In 1881, however, he said: "Now for many years I cannot endure to read a line of poetry; I have tried lately to read Shakspeare, and found it so intolerably dull that it nauseated me. I have also almost lost my taste for pictures or music. Music generally sets me thinking too energetically of what I have been at work on, instead of giving me pleasure. I retain some taste for fine scenery, but it does not cause me the exquisite delight which it formerly did." Darwin was convinced that the loss of these tastes was not only a loss of happiness, but might possibly be injurious to the intellect, and more probably to the moral character, by enfeebling the emotional side of one's nature. So far as he could judge, his mind had become in his later years a kind of machine for grinding general laws out of large collections of facts, and that atrophy had taken place in that part of the brain on which the higher aesthetic tastes depend. Curiously enough, however, he retained his relish for novels, and for books on history, biography, and travels.

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It is well known that Darwin was extremely reticent with regard to his religious views. He believed that a man's religion was essentially a private matter. Repeated attempts were made to draw him out upon the subject, and some of these were partially successful. Writing to a Dutch student in 1873, he said: "I may say that the impossibility of conceiving that this grand and wondrous universe, with our conscious selves, arose through chance seems to me the chief argument for the existence of God; but whether this is an argument of real value I have never been able to decide. I am aware that if we admit a First Cause, the mind still craves to know whence it came and how it arose. Nor can I overlook the difficulty from the immense amount of suffering through the world. I am also induced to defer to a certain extent to the judgment of the many able men who have fully believed in God; but here again I see how poor an argument this is. The safest conclusion seems to me that the whole subject is beyond the scope of man's intellect; but man can do his duty." To questions put by a German student in 1879, he replied: "Science has nothing to do with Christ, except in so far as the habit of scientific research makes a man cautious in admitting evidence. For myself I do not believe that there ever has been any revelation. As for a future life, every man must judge for himself between conflicting vague probabilities." In the same year he told another correspondent: "In my most extreme fluctuations I have never been an atheist in the sense of denying the existence of a God. I think that generally (and more and more as I grow older), but not always, that an Agnostic would be the more correct description of my state of mind." His latest view is indicated in a letter dated July 3, 1881. Here he expressed the "inward conviction that the universe is not the result of chance." He adds, however: "But, then, with me the horrid doubt always arises whether the convictions of man's mind, which has been developed from the mind of the lower animals, are of any value, or at all trustworthy. Would any one trust the convictions in a monkey's mind, if there are any convictions in such a mind?" The Duke of Argyll has recorded the few words on the subject spoken by Darwin in the last year of his life. The Duke said that it was impossible to look at the wonderful contrivances for certain purposes in nature, and fail to recognize that they were the effect and the expression of mind. Darwin looked at the Duke very hard, and said, "Well, that often comes over me with overwhelming force; but at other times"—here he shook his head vaguely—"it seems to go away."

III.

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We pass to a consideration of Darwin's masterworks, the "Origin of Species," the "Variation of Animals and Plants under Domestication," and the "Descent of Man." Before indicating the conclusions reached in the first of these works, we should point out to what extent Darwin had been preceded by dissenters from the belief once almost universally entertained by biologists that species were independently created, and, once created, were immutable. Lamarck was the first naturalist whose divergent views upon the subject excited much attention. In writings published at various dates from 1801 to 1815, he upheld the doctrine that all species, including man, are descended from other species. He pronounced it probable that all changes in the organic, as well as in the inorganic world, were the result of law, and not of miraculous interposition. He seems to have been led to his opinion that the change of species had been gradual by the difficulty experienced in distinguishing species from varieties by the almost perfect gradation of forms in certain groups, and by the analogy of domestic productions. With respect to the means of modification, he attributed something to the direct action of the physical conditions of life, something to the crossing of already existing forms, and much to use and disuse, or, in other words, to the effect of habit. Finally, he held that characters acquired by an existing individual might be transmitted to its offspring.

In 1813 Dr. W.C. Wells read before the Royal Society "An Account of a White Female, Part of whose Skin resembles that of a Negro." In this paper the author distinctly recognized the principle of natural selection, but applied it only to the races of man, and in man only to certain characters. After remarking that negroes and mulattoes enjoy an immunity from certain tropical diseases, he observed, first, that all animals tend to vary in some degree, and, secondly, that agriculturalists improve their domesticated animals by selection. He added that what is done in the latter case by art seems to be done with equal efficacy, though more slowly, by nature in the formation of varieties of mankind fitted for the countries which they inhabit. Again in 1831 Mr. Patrick Matthew published a work on "Naval Timber and Arboriculture," in which he put forth precisely the same view concerning the origin of species as that propounded by Mr. Wallace and by Darwin. Unfortunately for himself, the view was cursorily suggested in scattered passages of an appendix to a work on a different subject, so that it remained unnoticed until Mr. Matthew himself drew attention to it in 1860, after the publication of the "Origin of Species." We observe finally that Mr. Herbert Spencer, in an essay published in 1852, and republished six years later, contrasted the theories of the creation and the development of organic beings. He argued from the analogy of domestic productions, from the changes which the embryos of many species undergo, from the difficulty of distinguishing species and varieties, and from the principle of general gradation, that species have been modified; and he attributed the modification to the change of circumstances.

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The two volumes comprising the “Origin of Species” constitute, as the author said, one long argument. It is, of course, impossible in the space at our command to recapitulate in detail even the leading facts and inferences which are brought forward to prove that species have been modified during a long course of descent. We must confine ourselves to a succinct statement of the author’s general conclusions. What he undertakes to prove is that the modification of species during a long course of descent has been effected chiefly through the natural selection of numerous successive slight favorable variations, aided in an important manner by the inherited effects of the use and disuse of parts; and in an unimportant manner,—that is, in relation to adaptive structures, whether past or present, by the direct action of external conditions, and by variations which seem to us, in our ignorance, to arise spontaneously. It should be observed that Darwin does not attribute the modification exclusively to natural selection. What he asserts is: “I am convinced that natural selection has been the main, but not the exclusive, means of modification.” He submits that a false theory would hardly explain in so satisfactory a manner as does the theory of natural selection the several large classes of facts marshalled in the two volumes now under review. If it be objected that this is an unsafe method of arguing, Darwin rejoins that it is a method usual in judging of the common events of life, and has often been used by the greatest natural philosophers. The undulatory theory of light, for instance, has thus been arrived at; and the belief in the revolution of the earth on its own axis was, until lately, supported by scarcely any direct evidence. It is no valid objection to the Darwinian theory of the origin of species that science as yet throws no light on the far higher problem of the essence or origin of life. Neither has any one explained what is the essence of the attraction of gravity, though nobody now objects to following out the results consequent on this unknown element of attraction.

Why, it may be asked, did nearly all the most eminent naturalists and geologists until recently decline to believe in the mutability of species? Darwin replies that the belief that species were immutable productions was almost unavoidable as long as the history of the world was thought to be of short duration. Even now that we have acquired some idea of the lapse of time, men are too apt to assume without proof that the geological record is so perfect that it would have afforded plain evidence of the mutation of species if they had really undergone mutation. The chief cause, however, of the once-prevalent unwillingness to admit that one species has given birth to other and distinct species is the fact that men are slow to admit great changes of which they do not see the steps. The difficulty is the same which was experienced by many geologists when Lyell first insisted that long lines of inland cliffs had been formed and great valleys excavated, not by catastrophes, but by the slow-moving agencies which we see still at work. The human mind cannot grasp the full meaning of the term of even a million years; cannot add up and perceive the full effects of many slight variations accumulated during an almost infinite number of generations.

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When the first edition of the "Origin of Species" was published in 1859, Darwin wrote that he by no means expected to convince experienced naturalists whose minds were stocked with a multitude of facts, all regarded during a long course of years from a point of view directly opposite to his. He looked forward with confidence, however, to the future, to young and rising naturalists, who would be able to view both sides of the question with impartiality. He predicted that, when the conclusions reached by him and by Mr. Wallace concerning the origin of species should be generally accepted, there would be a considerable revolution in natural history. Naturalists, for instance, would be forced to acknowledge that the only distinction between species and well-marked varieties is that the latter are known or believed to be connected at the present day by intermediate gradations, whereas species were formerly, though they are not now, thus connected. It might thus come to pass that forms generally acknowledged in 1859 to be merely varieties, would thereafter be thought worthy of specific names; in which case scientific and common language would come into accordance. In short, Darwin looked forward to the time when species would have to be treated in the same manner as genera are treated by those naturalists who admit that genera are merely artificial combinations made for convenience.

Darwin also foresaw that when his theory of the origin of species should be adopted, other and more general departments of natural history would rise greatly in interest. The terms used by naturalists—such terms as affinity, relationship, community of type, paternity, morphology, adaptive characters, rudimentary and abortive organs, *etc*.—-would cease to be metaphorical, and would have a plain signification. "When," he wrote, "we no longer look at an organic being as a savage looks at a ship, as something wholly beyond his comprehension; when we regard every production of nature as one which has had a long history; when we contemplate every complex structure and instinct as the summing up of many contrivances, each useful to the possessor, in the same way as any great mechanical invention is the summing up of the labor, the experience, the reason, and even the blunders of numerous workmen; when we thus view each organic being, how far more interesting—I speak from experience—does the study of natural history become." Once more: "When we can feel assured that all the individuals of the same species, and all the closely allied species of most genera, have within a not very remote period descended from one parent, and have migrated from some one birthplace; and when we better know the many means of migration, then, by the light which geology now throws, and will continue to throw, on former changes of climate and of the level of the land, we shall surely be enabled to trace in an admirable manner the former migrations of the inhabitants of the whole world."

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When Darwin published the “Origin of Species,” he was aware that theologians and philosophers seemed to be fully satisfied with the view that each species had been independently created, and was immutable. To his own mind, however, it accorded better with what was known of the laws impressed on matter by the Creator that the production and extinction of the past and present inhabitants of the world should have been due to secondary causes like those determining the birth and death of the individual. “When I view,” he said, “all beings not as special creations, but as the lineal descendants of some few beings which lived long before the first bed of the Cambrian system was deposited, they seem to me to become ennobled.” And again: “As all the living forms of life are the lineal descendants of those which lived long before the Cambrian epoch, we may feel certain that the ordinary succession by generation has never once been broken, and that no cataclysm has desolated the whole world. Hence we may look with some confidence to a secure future of great length. And as natural selection works slowly by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection.”

For his own part, Darwin could see no good reason why the views propounded in the two volumes comprising the “Origin of Species” should shock the religious feelings of any one. Touching the likelihood of such a result, he reassured himself by recalling the fact that the greatest discovery ever made by man—namely, the law of the attraction of gravitation—was attacked by Leibnitz “as subversive of natural, and inferentially, of revealed, religion.” Darwin was confident that, if any such impressions were made by his theory, they would prove but transient, and that ultimately men would come to see that it is just as noble a conception of the Deity to believe that He created a few original forms capable of self-development into other and needful forms as to believe that it required the fresh act of creation to supply the voids caused by the action of His laws.

IV.

It was, as we have said, in 1868 that Darwin published the two volumes collectively entitled “Variation of Animals and Plants under Domestication.” It is the second and largely corrected edition brought out in 1875 which we have under our eye. It is the outcome of the views maintained by the author in this work and elsewhere that not only the various domestic races but the most distinct genera and orders within the same great class—for instance, mammals, birds, reptiles, and fishes—are all the descendants of one common progenitor, and the whole vast amount of difference between these forms has primarily arisen from simple variability. Darwin recognized that he who for the first time should consider the subject under this point of view would be struck dumb with amazement. He submits, however,

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that the amazement ought to be lessened when we reflect that beings almost infinite in number during an almost infinite lapse of time have often had their whole organization rendered in some degree plastic, and that each slight modification of structure which was in any way beneficial under excessively complex conditions of life has been preserved, whilst each which was in any way injurious has been rigorously destroyed. The long-continued accumulation of beneficial variations will infallibly have led to structures as diversified, as beautifully adapted for various purposes, and as excellently co-ordinated as we see in the animals and plants around us. Hence Darwin regards selection as the paramount power, whether applied by man to the formation of domestic beings or by nature to the production of species. Employing a favorite metaphor, he said: “If an architect were to rear a noble and commodious edifice without the use of cut stone, by selecting from the fragments at the base of a precipice wedge-form stones for his arches, elongated stones for his lintels, and flat stones for his roof, we should admire his skill and regard him as the paramount power. Now, the fragments of stone, though indispensable to the architect, bear to the edifice built by him the same relation which the fluctuating variations of organic beings bear to the varied and admirable structures ultimately acquired by their modified descendants.”

Some critics of the Darwinian theory of the origin of species have declared that natural selection explains nothing, unless the precise cause of each slight individual difference be made clear. Darwin rejoins that if it were explained to a savage utterly ignorant of the art of building how the edifice had been raised, stone upon stone, and why wedge-formed fragments were used for the arches, flat stones for the roof, *etc*.; and if the use of each part and of the whole building were pointed out,—it would be unreasonable if he declared that nothing had been made clear to him, because the precise cause of the shape of each fragment could not be told. This, in Darwin’s opinion, is a nearly parallel case, with the objection that selection explains nothing because we know not the cause of each individual difference in the structure of each being. The shape of the fragments of stone at the base of the hypothetical precipice may be called accidental, but the term is not strictly applicable; for the shape of each depends on a long sequence of events, all obeying natural laws; on the nature of the rock, on the lines of deposition or cleavage, on the form of the mountain, which depends on its upheaval and subsequent denudation, and, lastly, on the storm or earthquake which throws down the fragments.

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In regard to the use, however, to which the fragments may be put, their shape may be strictly said to be accidental. Here Darwin acknowledged that we are brought face to face with a great difficulty in alluding to which he felt that he was travelling beyond his proper province. “An omniscient Creator must have foreseen every consequence which results from the laws imposed by Him. But can it be reasonably maintained that the Creator intentionally ordered, if we use the words in any ordinary sense, that certain fragments of rock should assume certain shapes, so that the builder might erect his edifice? If the various laws which have determined the shape of each fragment were not predetermined for the builder’s sake, can it be maintained with any greater probability that He specially ordained for the sake of the breeder each of the innumerable variations in our domestic animals and plants,—many of these variations being of no service to man, and not beneficial, far more often injurious, to the creatures themselves? Did He ordain that the crop and tail-feathers of the pigeon should vary in order that the fancier might make his grotesque pouter and fan-tail breeds? Did He cause the frame and mental qualities of the dog to vary in order that a breed might be formed of indomitable ferocity with jaws fitted to pin down the bull for man’s brutal sport?”

It is obvious, however, that if we give up the principle in one case,—if we do not admit that the variations of the primeval dog were intentionally guided in order that the greyhound, for instance, that perfect image of symmetry and vigor, might be formed,—-no shadow of reason can be assigned for the belief that variations similar in nature and the result of the same general laws which have been the groundwork through natural selection of the formation of the most perfectly adapted animals in the world, man included, were intentionally and specially guided. Darwin, therefore, was unable to follow the distinguished botanist, Prof. Asa Gray, in his belief that “variation has been led along certain beneficial lines,” like a stream “along definite and useful lines of irrigation.” Darwin’s conclusion was that, if we assume that each particular variation was from the beginning of all time preordained, then that plasticity of organization which leads to many injurious deviations of structure, as well as the redundant power of reproduction which inevitably leads to a struggle for existence, and, as a consequence, to a natural selection or survival of the fittest, must appear to us superfluous laws of nature.

V.

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Next to the “Origin of Species,” the volume which sets forth Darwin’s theory of the “Descent of Man” naturally excited the most widespread attention. This book, which took the author three years to write, was published in 1871, a second and carefully revised edition appearing three years later. The data brought together occupy more than six hundred pages. The conclusions reached may be summed up in a few paragraphs. The principal induction from the evidence is that man is descended from some less highly organized form. It was Darwin’s conviction that the grounds upon which this conclusion rests will never be shaken, for the close similarity between man and the lower animals in embryonic development, as well as in innumerable points of structure and constitution, both of high and of the most trifling importance,—the rudiments which he retains and the abnormal reversions to which he is occasionally liable,—are facts which cannot be disputed. Viewed in the light of our knowledge of the whole organic world, their meaning is unmistakable. The great principle of evolution stands out clear and firm when these groups of facts are considered in connection with others, such as the mutual affinities of the members of the same group, their geographical distribution in past and present times, and their geological succession. It is pronounced incredible that all these facts should speak falsely. He who is not content to look like a savage at the phenomena of nature as disconnected cannot any longer believe that man is the product of a separate act of creation. He will be forced to admit that the close resemblance of the embryo of man to that, for instance, of a dog,—the construction of his skull, limbs, and whole frame on the same plan with that of other mammals, independently of the uses to which the parts may be put; the occasional reappearance of various structures, for instance, of several muscles which man does not normally possess, but which are common to the Quadrumana, and a crowd of analogous facts,—all point in the plainest manner to the conclusion that man is the co-descendant with other mammals of a common progenitor.

Darwin recognized that the high standard of our intellectual powers and moral disposition constitutes the greatest difficulty which presents itself after we have been driven by the mass of biological evidence to accept his conclusion as to the origin of man. Touching this point, he observes: “Every one who admits the principle of evolution must see that the mental powers of the higher animals, which are the same in kind with those of man, though so different in degree, are capable of advancement. Thus the interval between the mental powers of one of the higher apes and of a fish, or between those of an ant and scale-insect, is immense; yet their development does not offer any special difficulty, for with our domesticated animals the mental faculties are certainly variable, and the variations are inherited. No one doubts

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that their mental faculties are of the utmost importance to animals in a state of nature. Therefore the conditions are favorable for their development through natural selection. The same conclusion may be extended to man; the intellect must have been all-important to him, even at a very remote period, as enabling him to invent and use language, to make weapons, tools, traps, *etc*., whereby, with the aid of his social habits, he long ago became the most dominant of all living creatures."

It is further pointed out that a great stride in the development of man's intellect must have followed as soon as the half-art and half-instinct of language came into use; for the continued use of language must have reacted on the brain, and produced an inherited effect, and this again will have reacted on the improvement of language. The largeness of the brain in man relatively to his body, compared with the size of that organ in the lower animals, is attributable in chief part to the early use of some simple form of language, that engine which affixes signs to all sorts of objects and qualities, and excites trains of thought which would never arise from the mere impression of the senses, or, if they did arise, could not be followed out. The higher intellectual powers of man, such as those of ratiocination, abstraction, self-consciousness, *etc*., probably follow from the continued improvement and exercise of the other mental faculties.

How man's moral qualities came to be developed is an interesting problem which is considered by Darwin at some length. He holds that their foundation lies in the social instincts under which term are included family ties. These instincts are highly complex, and, in the case of the lower animals, give special tendencies toward certain definite actions. But the more important elements are love and the distinct emotion of sympathy. Animals endowed with the social instincts take pleasure in one another's company, warn one another of danger, defend and aid one another in many ways. These instincts do not extend to all the individuals of the species, but only to those of the same community. As, however, they are highly beneficial to the species, they have in all probability been acquired through natural selection. In Darwin's judgment the moral nature of man has reached its present standard partly through the advancement of his reasoning powers, and consequently, of a just public opinion, but especially from his sympathies having been rendered more tender and widely diffused through the effects of habit, example, instruction, and reflection. It is pronounced not improbable that, after long practice, virtuous tendencies may be inherited.

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Let us look a little more closely at the matter, for the difficulty of explaining morality forms one of the greatest obstacles to the acceptance of the Darwinian account of the descent of man. What do we mean by a moral being? Manifestly, a moral being is one who is capable of reflecting on his past actions and their motives, and of approving of some while he disapproves of others. Man is the one being who certainly deserves this designation, though attempts have recently been made to show that a rudimentary morality may be traced in some of the lower animals. In the fourth chapter of the book before us, Darwin undertakes to demonstrate that the moral sense follows,—first, from the enduring and ever-present nature of the social instincts; secondly, from man's appreciation of the approbation and disapprobation of his fellows; and, thirdly, from the high activity of his mental faculties, with past impressions extremely vivid; in these latter respects he differs from the lower animals. Owing to this condition of mind, man cannot avoid looking both backwards and forwards, and comparing past impressions. Hence, after some temporary desire or passion has mastered his social instincts, he reflects and compares the now weakened impression of such past impulses with the ever-present social instincts; and he then feels that sense of dissatisfaction which all unsatisfied instincts leave behind them, and resolves to act differently for the future. This dissatisfaction Darwin would identify with conscience. Any instinct permanently stronger or more enduring than another gives rise to a feeling which we express by saying that it *ought* to be obeyed. Darwin suggests that a pointer dog, if able to reflect on his past conduct, would say to himself I *ought* (as indeed we say of him) to have pointed at that hare, and not have yielded to the passing temptation of hunting it.

The belief in God has often been advanced as not only the greatest, but the most decisive, of all the distinctions between man and the lower animals. Darwin brings forward in the book before us a quantity of reasons for holding it to be impossible that this belief is innate or instinctive in man. In some races of men, for instance, we encounter a total want of the idea of God. On the other hand, a belief in all-pervading spiritual agencies seems to be universal, and apparently follows from a considerable advance in man's reason, and from a still greater advance in the faculties of imagination, curiosity, and wonder. "I am aware," says Darwin, "that the assumed instinctive belief in God has been used by many persons as an argument for His existence. But this is a rash argument, as we should thus be compelled to believe in the existence of many cruel and malignant spirits only a little more powerful than man; for the belief in them is far more general than in a beneficent deity. The idea of a universal and beneficent Creator does not seem to arise in the mind of man until he has been elevated by long-continued culture."

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How does the belief in the advancement of man from some low organized form bear on the belief in the immortality of the soul? Sir John Lubbock has proved that the barbarous races of man possess no clear belief of the kind; but, as Darwin continually reminds us, arguments derived from the primeval beliefs of savages are of little or no avail on either side of a question. Attention is directed by Darwin to the more relevant fact that few persons feel any anxiety from the impossibility of determining at what precise period in the development of the individual, from the first trace of a minute germinal vesicle, man becomes an immortal being. He submits that there should be no greater cause for anxiety because the period cannot possibly be determined in the gradually ascending organic scale.

Darwin was well aware that the conclusions arrived at in the work before us—namely, that man is descended from some lowly organized form—would be highly distasteful to many. The very persons, however, who regard the conclusions with distaste admit without hesitation that they are descended from barbarians. Darwin recalls the astonishment which he himself felt on first seeing a party of Fuegians on a wild and broken shore, when the reflection rushed upon his mind that such men had been his ancestors. These men were absolutely naked and bedaubed with paint, their long hair was tangled, their mouths frothed with excitement, and their expression was wild, startled, and distrustful. They possessed hardly any arts, and, like wild animals, lived on what they could catch; they had no government, and were merciless to every one not of their own small tribe. Remembering the impression made on him by the Fuegians, Darwin suggests that he who has seen a savage in his native land will not feel much shame if forced to acknowledge that the blood of some more humble creature flows in his veins. "For my own part," he says, "I would as soon be descended from that heroic little monkey who braved his dreaded enemy in order to save the life of his keeper,—or from that old baboon, who, descending from the mountains, carried away in triumph his young comrade from a crowd of astonished dogs,—as from a savage who delights to torture his enemies, offers up bloody sacrifices, practises infanticide without remorse, treats his wives like slaves, knows no decency, and is haunted by the grossest superstitions." Darwin holds, in fine, that man may be excused for feeling some pride at having risen, though not through his own exertions, to the very summit of the organic scale; it is further submitted that the fact of his having thus risen, instead of having been aboriginally placed there, may give him hope for a still higher destiny in the distant future.

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As a scientist, however, Darwin is not concerned with hopes or fears, but simply with the truth, as man's reason enables him to discern it. We must recognize, he thinks, as the truth, established by an overwhelming array of inductive evidence, that man, with all his noble qualities, with sympathy which he feels for the most debased, with benevolence which extends not only to other men, but to the humblest living creature, with his godlike intellect, which has penetrated into the movements and constitution of the solar system—with all these exalted powers—man still bears in his bodily frame the indelible stamp of his lowly origin.

VI.

We have said that Darwin's theory of the origin of species, together with its corollary, the descent of man, has met with almost universal acceptance by scientists. We have to use the qualifying adverb, because some of Darwin's contemporaries, including Virchow and Owen, not to mention St. George Mivart and the Duke of Argyll, have withheld their adhesion. Since his death, moreover, his disciples have tended to split into two schools. On the one hand, Weismann has rejected the Lamarckian factors,—the effect of use and disuse upon organs, and the transmissibility of acquired characters. The importance of these factors has been emphatically re-asserted, on the other hand, by Lankester and others. Whether biologists, however, range themselves in the Neo-Darwinian or in the Neo-Lamarckian camp, the value of the principle of natural selection is acknowledged by all, and nobody now asserts the independent creation and permanence of species.

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JOHN ERICSSON.

1803-1889.

NAVIES OF WAR AND COMMERCE.

BY W.F. DURAND, PH.D.

The exact combination of inspiration, heredity, and environment which serves to produce genius will perhaps ever be a problem beyond the skill of human intelligence. When the rare elements do combine, however, the result is always worthy of most careful study, both because great achievements furnish a healthy stimulus to emulation, and because some glimpse may be gained of Nature's working in the formation of her rarest products.

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Few lives better illustrate these remarks than that of John Ericsson. Born of middle-class parentage and with no apparent source of heredity from which to draw the stores of genius which he displayed throughout his life, and with surroundings in boyhood but little calculated to awaken and inspire the life-work which later made him famous, from this beginning and with these early surroundings John Ericsson became unquestionably the greatest of the engineers of the age in which he lived and of the century which witnessed such mighty advances along all engineering lines. The imprint left by Ericsson’s life on the engineering practice of his age was deep and lasting, and if one may dare look into the future, the day is far removed when engineers will have passed beyond their dependence on his life and labors.

It is perhaps not amiss that, before looking more closely at the achievements of Ericsson’s life and activity, note should be taken of the large dependence of our present civilization and mode of life on the engineer and his work.

In different ages of the world’s history each has received its name, appropriate or fanciful as the case may have been. For the modern age no name is perhaps more adequately descriptive than the “Age of Energy,” the age in which our entire fabric of civilization rests upon the utilization of the energies of nature for the needs of humanity, and to an extent little appreciated by those who have not considered the matter from this point of view. If we consider the various elements which enter into our modern civilization,—the items which enter into the daily life of the average man or woman; the items which we have come to consider as necessities and those which we may consider as luxuries; the items which go to make up our needs as expressed in terms of shelter, food, intercommunication between man and his fellow, and pleasure,—the most casual consideration of such will serve to show distributed throughout almost the entire fabric of our civilization dependence at some point on the power of the steam-engine, the water-wheel, or windmill, the subtle electric current, or the heat-energy of coal, petroleum oil, or natural gas. The harnessing and efficient utilization of these great natural energies is the direct function of the engineer, or more especially of the dynamic engineer, and in this noble guild of workers, Ericsson carved for himself an enduring place and left behind a record which should serve as an inspiration to all who are following the same pathway in later years.

No one feature perhaps better differentiates our modern civilization from that of earlier times, four hundred years ago, or even one hundred, than that of intercommunication between man and his fellow. Compare the opportunities for such intercommunication in the present with those in the time of Queen Elizabeth, Sir Isaac Newton, George Washington, or Napoleon I. We now have our steamships, steam and electric railroads, cable, telegraph, and telephone. A few years ago not a single one was known. The modern age is one which demands the utmost in the possibility of communication between man and his kind, and in this respect the wide world is now smaller than the confines of an English county a century ago.

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In this field, as we shall see, Ericsson did some of his greatest work, and left perhaps his most permanent record for the future.

Ericsson's life falls most naturally into three periods chronologically or geographically, and likewise into three periods professionally, though the latter mode of subdivision has by no means the same boundaries as the former. The first mode of subdivision gives us the life in Sweden, the life in England, and the life in the United States. The second mode gives us the life of struggle and obscurity, the life of struggle, achievement, and recognition, and the calmer and easier life of declining years with recognition, reward, and the assurance of a life's work well done.

John Ericsson was born in the province of Vermland, Sweden, in 1803. His father was Olof Ericsson, a mine owner and inspector who was well educated after the standard of his times, having graduated at the college in Karlstad, the principal town of the province. His mother was Britta Sophia Yngstrom, a woman of Flemish-Scotch descent, and to whom Ericsson seems to have owed many of his stronger characteristics. Three children were born: Caroline in 1800, Nils in 1802, and John in 1803. Of John's earliest boyhood we have but slight record, but there seems to have been a clear foreshadowing of his future genius. He was considered the wonder of the neighborhood, and busied himself day after day with the machinery of the mines, drawing the form on paper with his rude tools or making models with bits of wood and cord, and endeavoring thus to trace the mystery of its operation.

In 1811 the Ericsson family fell upon evil times. Due to a war with Russia, business became disturbed and in the end Olof Ericsson became financially ruined. This brought the little family face to face with the realities of life, and we soon after find the father occupying a position as inspector on the Goeta Canal, a project which was just then occupying serious attention after having been neglected for nearly one hundred years, and nearly three hundred years after it was first proposed in 1526. Through this connection, in 1815, John and Nils Ericsson were appointed as cadets in a corps of Mechanical Engineers to be employed in carrying out the Government's plans with reference to the canal. During the winter of 1816-17 and at the age of thirteen, John Ericsson received regular instruction from some of his officers in Algebra, Chemistry, Field Drawing, and Geometry, and the English language. Ericsson's education previous to this seems to have consisted chiefly in lessons at home or from tutors, after the manner of the time. He had thus received instruction in the ordinary branches and in drawing and some chemistry. His training in drawing seems to have been unusually thorough and comprehensive, and with a natural genius for such work, his later remarkable skill at the drawing board is doubtless in no small measure due to the excellent instruction which he received in his early years. His progress in his duties as a young engineer was rapid, and he was soon given employment in connection with the canal-work, involving much responsibility and calling for experience and skill.

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At length on reaching the age of seventeen he became stirred with military ambition, and, dissatisfied with his present prospects, he left his position with its opportunities for the future, and entered the Swedish army as ensign of a regiment of Field Chasseurs. This regiment was famous for its rifle practice, and Ericsson was soon one of its most expert marksmen. The routine of army life was, however, far from being sufficient to satisfy the uneasy genius of John Ericsson, and we soon find him engaged in topographical surveying for the Government, and so rapid and industrious in his work that as the surveyors were paid in accordance with the amount accomplished, he was carried on the pay rolls as two men, and paid as such, in order that the amount which he received might not seem too excessive for one individual. Even this was not sufficient to exhaust his energy, and about this time he conceived the idea of publishing a book of plates descriptive of the machinery commonly employed in the mining operations of his day. To this end he collected a large number of sketches which he had prepared in his earlier years, and made arrangements to take up the work of preparation for publication. The drawings selected were to be engraved for the book, and, nothing daunted by the undertaking, Ericsson proposed to do this work himself. After some discouragement the engraving was undertaken, and eighteen copper plates of the sixty-five selected, averaging in size fifteen by twenty inches, were completed within a year. In various ways the project met with delays, and it soon became apparent that the rapid advance in the applications of machinery to mining would render the work out of date, and it was at length abandoned.

At about this time Ericsson seems to have taken up seriously his work on his so-called “flame-engine,” certain experiments made by his father having suggested to him the hope that a source of power might in this way be developed which would be more economical than the steam-engine. At this point we see entering into Ericsson’s life an idea which never left him, which controlled much of his work in mid-life, and which attracted no small part of his attention throughout his closing years. This idea was the discovery of some form of heat-engine which should be more economical than the steam-engine, especially as it was in his day. The flame-engine idea grew rapidly, and soon absorbed his chief attention. Military life now lost its attraction, and in 1826 obtaining leave of absence he left his native land and turned his face toward London, doubtless with the hope strong within him that a substitute for the steam-engine had been found, and that his future lay secure and easy before him.

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The characteristic features of Ericsson’s life up to this time, when he had reached his twenty-third year, are energy, industry, independence, all in most pronounced degree, and combined with a most astonishing insight into mechanical and scientific questions. It was not a period of achievement, but one of formation and of development in those qualities which were soon to make him famous in both worlds. Of his work during this period of life little or nothing outside the idea embodied in the flame-engine can be said to belong to the permanent record of his life’s achievement. This appeared in the “Caloric” engine, and still later in the well-known Ericsson “Air” engine of the present day.

This era was one of development and promise, and richly were the promises fulfilled in the achievements of his later years. A careful study of his life to this point is sufficient to show that, with health and time, such a nature would certainly leave a mark wide and deep on the world in which it was placed. His characteristics were such that achievement was the very essence of life, and, with the promise and potency as revealed in this first twenty-three years of his life, we may be well prepared for the brilliant record of the remaining sixty-three.

With Ericsson’s arrival in London began the second important period of his life. His first efforts were directed toward the introduction of the flame-engine, but he soon found unexpected difficulties in the use of coal as fuel instead of wood, and it became clear that in order to live he must turn his attention to other matters for a time. Then followed a series of remarkable pieces of work in which Ericsson’s genius showed itself, either in original invention or in the adaptation and improvement of the existing facts and material of engineering practice. While thus occupied, his leave from his regiment expired, and he seems to have overlooked taking proper steps to have it renewed. He was thus placed technically in the attitude of a deserter. Through the intervention of a friend, however, he was soon afterward restored, and promoted to the rank of Captain in the Swedish Army. This commission he immediately resigned, and thus his record became technically cleared of all reproach.

To give a mere list of the work with which Ericsson was occupied during the years from 1827 to 1839, when he removed to the United States, would be no small task, and reference to the more important only can be here made. Compressed air for transmitting power, forced draft for boilers by means of centrifugal blowers, steam boilers of new and improved types, the surface condenser for marine engines, the location of the engines of a ship for war purposes below the water line, the steam fire-engine, the design and construction of the “Novelty” (a locomotive for the Rainhill contest in 1829, when Stephenson’s “Rocket” was awarded the prize, though Ericsson, heavily handicapped in time and by lack of

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a track on which to adjust and perfect the “Novelty,” achieved a result apparently in many ways superior to Stephenson’s with the “Rocket"), various designs for rotary engines, an apparatus for making salt from brine, further experimental work with various forms of heat, or so-called “caloric” engines, and the final development, in 1833, of a type from which great results were for a time expected, superheated steam and engines for its use, a deep-sea-sounding apparatus embodying the same principle as that later developed by Lord Kelvin in the well-known apparatus of the present day, a machine for cutting files automatically, various types of steam-engines, and finally his work in connection with the introduction of the screw-propeller as a means of propulsion for steam vessels. These are some of the important lines of work on which Ericsson was engaged during the twelve years of his life in London. In connection with some he was undoubtedly a pioneer, and deserves credit as an original inventor; in connection with others, his work was that of improvement or adaptation; but in all his influence was profound, and the legacy which we have received from this period of engineering progress is due in no small degree to Ericsson, and to his work in London during these years. At a later point we shall refer in some further detail to these questions, but desire for the moment, rather, to gain a broad and comprehensive view of his life as a whole.

Ericsson has been by some called a spendthrift in invention, and the term is not without some justice in its application. His genius was uneasy, and his mind was oppressed by the wealth of his ideas. It was this very wealth which led him from one idea to another, without always taking sufficient time in which to develop and perfect his plans. Rich in invention, he cared but little for exploitation, and when the truth of his predictions was demonstrated, or the ground of his expectation justified, he was eager for new achievements and new combinations of the materials of engineering progress. In this spirit of struggle and unrest, he passed the years in London, rapidly becoming known for his versatility in invention, and for his daring and originality in the details of his engineering work. From 1833 to 1839, or during the second half of this term of residence in London, he became in increasing measure absorbed in his work connected with the screw-propeller as a means of marine propulsion.

Ericsson’s name in the popular mind has been most commonly associated with the “Monitor” and her fight with the “Merrimac” in the Civil War, and next, probably, with the screw-propeller as a means of marine propulsion. It will, therefore, be proper at the present point to refer in some further detail to the circumstances connected with his relation to the introduction of the screw-propeller.

Regarding this question an entire volume might be written without doing more than justice to the subject, but only a brief statement of the chief facts can be here attempted.

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As early as the Seventeenth Century the possibility of developing a propulsive thrust by the use of a submerged helicoidal, or screw, propeller, had been vaguely recognized, and during the following, or Eighteenth Century, the same idea had been brought forward. It had been viewed in this connection, however, merely as a curiosity, and led to no immediate results. Later, in 1804, Francis B. Stevens, of New Jersey, in an experimental boat on the Hudson, operated twin screws, and demonstrated their applicability to the requirements of marine practice. These propellers, in fact, had a form far more nearly approaching the modern screw-propeller than did those which came somewhat later, and which marked the real entry of the screw-propeller into actual and practical service.

Again, in 1812, Ressel, a student in the University of Vienna, began to study the screw-propeller, and his first drawing dates from this time. In 1826 he carried on experiments in a barge driven by hand, and in 1827 an Austrian patent was granted him. Two years later he applied his screw to a boat with an engine of six horse-power, and a speed of six miles per hour was said to have been attained. Then came a bursting steam-pipe, and the police put a stop to the experiments, which seem to have had no further results.

Likewise in 1823 Captain Delisle, of the French Engineers, presented a memorial to his Government in which he urged the use of the submerged propeller for the propulsion of steam vessels. No especial attention was given to the suggestion, however, and it was apparently forgotten until later, when the propeller had become a demonstrated success. Then this memorial was remembered, and its author brought forward to receive his share of credit in connection with the adaptation of the propeller to marine propulsion.

These various attempts to introduce the screw-propeller seem curiously enough to have had no lasting result. They were not followed up, and in the mean time had to some extent passed out of memory, or, if remembered, the absence of result can hardly have acted as an incentive to fresh effort. At the same time it must be admitted that the screw-propeller as a possibility for marine propulsion was known in a vague way to the engineering practice of the day, and it is at this time of course quite impossible to say how much may have been known by Ericsson, Smith, or others concerned in later developments, or to what extent they may have been dependent for suggestion on what had preceded them. The question of who invented the screw-propeller in the absolute sense is entirely futile and without answer. No one could ever have reasonably advanced any such unique claim. At the best it is simply a question of the relative influence in the introduction, improvement, and practical application of what was the common property of the engineering practice of the day.

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In 1833, or at the period now under consideration, however, the paddle-wheel was the recognized instrument of marine propulsion. Since the beginning of the century it had been growing in use with the gradual growth in the application of steam, and at this time it held the field alone. Some years earlier it appears that some of the objections to the paddle-wheel had become plainly apparent to Ericsson, although, occupied with other matters as he was, there was no immediate result. He apparently recognized that the slow revolutions possible with the paddle-wheel did not favor the improvement of the steam-engine along the lines which have since been followed, and he saw clearly that for warship purposes the engines employed, exposed above the water-line to destruction from the shell of an enemy, were entirely out of the question. Finally in 1833 and 1834 we find him employed by a carrying company in London to conduct numerous trials with submerged propellers in the London and Birmingham canal. In an affidavit made in March, 1845, he states that in 1833 his attention was particularly called to the subject of oblique propulsion, and that under his direction propellers of various patterns and embodying these principles were fitted on a canal-boat named the “Francis,” and later in 1834 to another called the “Annatorius.” Shortly after this, or in 1835, his ideas took more definite form, and he refers to his work in a letter to his friend John Bourne in the following terms:—

“1835. Designed a rotary propeller to be actuated by steam-power consisting of a series of segments of a screw attached to a thin broad hoop supported by arms so twisted as also to form part of a screw. The propeller subsequently applied to the steamship ‘Princeton’ was identical with my said design of 1835. Even the mode adopted to determine, by geometrical construction, the twist of the blades and arms of the ‘Princeton’s’ and other propellers was identical with my design of the year last mentioned.”

At about this same time, or in 1835, the attention of Mr. F.P. Smith seems to have been drawn to the subject of the screw-propeller, and we find him taking out a patent for his form, consisting of an elongated helix or spiral of several turns, under date of May 31, 1836. Ericsson’s patent followed some six weeks later, or on July 13, 1836. While it thus appears that Ericsson had been studying the problem since 1833 or earlier, according to his own statements, there is no evidence that Smith’s attention was drawn to the matter earlier than 1835. Delay on Ericsson’s part in the matter of patent gives the earlier date to Smith. The mere date of a patent, however, is of small moment for our present purposes. It must be admitted that the modern form of screw-propeller is quite unlike either of these original forms, although they all involve of course the same fundamental principles. Ericsson’s propeller may properly be called an engineering success, built on sound principles, but improved and largely modified by the results of later experience and research. Smith’s propeller, while capable of propelling a boat, was the design of an amateur rather than of an engineer, and in comparison with Ericsson’s seemed to show a somewhat less accurate appreciation of the underlying principles upon which the propeller operates.

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In the present case, as we have noted above, the question is not so much one of invention as of influence in introduction, adaptation, and improvement. The screw-propeller was already known, but had not been introduced into and made a part of actual engineering practice. Services in this direction are all that can be claimed for any of those concerned with the question during the third decade of the Nineteenth Century. From this point of view we must give to Ericsson large credit. He had the courage of his convictions, and did not allow his work in this direction to lapse for lack of effort on his part to secure its introduction into the practice of the day.

Thus, in 1837, the “Francis B. Ogden” was built for the special purpose of testing the power of the screw-propeller, and was operated on the Thames for the benefit of the British Admiralty and many others. Shortly after this, and largely through the influence of Capt. Robert F. Stockton of the American Navy and Francis B. Ogden, the American Consul at Liverpool, Ericsson began to consider a visit to the United States for the purpose of building, under Stockton’s auspices, a vessel for the United States Navy. While these negotiations were under way, in 1838, he built for Captain Stockton a screw-steamer named the “Robert F. Stockton,” the trials of which attracted much attention from the public at large and from engineers of the time. At about the same period Ericsson’s propeller was fitted to a canal-boat called the “Novelty,” plying between Manchester and London. This was presumably the first instance of a screw-propeller employed on a vessel actually used for commercial purposes.

Finally, in pursuance of Ericsson’s plans with Captain Stockton, he left England Nov. 1, 1839, and started for New York in the steamer “Great Western,” where he arrived November 23, after a long and stormy passage.

We now reach the final scene of Ericsson’s life and professional activities. His visit was at first intended only as temporary, and he seems to have anticipated an early return after carrying out his plans with reference to a ship for the United States Navy. To quote from a letter to his friend, Mr. John O. Sargent, he says: “I visited this country at Mr. Ogden’s most earnest solicitations to introduce my propeller on the canals and inland waters of the United States. I had at the same time strong reasons for supposing that Stockton would be able to start the ‘big frigate’ for which I had prepared such laborious plans in England.” The event was otherwise determined, however, and during the remaining fifty years of his life he lived and wrought in the New World, and as a citizen of his adopted country.

If the record of his twelve years of work in London was long, that for the remaining and maturer years of his life may well be imagined as vastly greater. During the earlier part of this period, or until the Civil War, when all his energies were concentrated upon his work in connection with the “Monitor” type of warship, we find the same wealth of invention and human energy, but for the most part directed along lines related to marine and naval construction. It was a period of training for the fuller fruitage of his genius during the Civil War.

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Shortly after his arrival, or in 1840, a prize was offered by the Mechanics' Institute of New York for the best plan of a steam fire-engine. With his previous experience in London, Ericsson easily carried off the palm and was awarded the prize. He further occupied himself with the introduction of propellers on boats engaged in the inland navigation of the United States, with the design and construction of the United States steam frigate "Princeton," with the development of the compound principle in the steam-engine, then in 1851 with his hot-air ship "Ericsson," or ship propelled by hot-air or caloric engines, as they were then termed, and later with caloric engines in smaller sizes for stationary purposes, of which several thousand were sold during the next succeeding years.

In the work of introducing his propellers good progress was made, especially in boats built for use on the Great Lakes, so that by 1844, when the U.S.S. "Princeton" went into commission, there were in use some twenty-five vessels with the screw-propeller as a means of propulsion.

The project of building a vessel for the American Navy, the purpose which had most strongly attracted Ericsson to the United States, suffered long delay in connection with the arrangements between Captain Stockton and the naval authorities at Washington. At length, in 1841, Captain Stockton was authorized to proceed with the construction of a screw steam frigate of about one thousand tons. This was the U.S.S. "Princeton," which marks an epoch as the first screw vessel-of-war. She was followed by the French "Pomone" in 1843, and the English "Amphion" in 1844, for the equipment of which Ericsson's agent in England, Count Von Rosen, received commissions from the French and English governments respectively.

The "Princeton" was completed in due time and was equipped with two 12-inch wrought-iron guns, one brought by Ericsson from England and one designed and built under the direction of Captain Stockton. At the trials of the ship in 1844 the latter gun exploded, killing the Secretaries of State and of the Navy, besides other prominent visitors on board, and wounding several others. This terrible disaster threw an entirely undeserved stigma upon the ship herself and upon Ericsson's work, and it was not until many years after that his name was entirely free from some kind of reproach in connection with the "Princeton" and the deplorable results of the accident on board.

These are some of the principal lines of work with which Ericsson occupied himself during the twenty-two years between 1839 and 1861. At the latter date came the supreme opportunity of his life, and his services in the art of naval construction during the remainder of the Civil War, which was then in progress, are a part of the history of that great struggle. Here, as with the propeller, volumes might be written in the attempt to give a full account of the inception, growth, and final vindication of Ericsson's ideas regarding naval offence and defence, as expressed by the means available in the engineering practice of the day. The leading points only can be summarized.

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The question of armored ships was in the air. The advantages of armor had been already demonstrated on the French ship “Gloire” and others in connection with the naval part of the Crimean War, and there was a feeling that ironclads of some kind were a necessity of the situation. These facts were perhaps more clearly realized at the South than at the North; and early in 1861 we find Mr. Stephen R. Mallory, the Confederate Secretary of the Navy, taking active steps to raise the “Merrimac,” which had been sunken at the Norfolk Navy Yard, and convert her into an armor-clad. Information regarding this project naturally became known to the Federal authorities, and occasioned President Lincoln and the entire Cabinet the most serious anxiety. At length on August 3, 1861, the appointment of a Board was authorized, the duty of which it should be to examine into the question fully, obtain plans, and recommend the construction of such armor-clads as they should judge best suited to the demands of the situation.

Shortly after this, Ericsson forwarded to President Lincoln a communication in which he offered to construct a vessel “for the destruction of the Rebel fleet at Norfolk and for scouring the Southern rivers and inlets of all craft protected by Rebel batteries.” For one reason or another this communication does not seem to have produced any immediate result. Later, however, when the Board made its report dated September 16, they registered the opinion that the present demand called for “vessels invulnerable to shot, of light draft of water, before going into a more perfect system of large iron-clad seagoing vessels of war.” In pursuance of this idea they recommended the construction of three vessels,—Ericsson’s floating battery, a broadside vessel later known as the “Ironsides,” and the “Galena.” Mr. C.S. Bushnell, who was instrumental in bringing Ericsson’s plans actually before the Board, later associated with himself and Ericsson in the project two gentlemen of means, and large manufacturers of iron plate, Mr. John A. Griswold and Mr. John F. Winslow, who advanced most of the money needed, Mr. Bushnell supplying the remainder. The keel was laid Oct. 25, 1861, and the “Monitor,” as she was named by Ericsson, was launched Jan. 30, 1862, and was turned over to the Government Feb. 19, 1862. This brief record of construction leaves untold all history of the ceaseless struggle against time and of the superb organization and distribution of the work which made possible the completion of such a piece of work in the period of one hundred working days.

One important fact which goes far to explain this astonishing speed in design and construction is found in the fact that Ericsson was not dealing with an entirely new and freshly developed proposition. He has stated that the thought of a floating battery, which should be small in size, but impregnable to the heaviest guns known and yet heavily armed herself, had long occupied his thoughts in connection with the

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problem of the defence of Sweden. Ericsson never forgot his native land, and gave to her political troubles and to the question of her defence against her more powerful neighbors much serious thought. As a result of this study, he had produced as early as 1854 a design embodying all the essential features of the “Monitor,” and this design, shown by a model, was in that year sent to Napoleon III., who was then at war with Russia. This was in the hope that he might in this way contribute to the overthrow of the latter, the hereditary enemy of his native land.

The design, however, was not adopted, and after it was returned was laid aside to collect the dust of his office, until the experiences of the Civil War brought it again to the light. The plan in all its main features had therefore long been matured, and it only remained to proceed rapidly with the details and with the realization of the idea in the most suitable materials to be obtained.

The result of the battle between the “Monitor” and the “Merrimac” in Hampton Roads is a part of history. The relentless devastation which the latter had begun on the old wooden ships of the American Navy at Hampton Roads was stayed, and the wild fears at the North concerning the destruction which she might cause to the shipping and to the seaboard cities was calmed. The “Merrimac” met her master, and retired from the conflict crippled and shorn of power for further evil. A short time later she sank beneath the waters of the Chesapeake, and is now remembered only as the antagonist of the “Monitor.”

If the result of this battle between the “Monitor” and the “Merrimac” marked a turning-point in the naval aspect of the Civil War, it wrought a no less marked change in the standing and fortunes of her designer. Some of his engineering efforts had not met with the success for which he or his friends had hoped. The engines of the air-ship, while a success as a piece of mechanism, were so enormous and heavy that she had to be considered as a commercial failure, and the venture was not repeated; the deplorable accident on the “Princeton” was by some held to be in part chargeable to Ericsson, though a later and full knowledge of the circumstances shows that such was in no wise the case. Again, Ericsson, as an experimenter and pioneer, was by some considered as a dreamer, and before the “Monitor” was completed there was no lack of croakers who prophesied failure or who openly ridiculed the idea. This condition was of course natural. In many ways Ericsson was ahead of his age; and, again, it must not be supposed that he avoided mistakes or that all of his work fully realized the expectations which were based upon it. Furthermore, Ericsson’s spirit was proud, and he was little disposed to accept criticism from those whom he felt to be unqualified to pass adequate judgment on his work, while he was especially impatient under the system by which government work was done. He was therefore but little disposed

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to pleasantly submit to the exasperating delays and interferences with his work which arose from the methods of doing public business, and it is no more than the simple truth to say that during the preceding years the relations between Ericsson and the officials of the Navy Department had often become seriously strained, and they were seldom in cordial accord regarding the various questions which arose in connection with his public work.

With the demonstration made by the “Monitor,” however, the attitude of the public changed in a moment, and Ericsson was hailed on every hand as a public benefactor. He received the thanks of Congress on March 28, 1862, and of the Legislature of the State of New York a little later. Besides these, he was the recipient of numbers of memorials and mementoes, and of such praise in every form as might well have disturbed the equilibrium of a mind less well balanced. In all this change of public opinion, the one thing which must have given him the deepest satisfaction was the change in the attitude of the naval authorities at Washington. He was now considered as one whose ideas had demonstrated their right to serious and respectful attention, and a large fleet of vessels of the monitor type was ordered, similar to but larger than the prototype, and containing such minor changes as experience had suggested. Yet even this was not accomplished without objection. The officers of the navy were accustomed to the old type of wooden ship, and were slow to realize that naval war was, after all, an engineering problem, and that the ideas of the engineer must now be substituted for those which had been sanctified by long ages of past experience. Still, the demonstration was too convincing to admit of serious question, and Ericsson and his associates in business were busily occupied during the remainder of the war in the design and construction of a numerous fleet of vessels of the monitor type.

Ericsson’s work during this period was enormous. One design followed another in quick succession, while work of supervision and inspection and cares of a business nature all combined to make a burden which would have broken down a nature less determined and self-centred, and a body less inured to physical endurance and sustained nervous tension.

This prodigious load was not so much but that he found time to devote to the needs of other nations, and in 1862 he offered to construct for the Chilian government a monitor similar to those under construction for the United States, while later a similar offer was made to the Peruvian Government. With the close of the Civil War Ericsson found still further time to devote to the introduction of this type of vessel into foreign navies, and a considerable part of his time seems to have been occupied with projects of this character, and more particularly with the question of the naval defence of his native land. As regards the introduction of warships of the monitor type,

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the results were not so pronounced as might have been expected, and while the influence of the idea is seen in the practice of every maritime nation in regard to the construction of its warships, still, for the most part, the leading nations preferred to make application of the idea in their own way rather than order such vessels direct from their original designer. Yet in not a few cases the original type was faithfully copied, though it is not always clear to what extent Ericsson himself may have had direct contact with their designs. In 1866 the Swedes were able to test the first of a small fleet of monitors built after Ericsson's plans. This was called the "John Ericsson," and was armed with two 15-inch guns presented to Sweden by Ericsson himself. Later, in 1868, he designed for Spain and superintended the construction of thirty small gunboats for use in Cuban waters.

For nearly ten years now Ericsson had devoted most of his energies to the art of war. It was a time of change and unrest. Heavy guns and armor had brought about a complete break with the past. The torpedo, which had made its appearance in crude form during the Civil War, was attracting more and more attention, and questions of naval offence and defence and of the best governmental policy were attracting the serious attention of all whose duty led them into relation with such matters. Into this problem in its broadest aspects Ericsson threw himself in the early 'seventies with all the ardor of his younger days.

It is proper to explain here that there was one feature of the earlier plans which were submitted to Napoleon III. in 1854, which he did not embody in the "Monitor," and which, indeed, was omitted from all published plans and descriptions of the system given out in former years. This was a system of submarine or subaqueous attack, which, he states in a letter to John Bourne, had attracted his attention since 1826. The time now seemed ripe for the presentation and development of this idea, and he accordingly developed his designs for a torpedo, and for a method of firing it under water from a gun carried in the bow of a boat, and suitably opening to allow the discharge of the torpedo projectile. This was Ericsson's so-called "Destroyer" system, and was embodied finally in a boat called the "Destroyer," which he built in company with his friend, Mr. C.H. Delamater, and with which he carried on numerous experiments. In the end, however, the system did not commend itself to the naval authorities, and the "Destroyer" was left on her designer's hands, an instance of difference of opinion between Ericsson and those charged with the duty of naval administration, and with no supreme test of war to provide opportunity for the determination as to which were the more correct in their judgment. With the "Destroyer," and his work in connection with her, closes the record of Ericsson's connection with the advance in naval construction.

During these later years of his life it must not be supposed that he was less busily occupied than in earlier life. His was a nature which knew no rest, and to the last day of his life he was literally in the harness. Only brief mention however can be made of some of the more important lines of work which interested the closing years of Ericsson's life.

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In connection with his naval designs, he devoted much study to the improvement of heavy ordnance, both as to the gun and its mounting. In particular, his mounting of the guns in the “Monitor” was quite original, and the friction arrangement for absorbing the recoil was a great improvement over methods then in use, and served as a model for many copies and adaptations of the same principles in later years by other designers. In 1863 he also designed and built for the acceptance of the Government a forged 13-inch wrought-iron gun. While his design was an advance on those of the day, the demands on the makers of iron forgings were more than could be successfully met, and the gun developed some slight cracks in the test, which prevented further developments on this line. Ericsson always maintained that the tests to which this gun was submitted were unfairly severe, and he showed how the defects could be remedied by a steel lining. But the Naval Bureau of Ordnance insisted that this should be done at his own expense, and as he had already lost some $20,000 on the gun, he was unwilling to proceed farther, and the matter was allowed to lapse.

Throughout his entire career the improvement of the steam-engine occupied a large share of Ericsson’s attention, and in particular was this the case in connection with his naval designs. From the “Princeton,” in 1841, to the “Destroyer,” in 1878, there succeeded one long series of types and forms of steam-engine, each in his opinion the best adapted to the circumstances of the case. Naturally, opinions differ, and he was brought into competition with other able engineers, and his designs were often called into question or subjected to criticism. In 1863, in competition with Chief Engineer Isherwood of the navy, engines were designed for twin ships, the “Madawaska,” afterward known as the “Tennessee,” and the “Wampanoag,” afterward called the “Florida.” This was a battle royal of types and modes of application of the power of the steam-engine to the propulsion of ships. The result was a victory for Isherwood, although the “Madawaska,” which was first subjected to trial, made a speed higher than any warship at that time afloat. This was exceeded by the “Wampanoag” a short time later; but neither engine was of an enduring type, and after a time the machinery of the “Madawaska” was removed, and she was repowered with a later type of machinery, and long did service as the “Tennessee” in the list of wooden frigates of the navy. The “Florida” was too expensive to maintain in commission, and the special circumstances which had called her into existence having passed by, she was laid up at New London, and never again saw active service.

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Keenly as Ericsson was interested in the steam-engine, it must be admitted that he always showed a more profound interest in some form of engine which should be able to displace it with a superior efficiency; and hence his long series of efforts relating to the flame-engine, the caloric engine, the gas-engine, and finally the solar engine,—with either steam or heated air as the medium for carrying the heat. During the last years of his life some of his most patient and careful study was given to the perfection of a solar engine, or engine for utilizing directly the heat of the sun instead of that of coal or other carbon compounds. Besides this direct line of study and experimentation, he gave during these years much thought to various scientific problems connected with solar energy, the tides, gravitation, the nature of heat, *etc*., *etc*. A plan for deriving power direct from the tides, improvements in high-speed engines for electric-lighting purposes, further improvements in his hot-air engine in small sizes for commercial purposes,—-these are some of the further lines of work which occupied the attention of his closing years.

But the most cunningly devised of all mechanisms, the heart and brain, must sooner or later tire and cease from their labors. The motive energy becomes exhausted, and the mechanism must cease its work. So it was with John Ericsson. In the first hour of the morning of March 8, 1889, Ericsson died. This was within one day of the twenty-seventh anniversary of the battle at Hampton Roads, the event with which the name of Ericsson will always be associated, and which has given to it a significance that will never be forgotten. His remains were first interred in New York, and then, in 1890, in accordance with the request of the Swedish Government, they were returned with impressive services to his native land, where they now rest. In his death he received his highest honors, for his remains were conveyed across the Atlantic by the U.S.S. “Baltimore,” one of the new ships of the navy specially detailed for that service, and on both sides, in the United States and in Sweden, the event was marked with every honor and ceremony which could indicate the significance of his life and services for his adopted land and for the world at large.

The two pieces of work which perhaps will be most permanently linked with the name of Ericsson are the screw-propeller as a means of marine propulsion, and the “Monitor” as a type of warship. In addition to these, however, his life-work was rich in results which bore direct relation to many other improvements in the broad field of marine engineering and naval architecture. Of these a few of the more important may be mentioned, such as the surface condenser, distiller, and evaporator, forced draft for combustion, placing machinery of warships below the water-line, and their protection by coal, ventilation by fan-blowers, together with a vast variety of items involved in the conception and design of the “Monitor” as a whole, and in his other naval designs.

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In order to appreciate the influence of Ericsson's life and work on the field of marine construction, a brief glance may profitably be taken at this branch of engineering work as it was before Ericsson's time, and as it is now.

The material employed for shipbuilding was almost entirely wood. This was displaced in the 'sixties and 'seventies by iron, which in turn was displaced by steel, so that at the present time, except for special reason, no material other than steel is thought of for this purpose. With the gradual displacement of wood by iron in the mercantile marine, Ericsson's relation was only indirect. Some of the earlier mercantile vessels in which he was interested were of wood and some of iron. In the field of warship construction, however, his influence through the "Monitor" was more direct, especially as to the value of metal armor as a protection against great gun-fire. Still, it is no more than justice to say that with the change from wood to iron which took place during the active part of his life, Ericsson had only an indirect relation, and the change would doubtless have come about at the same time, and in much the same general way as it did, independent of any influence which his work may have had upon the question. Turning to the means of propulsion, we find sails as the main, or almost only, reliance during the early years of the century. The steam-engine operating paddle-wheels had come to be recognized as a possibility, and under certain conditions as a commercial success. The screw-propeller as a means of propulsion was known only as a freak idea, and was without status or recognition as a commercial or practical means for propelling ships. So far as the screw-propeller was thought of as a means of propulsion, it lay under a suspicion of loss of efficiency due to the oblique nature of its action, and this was supposed to be such as to render it necessarily and essentially less efficient than the paddle-wheel.

Ericsson lived to see the use of sails almost entirely discarded for war purposes, and for mercantile purposes relegated to ships for special service and of continually decreasing importance. He lived to see the steam-engine take its place as the only means for supplying the power required to propel warships, and attain a position of almost equal relative importance in the mercantile marine. He lived to see the paddle-wheel grow in importance and estimation as a means of propulsion only in turn to be supplanted by the screw-propeller, which gradually increased in engineering favor from the days of its obscure infancy until it became the only means employed for the propulsion of ships navigating the high seas, while it had become a most serious rival to the paddle-wheel even for the purposes of interior and shallow-water navigation,—long a field considered as peculiarly suited to the paddle-wheel and to the engines adapted to its operation.

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Regarding the change from wind to steam for the motive-power of ships, Ericsson did his full share among the engineers of his day, but it would be unfair to many others to claim for him any exclusive or preponderating influence in this movement, and in such matters it is difficult to clearly define the services of any one man. The lines of progress, however, have been in accord with his studies, and his work has certainly had a most direct and powerful influence upon the movement. The most important points of contact between Ericsson's work and these advances were in connection with his introduction of the surface condenser, the use of artificial draft, devices for heating feed water, his studies in superheated steam and its use, and his work in connection with the development of the compound principle in steam-engines, his relation to the introduction of the screw-propeller, and to the use of twin screws at a later time. He also devised and adapted many new types of engines for marine purposes, having respect to the geometrical character of the connections by means of which a reciprocating motion of the piston may be transformed into a rotary motion of the shaft. In particular, he was the first to introduce and show the advantages of engines directly connected to the propeller-shaft, instead of through the more indirect and clumsy modes which others had previously thought necessary.

Aside from his relation to the screw-propeller, perhaps no item of his work in connection with the steam-engine is of more importance than the surface condenser, with its variant forms in the distiller and evaporator. If Ericsson had done nothing else, his claims to recognition and remembrance as an engineer and benefactor might have been well founded on his work in this connection. As it is, the fact that he was so largely instrumental in their perfection and adaptation to marine uses is wellnigh forgotten in the brighter light of his other achievements.

Regarding Ericsson's relation to the successful introduction of the screw-propeller, little need be added to what has already been said. Whatever may be urged regarding dates and patents or earlier years in which the screw-propeller was used, it is a fact that in 1833-35 it was not recognized as an accepted mode of propulsion. While known as a possibility, it had no standing in the engineering practice of the day. A few years later it was recognized as an accepted mode of propulsion and had gained a permanent and definite place in the practice of the day,—a place which has continued to grow in importance until its earlier rival, the paddle-wheel, is almost on the brink of relegation to museums of antiquities, except possibly for rare and special shallow-water uses. A careful and dispassionate study of the facts, so far as they can be known at the present time, seems to indicate clearly that of those who were concerned in successfully adapting the screw-propeller to the needs of marine propulsion and in laying the foundation for these changed conditions, especially in the United States, none was so prominent as Ericsson, or so fairly deserving of the chief credit; and with this judgment the mature thought of the present day seems to agree with little dissent.

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Turning to a consideration from a similar point of view of Ericsson's services in connection with warship design and construction, note may be first taken of the condition of the art of naval warfare in the years 1840-50, or when Ericsson first began his labors in this field.

The material used was wood, the means of propulsion sails, with some thought of steam-engines and paddle-wheels; the means of offence were cast-iron guns large in number but small in size, the largest being 9 or 11 inches in diameter and throwing a shell of some 75 or 130 pounds weight, while the means of defence consisted solely in the "wooden walls," and modern ideas regarding armor had not even appeared above the horizon.

Ericsson's contributions to the art of naval warfare are embodied in the "Princeton," the "Monitor" and its class, and the "Destroyer." In the "Princeton" the material used was wood, and in the "Monitor" and "Destroyer" iron, following simply the developments of the age. In the three the means of propulsion was by screw-propeller. In the "Princeton" the means of offence were two 12-inch wrought-iron guns, as already noted. In the "Monitor" and its type the means of offence were two 11-inch smooth-bore cast-iron guns, followed later by larger guns of 13 and 15 inches of similar type. In the double-turreted monitors four such guns were of course installed. In the "Destroyer" the means of offence was a single gun for discharging a torpedo under water at the bow. On the "Princeton" the means of defence consisted still in wooden walls, while in the "Monitor" and its class the change was profound and complete. The essential idea of the "Monitor" was low freeboard and thus small exposed surface to the ship herself, combined with the mounting of guns in circular revolving turrets, thus giving an all-around fire and on the whole making possible an adequate protection of the exposed parts of the ship and providing for the combination in maximum proportions of armored protection and heavy guns for offence. On the "Destroyer" the means of defence consisted simply in a light deflecting deck armor forward, the vessel being intended to fight bows on and depending on her means of offence rather than defence, which were made quite secondary in character.

The "Monitor," however, was Ericsson's great contribution to the art of naval war, and with it his name will always be associated. It broke with the past in every way. It reduced the number of guns from many to few, two or at most four; it reduced the freeboard from the lofty topsides of the old ship-of-the-line to an insignificant two or three feet, and thus made of the target a circular fort and a low-lying strip of armor. It placed the guns in this circular fort and covered it with armor thick enough to insure safety against any guns then afloat, and thus, as perfectly as the engineering means of the day would permit, insured the combination of offensive and defensive features in maximum degree.

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It cleared away at one stroke masts, sails, and all the lofty top-hamper which since time immemorial had seemed as much an essential feature of the fighting ship as the guns themselves. It transformed the design of the fighting ship from the older ideals expressed in the American frigate “Constitution,” or the English “Victory,” to the simplest terms of offence, defence, and steam motive-power. It made of the man-of-war a machine rather than a ship, an engine of destruction to be operated by engineers rather than by officers of the ancient and traditional type. There is small wonder that in all quarters the idea of ships of this type was not received with enthusiasm. The break with the past was too definite and complete. The monitor type represented simply the solution of the problem of naval warfare worked out by a man untrammelled by the traditions of the past and determined only on reducing such a ship to the simplest terms of offence and defence as expressed by the engineering materials and possibilities of the day. Judged from this standpoint, the vessel seems beyond criticism. She filled perfectly the ideal set before himself by her designer, and represents as a complete and harmonious whole what must still be recognized as the most perfect solution of the problem in terms of the possibilities of those days.

It is proper here that due reference should be made to the claims in behalf of Mr. Theodore R. Timby as an inventor of the turret and of the monitor idea as expressed thereby. These claims and the main facts in the case have long been known, and there should certainly be no attempt to take from any one his due share in the developments which gave to our nation a “Monitor” in her hour of need. It is well known that Mr. Timby between 1840 and 1850 conceived the idea of a revolving fort of iron mounted with numerous guns and intended to take the place of the masonry or earth-structures in common use for such purposes. He seems also to have conceived of a similar structure for use on a ship of low freeboard, and a model showing such a design was constructed. In 1843 he filed a caveat for the invention of the revolving turret. Here the matter apparently rested until 1862, and after the battle between the “Monitor” and “Merrimac,” when he took out a patent which was dated July 8, 1862, covering “a revolving tower for defensive and offensive warfare, whether on land or water.” Ericsson’s associates in the business of building monitors for the Government acquired these patents of Timby, presumably as shrewd business men, in order to quiet any claim on his part, and to have the plan available for land forts, should the opportunity arise to push the business in this direction. There is no question but that Ericsson was antedated by Timby in the suggestion of a revolving turret, at least in so far as public notice is concerned. Ericsson frankly admitted this, and stated that he made no claim to absolute originality in this respect.

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He further stated what is undoubtedly true, that the main idea in the turret, that of a circular revolving fort, antedates the Nineteenth Century as a whole, and its origin is lost in the uncertainties of early tradition. It is simply one of those early ideas which naturally must have been known in essence since time immemorial, and as such it was the common property of the engineering practice of the century. It belongs neither to Timby nor to Ericsson, and no claims regarding priority in this respect are worthy of serious consideration. The question is not who first conceived the idea of a revolving fort, but who designed and built the “Monitor” as she was, and as she met the “Merrimac” on the 9th of March, 1862. The answer to the latter is too well known a part of the history of the times to admit of question or to call for further notice. Ericsson’s claim for recognition in this respect rests not on any priority of idea regarding the use of a circular fort, but rather upon the actual “Monitor” as she was built and as she crushed at one blow the sea-power of the South, and representing as it did a completely and carefully designed whole, dating back to the earlier dealings with Napoleon III. in 1854. This is an age which judges men by what they do, and judged by this standard Ericsson’s claims in connection with the monitor type of warship are never likely to be seriously questioned.

Taking Ericsson’s life and work, what portion remains as a permanent acquisition or as a part of the practice of the present age? This is a question which merits at least a moment’s notice.

We should not make the mistake of thinking that permanency is necessarily a test of merit, or that the value of his services to the world should be judged by such parts of his work as are plainly apparent in the practice of the present day. A piece of work must be judged by the circumstances which brought it forth, and by the completeness and perfection of its adaptation to the needs and possibilities of its age.

We have then the steam fire-engine; compressed air which he early employed in England, and which has become an instrument of enormous importance in connection with the industrial progress of the age, although this is in no especial degree due to his efforts; the surface condenser, distiller, and evaporator are a permanently and absolutely essential part of modern marine practice; the screw-propeller has almost sole possession of the field of marine propulsion; modern marine engines and boilers in naval practice are always placed below the water-line and are protected by deflective deck armor and frequently by coal as well; the turret has become a permanent and accepted part of the practice of the age, while the monitor type in its essential feature seems to be evanescent.

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The modern battleship is a vastly more complex structure, and represents more complex ideas and combinations than did Ericsson’s “Monitor.” It contains a battery of guns of the heaviest type known to naval ordnance. At present such guns are usually of 12-inch bore and throw a shell of about 800 pounds weight, with an initial velocity of nearly 3,000 feet per second. Then there is a supporting battery of guns, 6, 7, or 8 inches in diameter of bore, and finally a secondary battery of smaller quick-firing guns, throwing shells of from 1 pound to 20 or 30 pounds weight, and added to these there may be a torpedo outfit as well. The exigencies of fighting ships at sea and in all weathers seems to have pronounced against the monitor type with its low freeboard as unsuitable for use on the open sea, while the enormous advances in modern guns and armor have made a totally different problem of the distribution of means offensive and defensive. Again, the monitor type was never intended for long cruising, or indeed for other service than the defence of coasts and harbors. The policy of building a vessel thus adapted only to an inner line of defence, and not adapted to an outer line of defence and offence as well, has been further called in question, and the judgment of the present day has decided against such policy. It is true that in the so-called “new navy,” begun in 1883, one monitor, the “Monterey,” has been built, while four others of older type have been somewhat modernized, and there are three monitors building at the present time. It may be doubted, however, if they will be followed by others, at least so long as the conditions of naval warfare and the spirit of public policy remain as they now are.

The monitor type was a perfect solution of the problem of its day, and nobly it answered the calls made on it. The problem has now changed, the conditions affecting its solution have also changed, and it is no discredit to the original type that it now seems to have had its day, and that it must give way to other forms more perfectly expressing the spirit of the present age, and the means available for the solution of present-day problems in the art of naval war.

In many ways, however, the influence of Ericsson’s work still lives in the modern battleship, and while in our modern designs we have gotten far away from the essential features of the monitor type, yet it is not too much to say that the germ of the modern battleship is in many ways found in the “Monitor,” especially as expressed in terms of concentration of heavy gun-fire and localized protection of gun positions; and in more ways than may be suspected, the influence of Ericsson and of his work had its part in the developments which have led to the splendid designs of the present day.

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Returning again to our note of the dependence of the present age on Ericsson, mention may be made of the blower for forcing the combustion in steam-boilers as a well-established feature of standard marine practice, and one absolutely essential to the development of the highest attainable speeds, such as are required in warships, and especially in those of the torpedo and modern “Destroyer” types. Likewise the use of the fan for ventilation, as used by him in his early practice, has become a necessity of modern conditions both on naval and passenger ships, for the health and comfort of both passengers and crew. His long series of experiments and his years of labor on air and other forms of “caloric” engine are only represented by the “Ericsson air-engine” now on the market, and having its fair share of service in locations where simplicity of operation and scarcity of water may naturally suggest its use.

Of his labors in connection with a solar engine, and with other questions which occupied much of the time of his closing years, we have but little direct result. Others are at work on the idea of the solar engine, and it may be that a practicable solution of the problem will be found.

Ericsson’s lasting imprint on engineering practice, curious as it may seem, was made in his earlier and middle life, rather than in his later years, and we have even more in the way of permanent acquisition from his earlier than from his middle years. This results from the fact that in middle life he was largely engaged on warship designs, admirably adapted to the needs of the time and to the possibilities of the age, but no longer suited to either, while in later life he no longer found it necessary to work at problems which would produce a direct financial return, and therefore interested himself in a variety of questions somewhat farther removed from the walks of every-day engineering practice than those with which he was occupied in earlier life.

In personality Ericsson possessed the most pronounced and self-centred characteristics. Professionally he felt that to him had been granted a larger measure of insight than to others into the mysteries of nature as expressed in the laws of mechanics, and he was therefore little disposed to listen to the advice or criticism of those about him. This was undoubtedly one of Ericsson’s most pronounced professional faults. He did not realize that with all his insight into the laws of mechanics and all his capacity for applying these laws to the solution of the problems under consideration, he might well make some use of the work of his fellow-laborers in the same field. So little disposed was he to thus use the work of others that a given device or idea which had been in previous use was often rejected and search made for another, different and original, even though it might involve only some relatively trivial part of the work. He was simply unwilling to follow in the lead of others.

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He must lead or have none of it, and thus the fact that a device or expedient was in common use would furnish an argument against rather than for its adoption. His natural mode of work was utterly to disregard precedent and to seek for fundamental solutions of his problems, having only in view the conditions to be fulfilled, the laws of mechanics, and the engineering materials of construction. This habit of independence and of seclusion within the narrow circle of his own work so grew upon him in later years that mechanical science made many advances of which he took little or no note, and of which he refused to avail himself, even though he might have done so greatly to his own advantage.

In his later years, in a letter to his friend Captain Adlersparre, he says: “Do not laugh at me now, Captain, when I say that nobody can mislead me. Do not condemn me if I at the same time confess that I am directed by nobody’s judgment but my own, and that I never consult anybody and take nobody’s advice.” In all matters connected with his work his will was imperious, and he would brook no interference or criticism. His temper was high, his organization sensitive, and many times throughout his life, relations with his best friends became strained by his instability of temper or impatience with what he might construe as a criticism regarding his work. With this instability of temper, however, was combined a deep-seated tenderness and kindness of heart, and he was as quick to forget the cause of offence as he was to manifest displeasure upon occasion.

Notwithstanding the asperities of Ericsson’s character in regard to his professional work, and his entire lack of effort to make friends among the learned of his day, recognition and unsought honors came in upon him. He was elected to honorary membership in the societies of note in the United States and Sweden, and in addition to the thanks of Congress and of the Legislature of the State of New York, he received a resolution of thanks from the Swedish Riksdag, or Parliament, in 1865. In 1862 he was granted the rarely bestowed Rumford medal, and received at other times during his life medals, honors, and decorations such as have perhaps fallen to no other who has wrought in the same field of human effort. While recognition of this character pleased him greatly when it came spontaneously and willingly, he placed but little value on that which he thought grudgingly or tardily tendered, and in one or two instances refused membership in societies which he thought granted in that manner.

A large measure of this independence of character is necessary to the performance of the work which Ericsson did. Had he been ever ready to listen to the views of others, and to modify his ideas in accordance with them, his greatest achievements would never have been accomplished. In Ericsson, however, this characteristic was carried to an undue extreme, and he might unquestionably have accomplished more had he been able to co-operate with others and to accept and use freely the best work of contemporaries in his own field.

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Ericsson was essentially a designing rather than a constructing engineer. His genius lay in new adaptations of the principles of mechanics or in new combinations of the elements of engineering practice in such way as to further the purposes in view. His mode of expression was the drawing-board. While he wrote vigorously and well, and while he was a frequent contributor in later years to scientific literature, especially on the subject of solar physics, yet his best and natural mode of expression was the graphical representation of his designs on the drawing-board. Forms and combinations took shape in his brain and were transferred to the drawing with marvellous speed and skill. Those who have been associated with him bear testimony that the amount of his work was simply astounding, and that only by a combination of the most remarkable celerity and industry could they have been accomplished.

These drawings were furthermore so minute in detail and so accurate in dimension that as a rule he did not find it necessary to give further attention to the matter after it had left his hands. Of the many parts of a complicated mechanism, one could be sent for construction to one shop and another elsewhere, all ultimately coming together and making a harmonious and perfectly fitting whole. In no other way could such astonishing speed in the detailed construction of the “Monitor” and other vessels of her type possibly have been made; and the fact that such speed in construction was obtained, and largely in this manner, is by no means the least impressive of the many evidences of Ericsson’s genius as a designer.

The designs once completed on the drawing-board, however, Ericsson’s interest in the work ceased in great measure, and as a rule he paid but little attention to constructive details, and took but slight interest in the completed whole. Thus he is said to have visited his “Destroyer” but once after she was built, and then simply in search of his assistant. He also declined an invitation from the Assistant Secretary of the Navy to visit Hampton Roads and inspect the “Monitor” immediately after her fight with the “Merrimac.” He seemed to have no curiosity to inspect his work after it had left his hands, or to receive a report as to the practical working of his designs. This shows a peculiar lack of appreciation of the value of intimate contact with constructive and operative engineering work. No one could hope to avoid errors, or to realize by drawing-board alone the best possible solution of engineering problems. Ericsson wilfully handicapped himself in this manner, and might unquestionably have more effectively improved and perfected his ideas had he been disposed to combine with his designs at the drawing-board practical contact with his work as constructed.

His work was all done in his office at his house. For the last twenty-five years of his life he lived at 36 Beach Street, New York, where he wrought every day in the year, and often until far into the night. His office contained, beside his drawing-table and other furniture, a long table, on which at times, when overcome by fatigue, he would stretch himself and take a short nap, using a dictionary or low wooden box for a pillow.

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His relations with his native land were always close, and, as already hinted, he gave much of his best effort to the study of means for her defence. Toward his friends and relatives he was the embodiment of watchful care and generosity. His private benefactions were for his means large, and were given with a whole-hearted generosity which must have added much to the love and esteem in which the recipients regarded him. His public benefactions were also notable, and during the later years of his life he gave away regularly no inconsiderable share of his income. Though gifted with reasonable prudence, he had no conception of the “business sense,” and no capacity as a money-getter. After acquiring by his inventions and enterprise a modest competence, he devoted himself almost entirely to work less directly related to a financial return, and lived comfortably upon the principal which his earlier efforts had provided.

Ericsson had absolute faith in himself and in his mission to render available the energies of nature for the uses of humanity and civilization. His character was framed about the central idea of fidelity to this mission. He was dogmatic and optimistic as regards his own work; he had a contemptuous indifference to the work of others, and a disregard of the help which he might derive from a closer study of such work. He trained himself, body, mind, and affections, solely with reference to his mission, and allowed no interference with it. He was the embodiment of physical and mental vigor, prodigious industry, continuity of purpose, indomitable courage, capacity for great concentration of mind, and oblivion to all distracting surroundings. With such characteristics, combined with the rare endowment of mental capacity and insight regarding the principles of engineering science, small wonder is it that his life was one so rich in results. It could not have been otherwise, and the results simply came as a consequence of the combination of the characteristics of the man and the surroundings in which he was placed.

The question as to how much more or how much better he might have done had he possessed more faith in the work of others and a willingness to be guided in some measure by their experience is of course idle. Ericsson was a combination of certain capacities and characteristics; a combination of other capacities and characteristics would not have been Ericsson, and any discussion of such a supposition is therefore aside from the purpose of this sketch.

John Ericsson lived in a period of rapid engineering development and change. Old ideals were passing away, and the heritage which the Nineteenth Century was able to pass on to the Twentieth was in preparation. In this preparation Ericsson bore a large and most important part. So long as ships traverse the seas, Ericsson’s name will be remembered for his work in connection with the introduction of the screw-propeller. So long as the memory of naval

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warfare endures, Ericsson's name will be remembered for the part which he bore in the transition from wood to iron, from unarmored ships to turrets and armor, from scattered to concentrated energy of gun-fire, and for his general share in the developments which have led to the ideal of a battleship prevailing at the opening of the Twentieth century. For these and for many other achievements he will be remembered, and his life and works should serve as a constant stimulus to those upon whom the engineering work of the present age has fallen, to see that with equal fidelity they live up to the possibilities of their endowments and opportunities, and serve with like fervency and zeal the needs of the age in which they are placed.

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LI HUNG CHANG.

1823-1901.

THE FAR EAST.

BY W.A.P. MARTIN, D.D., LL.D

INTRODUCTORY.

Five years ago Earl Li was at the head of the "Tsungli Yamen," or Foreign Office in Peking. The present writer, having known him long and intimately, called one morning to request a letter of recommendation to aid in raising money for an International Institute projected by the Rev. Dr. Reid. "He's got one letter; why does he want another?" asked Li, in a tone of mingled surprise and irritation. "True," said I, "but that is from the Tsungli Yamen. Nobody in America knows anything about the Yamen. What he wants is a personal letter from you; because the only Chinese name besides Confucius that is known outside of China is Li Hung Chang."

"I'll give it! I'll give it!" he exclaimed, smiling from ear to ear at the thought of his world-wide reputation.

This was taking him on his weak side; but it was fact, not flattery.

Over forty years ago Li's rising star first came to view in connection with operations against the rebels in the vicinity of Shanghai, and from that day to this, every war, domestic or foreign, has served to raise it higher and make it shine the brighter. It reached its zenith in 1901, when after settling terms of peace with several foreign powers he passed off the stage at the ripe age of fourscore. What better type to set forth his age and nation than the man who, through a long career of unexampled activity, won for himself a triple crown of literary, military, and civil honors? In physique he was a noble specimen of his race, over six feet in height, and in his earlier years uncommonly handsome. The first half of his existence was passed in comparative obscurity at Hofei in Anhui, a region remote from contact with foreign nations.

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It was there his character was formed, on native models; there he carried off the higher prizes of the literary arena; and there he became fitted for the role of China's typical statesman.

His career in outline may be stated in a few words. His native province being overrun by rebels, he passed from the school-room to the camp, and got his earliest lessons in the military art under the leadership of the eminent viceroy Tseng Ko Fan. The neighboring province of Kiangsu falling into the hands of rebel hordes a few years later, he won renown by recapturing its principal cities, by the aid of such men as the American Ward and the English Gordon. His success as a general made him governor of Kiangsu, and his success as governor raised him to the rank of viceroy, holding for many years a post at one or other of the foci of foreign trade north or south.

Beyond the borders of China he was twice sent on special embassies, and once he made the tour of the globe; but his most brilliant achievement was in twice making peace on honorable terms, when his country was lying prostrate before a victorious enemy.

It remains to expand this incomparable catalogue; but to make intelligible that remarkable series of events in which he bore such a conspicuous part, we must first invite our readers to accompany us in a historical retrospect in which we shall point out the opening and growth of foreign intercourse.

I.

INTERCOURSE WITH CHINA BY LAND.

Of the nature of that intercourse in its earlier period, there exists a monument that speaks volumes. That is no other than the Great Wall; which, hugest of the works of man, stretches along the northern frontier of China proper for one thousand five hundred miles from the sea to the desert of Gobi. Erected 255 B.C. it shows that even at that early date the enemies most dreaded by the Chinese were on the north. Yet how signally it failed to effect its purpose! For since that epoch the provinces of Northern China have passed no fewer than seven centuries under Tartar sway. Two Tartar dynasties have succeeded in subjugating the whole empire, and they have transmitted beyond the seas a reputation which quite eclipses the fame of China's ancient sovereigns.

In fact, that which first made China known to the western world was its conquest by the Mongols in the thirteenth century. Barbarous nomads, with longing eyes forever directed to the sunny plains of the south, they also conquered India, bringing under their sceptre the two richest regions of the globe. Of Genghis and Kubla, it may be asserted that they realized a more extended dominion than Alexander, Caesar, or Napoleon ever dreamed of. But

> "Extended empire, like expanded gold,
> Exchanges solid strength for feeble splendor."

Their tenure of China was of short duration,—less than a century. In India, however, their successors, the great Moguls, continued to maintain a semblance of sovereignty even down to our own times, when they were wiped from the blackboard for having taken part in the Sepoy mutiny.

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Liberal beyond precedent, Kubla Khan encouraged the establishment of a Christian bishopric, in which John de Monte Corvino was the first representative of the Holy See. He also welcomed those adventurous Italians, the Polos, and sought to make use of them to open communication with Europe. Yet we cannot forbear to express a doubt, whether, aside from the Christian religion, Europe in that age had much in the way of civilization to impart to China.

Three of the native dynasties, which preceded the Mongol conquest, made themselves famous by advancing the interests of civilization. The house of Han (B.C. 202-A.D. 221) restored the sacred books, which the builder of the Great Wall had destroyed in order to obliterate all traces of feudalism and make the people submit to a centralized government. Even down to the present day, the Chinese are proud to describe themselves as “sons of Han.” The house of Tang, A.D. 618-908, is noted above all for the literary style of its prose-writers and the genius of its poets. In South China the people are fond of calling themselves “sons of Tang.” The house of Sung, A.D. 970-1127, shows a galaxy of philosophers and scholars, whose expositions and speculations are accepted as the standard of orthodoxy. More acute reasoners it would be difficult to find in any country; and in the line of erudition they have never been surpassed.

It is reported that in 643 the Emperor Theodosius sent an envoy to China with presents of rubies and emeralds. Nestorian missionaries also presented themselves at court. The Emperor received them with respect, heard them recite the articles of their creed, and ordered a temple to be erected for them at his capital. This was in the palmy period of the Tangs, when the frontiers of the Empire had been pushed to the borders of the Caspian Sea.

If China in part or in whole was sometimes conquered by Tartars, it is only fair to state that the greatest of the native sovereigns more than once reduced the extramural Tartars to subjection. Between the two races there existed an almost unceasing conflict, which had the effect of civilizing the one and of preventing the other from lapsing into lethargy.

About B.C. 100, Su Wu, one of China’s famous diplomatists, was sent on an embassy to the Grand Khan of Tartary. An ode, which he addressed to his wife on the eve of his perilous expedition, speaks alike for the domestic affections of the Chinese and for their ancient literary culture.

“Twin trees whose boughs together twine,
  Two birds that guard one nest,
We’ll soon be far asunder torn
  As sunrise from the west.

“Hearts knit in childhood’s innocence,
Long bound in Hymen’s ties,
One goes to distant battlefields,
One sits at home and sighs.

“Like carrier dove, though seas divide,
I’ll seek my lonely mate;
But if afar I find a grave,
You’ll mourn my hapless fate.

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“To us the future’s all unknown;
  In memory seek relief.
Come, touch the chords you know so well,
  And let them soothe our grief.”

II.

INTERCOURSE BY SEA.

In 1388 the Mongols were expelled. The Christian bishopric was swept away, and left no trace; but a book of the younger Polo, describing the wealth of China, gave rise to marvellous results. Together with the magnetic needle, which originated in China, it led to centuries of effort to open a way by sea to that far-off fairyland. It was from Marco Polo that Columbus derived his inspiration to seek a short road to the far East by steering to the West,—finding a new world athwart his pathway. It was the same needle, if not the same book, that impelled Vasco da Gama to push his way across the Indian Ocean, after the Cape of Good Hope had been doubled by Bartholomew Diaz. A century later the same book led Henry Hudson to search for some inlet or strait that might open a way to China, when, instead of it, he discovered the port of New York.

The mariner’s compass, which wrought this revolution on the map of the world, is only one of many discoveries made by the ancient Chinese, which, unfruitful in their native land, have, after a change of climate, transformed the face of the globe.

The polarity of the loadstone was observed in China over a thousand years before the Christian era. One of their emperors, it is said, provided certain foreign ambassadors with “south-pointing chariots,” so that they might not go astray on their way home. To this day the magnetic needle in China continues to be called by a name which means that it points to the south. It heads a long list of contraries in the notions of the Chinese as compared with our own, such, for example, as beginning to read at the back of a book; placing the seat of honor on the left hand; keeping to the left in passing on the street, with many others, so numerous as to suggest that the same law that placed their feet opposite to ours must have turned their heads the other way. To the Chinese the “south-pointing needle” continued to be a mere plaything to be seen every day in the sedan chair of a mandarin, or in wheeled vehicles. If employed on the water, it was only used in coasting voyages.

So with gunpowder, of which the Arabs were transmitters, not inventors. In other lands it revolutionized the art of war, clothing their people with irresistible might, while in its native home it remained undeveloped and served chiefly for fireworks. Have we not seen, even in this our day, the rank and file of the Chinese army equipped with bows and arrows? The few who were provided with firearms, for want of gunlocks, had to set them off by a slow-match of burning tow; and cannon, meant to guard the mouth of the Peiho, were trained on the channel and fixed on immovable frames.

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The art of printing was known in China five centuries before it made its way to Europe. The Confucian classics having been engraved on stone to secure them from being again burned up, as they had been by the builder of the great wall, the rubbings taken from those stones were printing. It required nothing but the substitution of wood for stone and of *relievo* for *intaglio* to give that art the form it now has. The smallest scrap of printed paper in the lining of a tea chest, or wrapped about a roll of silk, would suffice to suggest the whole art to a mind like that of Gutenberg. In China it never emerged from the state of wood engraving. The “Peking Gazette,” the oldest newspaper in the world, is printed on divisible types, but they are of wood, not metal, more than one attempt to introduce metallic types having proved unsuccessful, for the want of that happy alloy known as type-metal. It is from us that they have learned the art of casting type, especially that splendid achievement, the making of stereotype plates, and, later, electrotype plates, by the aid of electricity and acid solutions. Chemistry, from which this beautiful art takes its rise, carries us back to China, for it was there that alchemy had its birth, as I have elsewhere shown.[4]

[Footnote 4: “The Lore of Cathay.” New York: Fleming R. Revell Co., p. 41.]

Man’s first desire is long life; his second, to be rich. The Taoist philosophy commenced with the former before the Christian era, but it was not long in finding its way to the latter. A powerful impulse was thus given to research in the three departments of science,—chemistry, botany, and geography. As in the case of gunpowder, the Arabs transmitted these discoveries to the West, and along with them the Chinese doctrine as to the twofold objects of alchemic studies,—the elixir of life and the philosopher’s stone.

From this double root sprang the chemistry of the West, which in no mean sense has fulfilled its promise by prolonging life and enriching mankind. In all these the West has performed the part of a nursing mother, but she has brought the nursling back full grown, and prepared to repay its obligation to its true parent by effective service.

Portuguese merchants made their way to Canton early in the sixteenth century, but it was not till the latter part of the century that Catholic missionaries entered on their grand crusade. In 1601 the Jesuit pioneer Matteo Ricci and his associates, impelled by religion and armed with science, presented themselves at the court of Peking. The Chinese had been able to reckon the length of the year with remarkable accuracy two thousand years before the time of Christ, but their science had made no headway. The missionaries found their calendar in a state of confusion, vanquished the native astronomers in fair competition, and were formally installed as keepers of the Imperial Observatory; and these missionaries supervised the casting of the bronze instruments which have since been taken to Berlin.

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This honor they retained even after the fall of the native dynasty that patronized them. When the Manchus effected their conquest in 1644, not only were the Jesuit missionaries left in charge of the observatory, but the heir apparent was placed under their instruction. Coming to the throne in 1662, under the now illustrious title of *Kanghi*, the young prince showed himself a generous patron as he had previously been a respectful pupil. He was apparently not averse to the idea of his people's adopting Christianity as their national religion, and allowed the missionaries a free hand to plant churches throughout the vast interior. Rarely if ever has so fine an opportunity offered for making an easy conquest of a pagan empire. It was lost through the jealousy of contending societies, and especially through the blunder of an infallible Pope. The Dominicans denounced the Jesuits for tolerating the practice of pagan rites, such as the worship of ancestors, and for employing for God the name of a pagan deity. The name which they then objected to was Shang-ti, Supreme Ruler, a venerable designation for the Supreme Power found in the earliest of the Chinese canonical books, and at this day accepted by a large proportion of Protestant missionaries.

The question as to its fitness was referred to the Emperor, who decided in favor of the Jesuits. It was then brought before the Papal See, condemned as idolatrous, and Tien Chu, the Lord of Heaven, adopted in its stead. That Shang-ti, however pure in origin, had come to be applied to a whole class of deities was perfectly true, but the name proposed in its stead was not free from a taint of idolatry,—Tien Chu, Lord of Heaven, being one of eight divinities, and worshipped along with Ti Chu, Lord of Earth, Hai Chu, Lord of the Sea, *etc*.

The manner in which his opinions had been set aside by the Pope had no doubt a repelling influence on the mind of the Emperor, so that if he had ever felt inclined to embrace Christianity, he drew back in his later years. Not only so, but he left behind him a series of Maxims in which he censures the foreign creed and warns his people against it. These Maxims were ordered to be read in public by mandarins, and they continue to be recited and expounded as a sort of religious ritual. Is it surprising that this lost opportunity was followed by a century and a half of open persecution? That most of the churches survived, not only attests the zeal with which the Faith had been propagated, it throws a pleasing light on the force of the Chinese character. At the dawn of our new epoch, there were still some half a million converts,—with here and there a foreign Father hiding in their midst.

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In bringing about this change of policy there was indeed another influence at work. Had not the Emperor of China heard some rumors of what was going on in the dominion of his cousin, the Great Mogul—how the French were dispossessing the Portuguese; and how the English later on succeeded in expelling the French? How could they doubt that a large community of native Christians would act as an auxiliary to any foreign invader? A suspicion of this kind had in fact sprung up under the preceding dynasty. In consequence of it not a single seaport except Macao was opened to foreign trade; and when foreigners went to Canton, they were lodged in a suburb and not allowed to penetrate within the walls of the provincial capital. Such misgivings as to the designs of foreigners we find strikingly expressed in a book of that period called “Strange Stories of an Idle Student.”

One story is as follows: When Red-Haired Barbarians first appeared on our coast they were not allowed to come ashore. They begged, however, to be permitted to spread a carpet on which to dry their goods, and this being granted, they took the carpet by its corners and stretched it so that it covered several acres. On this, they debarked in great force and, drawing their swords, took possession of the surrounding country.

III.

THE OPIUM WAR.

The first great event that woke China from her dream of solitary grandeur was the war with England, which broke out in 1839 and was closed three years later by the Treaty of Nanking. It was not, however, all that was needed to effect that object. It made the giant rub her eyes and give a reluctant assent to terms imposed by superior force. But many a rude lesson was still required before she came to perceive her true position, as on the lower side of an inclined plane. To bring her to this discovery four more foreign wars were to follow before the end of the century, culminating in a siege in Peking and massacres throughout the northern provinces which may be looked on as the fifth act in a long and bloody tragedy.

In the last three wars Li Hung Chang was a prominent actor. In the first two he took no part. Yet was it the shock which they gave to the empire that drove him from a life of literary seclusion to do battle in a more public arena.

The Opium War of 1839 is not improperly so designated, but nothing is more erroneous than to infer that it was waged by England for the purpose of forcing the product of her Indian poppy fields on the markets of China. Opium was the occasion, not the cause. The cause, if we are to put it in a single word, was the overbearing arrogance of an Oriental despotism, which refused to recognize any equal in the family of nations.

In the Straits settlements and in the seaports of India, Chinese merchants had been brought under sway of the bewitching narcotic. It found its way to their southern seaports, and without being recognized as an article of commerce, the trade expanded with startling rapidity. The Emperor, Tao Kwang, one of the most humane of rulers, resolved to take measures for the suppression of the vice. He had come to the throne in 1820; and there is a story that he was moved to action by the untimely fate of his eldest son, who had fallen a victim to the seductive poison.

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Commissioner Lin, whom he selected to carry out his prohibitory policy, was a fit instrument for such a master, equally virtuous in his aims and equally tyrannical in his mode of proceeding. Arriving at Canton, his first object was to get possession of the forbidden drug, which was stored on ships outside the harbor. This he thought to accomplish by surrounding the whole foreign community by soldiers and threatening them with death if the opium was not promptly surrendered. While its owners or their agents hesitated, Captain Elliot, the British Superintendent of Trade, came up from Macao, and demanded to share the duress of his nationals. He then called on them to deliver up the drug to him to be used in the service of the Queen for the ransom of the lives of her subjects, assuring them that they would be reimbursed from the public treasury. No fewer than twenty-one thousand chests, valued at nine million dollars, were brought in from the opium ships and formally handed over to Commissioner Lin. The foreign community was set free, and the drug destroyed by being mixed with quicklime.

War was made to punish this outrage on the rights of the foreign community, and to exact indemnity for the seizure of their property. Canton was not captured, but held to ransom, and the haughty Viceroy sent into exile. Other cities were taken and held; and, in 1842, a treaty of peace was signed at Nanking by which five ports were opened to foreign trade. The embargo on opium was not withdrawn; but the defeat of the Chinese resulted in a virtual immunity from seizure together with a growth of the traffic, such as to justify the ill-odored name which that war still bears in history.

Treaties with other powers followed in quick succession. On demand of the French Minister, the Emperor recalled his prohibitory decrees against Christianity and issued an Edict of Toleration. If the opening of the ports gave a stimulus to trade, the decree of toleration opened a door for missionary enterprise. As yet, however, neither merchant nor missionary was allowed to penetrate into the interior; while the capital and the whole of the northern seacoast remained inaccessible. This was obviously a state of things that could not be permanent; yet fifteen years were to pass before another war came to settle the terms of intercourse on a broader basis.

When the war broke out, Li Hung Chang was seventeen years of age, living at Hofei in Anhui. As there were then no newspapers in China it may be doubted whether he heard of it until a British squadron sailed up to Nanking and extorted a treaty at the cannon’s mouth. Li was rudely startled by the appearance of a new force, to which there was no allusion in any of his ancient books. Along with the sailing-ships there were two or three small steamers. It struck the Chinese with astonishment to see them make head against wind and tide. *Shin Chuan*, “ships of the gods,” is the name they gave those mysterious vessels. Little could Li foresee the part he was destined to take in creating a steam navy for China.

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Descended from a long line of scholars, he was supposed to be born to the pursuit of letters. He did, in fact, devote himself to study with unflagging zeal, because he had as yet no temptation to turn aside. Was there not, moreover, an open door before his face inviting him to win for himself the honors of a mandarinate? In his native town he placed his foot on the first step of the ladder by gaining the degree of A.B., or, in Chinese, “Budding Genius.” At the provincial capital he next carried off the laurel of the second degree, which is worth more than our A.M., not merely because it is not conferred in course, but because it falls to the lot of only one in a hundred among some thousands of competitors. These provincial tournaments occur but once in three years; and the successful candidates proceed to Peking to compete for the third degree, or D.C.L.,—*Tsin-shi*, or, “Fit for Office.” Here the chances amount to three per cent.

Li’s fortunes were again propitious, and in company with two or three hundred new-made doctors, he was summoned to the palace to contend in presence of the emperor for the honor of a seat in the Imperial Academy,—the Hanlin, or “Forest of Pencils.” Here also he met with success, but he was not among the first three whose names are marked by the vermilion pen of majesty, each of whom sheds lustre on his native province. The highest of the three is called Chuang Yuen, “Head of the List” or “Prince of Letters.” In the ’fifties it fell to a native of Ningpo, where I then lived. His good luck was announced to his wife by the magistrate in person, who conducted her to the six gates, at each of which she scattered a handful of rice, as an omen of good fortune. In the ’sixties, when I had removed to Peking, this honor was for the first time conferred on a Manchu, a son of the General Saishanga. His daughter was deemed a fit consort for the heir to the throne, wearing for a short time the tiara of empress, and committing suicide on the death of her lord.

In the two previous contests, handwriting goes for nothing, but in this it is not without weight, as the avowed object is to select scribes for the service of the throne. On those occasions extent of erudition and originality of thought are the qualities most esteemed; but this time the order of merit is decided by superficial elegance of style, and by facility in the composition of verse.

However defective the standard of learning, this long course of competition, extending over ten or fifteen years, has the effect of bringing before the throne a body of men each of whom is the survivor of a hundred contests. No country can boast a better system for the selection of talent, and the government guards it with jealous care. I have known more than one examiner put to death for tampering with this ballot-box of the Empire. For ages it has provided the state with able officers; nor is its least merit that of converting a dangerous demagogue into a quiet student.

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While waiting for an appointment, Li heard with dismay that Nanking had been taken by a body of rebels, and that his native province was in danger of being overrun by them. A new career opened before him,—one that led more directly to the highest offices within the gift of the sovereign. Asking a commission in the army, he was assigned to a position on the staff of Tsengkofan, father of the Marquis Tseng, who was afterwards Minister to England.

This rebellion, among the strangest of strange things, now claims our attention.

IV.

THE TAIPING REBELLION.

In April, 1853, the news reached us that Nanking had fallen into the hands of a body of rebels who, by a curious irony, called themselves Taipings, “Soldiers of Peace.”

They were Chinese, not Manchus, and their leaders were all from the extreme south. Starting near Canton, they had proclaimed as their object the expulsion of the Tartars. Overrunning Kwangsi and Hunan, they had got possession of Hankow and the two adjacent cities,—a centre of wealth which may be compared to the three cities that form our Greater New York. Everywhere they put to flight the government forces; but they did not choose to stop anywhere short of the ancient capital of the Mings. Seizing some thousands of junks, they filled them with the plunder of that rich mart, and sweeping down the river, carried by assault every city on its banks until they reached Nanking. Its resistance was quickly overcome; and putting to death the entire garrison of twenty-five thousand Manchus, they announced their intention to make it the capital of their empire, as Hung Wu had done when he drove out the Mongols and restored freedom to the Chinese race.

In a few months they despatched an expedition to expel the Manchus from Peking. But that proved a more difficult task than they expected. Before the detachment had arrived at Tientsin, it was met on the Grand Canal by a strong force under Sengkolinsin, the Mongol prince. Obliged to winter on the way, it was divided and cut off in detail; this defeat making it evident to all the world that the Manchu domination might still hope for a considerable lease of life. The blood and rapine which everywhere marked their pathway alienated the sympathy of foreigners from the Soldiers of Peace. Nor did the new power at Nanking manifest the least anxiety to obtain foreign aid, feeling assured of ultimate triumph. Yet, indifferent as they were to the co-operation of foreigners, the Taipings proclaimed themselves Christians, and appeared to aim their blows no less at lifeless idols than at living enemies. Shangti, the Supreme Ruler, the God of the ancient sages, was the object of their worship. They found his name in the Christian Bibles, and they published the Bible as the source of their new faith. Their faith amounted to a frenzy, giving them courage in battle, but not imparting the self-control essential to

Christian morality. Filling their coffers with spoil, they stocked their harems with the wives and daughters of their enemies. If their lives had been more decent, they might have had a better chance to secure the favor of those powerful nations which had now become the arbiters of destiny in China.

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The leader of the movement was a Cantonese by the name of Hung Siu Chuen. A copy of the Bible having fallen into his hands, he applied to a Baptist missionary for instruction. How much he learned may be inferred from the fact that he gave his followers a new form of baptism, requiring them to wash the bosom as a sign for cleansing the heart. He had ecstatic visions, and preached a crusade against idolatry and the Manchus. The ease with which the Manchus had been beaten by the British in 1842 had revealed their weakness, and the new faith supplied the rebels with a fresh source of power. They mixed the teachings of the Gospel with new revelations as freely as Mohammed did in propagating the religion of the Koran. The chief called himself the younger brother of Jesus Christ. His prime minister assumed the title of the Holy Ghost; and his counsels were given out as decrees from Heaven. All this had an air of blasphemy that shocked the sensibilities of foreigners, and compelled them to stand aloof or to support the Manchus.

The native authorities were permitted to engage foreign ships and seamen to operate against the rebels, who sustained a siege in Nanking almost as long as the siege of Troy. From Shanghai, Suchau, and other cities the Taipings were driven out by the aid of foreigners, chiefly led by Ward and Gordon, the former an American, the latter a Briton. General Ward was never under the command of Li Hung Chang; but to him more than to any other foreigner belongs the honor of turning the tide of the Taiping Rebellion. A soldier of fortune, he offered to throw his sword into the government scale if it were paid for with many times its weight in gold. Gathering a nondescript force of various nationalities, he recaptured the city of Sungkiang, and followed this up by such a series of successes that his little troop came to be known as the “Ever-victorious Army.” Falling before the walls of Tseki, he was interred with pomp at the scene of his first victory, where a temple was erected to his memory, and he is now reckoned among the “Joss” of the Chinese Empire. His force was taken into Li’s pay.

General Gordon (the same who fell at Khartoum) acted under the direction of Li Hung Chang; and his chief exploit was the recovery of Suchau. Unable to resist his artillery, the rebel chiefs offered to capitulate. They were assured by him that their lives would be spared. To this Li Hung Chang consented, and the stronghold was at once surrendered. Regardless of his plighted faith, Li caused the five leaders to be beheaded, an act of treachery which filled Gordon with such fury that he went from camp to camp, looking for Li, determined to put a bullet in his head. Li, however, avoided a meeting until Gordon’s wrath had time to subside, and that treacherous act laid the foundation of his future fortunes. He was made governor of the province, and for forty years he rose in power and influence.

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Not only was this terrible rebellion which laid waste the fairest provinces a sequel to the first war with England, it was prolonged and aggravated by a second war which broke out in 1857. In 1863, the last stronghold of the rebels was recaptured, and the rebellion finally suppressed, after twelve years of dismal carnage. In bringing about this result, no names are more conspicuous than those of Li Hung Chang and General Gordon, whose sobriquet of “Chinese Gordon” ever afterwards characterized him. Li’s good fortune served him well in this war. Having won the favor of the Court, he was in command of the forces of eastern Kiangsu, and all the brilliant successes of Ward and Gordon were credited to him. He was not only made governor of the province, but also created an Earl in perpetuity.

V.

THE “ARROW” WAR; THE TREATIES.

Never did a smaller spark ignite a greater conflagration. In 1856 a native junk named the “Arrow,” sailing under a British flag, was seized for piracy, her flag hauled down and her crew thrown into prison at Canton. On demand of Sir John Bowring, Governor of Hong Kong, they were handed over to Consul Parkes (later Sir Harry); but he refused to receive them because they were not accompanied by a suitable apology. The haughty Viceroy Yeh put them all to death, provoking reprisals on the part of the British, resulting in the occupation of Canton and the capture of Peking after three campaigns to the north.

In this war England had France for ally; as the two powers had been associated in that hugest of blunders, the Crimean War. Nor was the alliance a less blunder on this occasion. Napoleon’s excuse for participation was the murder of a missionary in Kwangsi; but his real motive was a desire to checkmate Great Britain, and prevent the conquest of new territory. In the Opium War she had stopped at Nanking, leaving the pride of China unhumbled, and the state of relations so unstable that another war was required to place them on a better footing. England, with unselfish generosity, invited the co-operation of Russia and the United States. Either power might have found as good a pretext for hostile action as that of France; but they chose to maintain an attitude of neutrality, offering only such moral support as might enable them to gather up the apples after the others had shaken the tree. In 1857 Canton was taken and held by the allies. The next spring the envoys of the four powers, each with a considerable naval force, proceeded to the mouth of the Peiho, the gateway to a capital as secluded and exclusive as that of the Grand Lama. The forts made a show of resistance, but they were put to silence in less than half an hour; and negotiations which had been opened by the neutrals were resumed at Tientsin.

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Dr. S. Wells Williams was Chinese secretary to the United States minister, Mr. William B. Reed; and I acted as interpreter for the spoken language. An article in favor of Christian missions occasioned some delay; and Mr. Reed, who was vain and shallow, said to us, “Now, gentlemen, hurry up with your missionary article for I intend to sign my treaty on the 18th of June [Waterloo day] with or without that clause.” Fancy a mind that could think of a treaty obtained by British guns as entitling him to be associated with Wellington! Yet Mr. Reed had the effrontery to say that he “expected us to make the missionary societies duly sensible of their obligations” to him. That twenty-ninth article was the gem of the treaty; and it had the honor of being copied into that of Lord Elgin, which was signed eight days later.

High-minded, philanthropic, and upright, Lord Elgin made a mistake which led to a renewal of the war. He refused to place Tientsin on the list of open ports, because, as he said, “Foreign powers would make use of it to overawe the Chinese capital,”—just as if overawing was not a matter of prime necessity. He hastened away to India to aid in suppressing the Sepoy mutiny, eventually becoming viceroy after another campaign in China. His brother, Sir F. Bruce, succeeded him as minister in China; and twelve months later (July, 1859) the ministers of the four powers were again at the mouth of the Peiho on their way to Peking for the exchange of ratified copies of the several treaties. The United States minister was John E. Ward, a noble-hearted son of Georgia, and the chief of our little squadron was the gallant old Commodore Tatnall.

We were not a little surprised to see the demolished forts completely rebuilt, and frowning defiance. We were told by officers who came down to the shore that no vessel would be allowed to pass; but that the way to Peking was open to us *via* Peitang, a small port to the north.

To this Mr. Ward made no objection, but the British, who had so recently held the keys of the capital, were indignant to be met by such a rebuff. They steamed ahead between the forts, leaving the Chinese to take the consequences. All at once the long line of batteries opened fire. One or two gunboats were sunk; two or three were stranded. A storming party was repulsed, and Admiral Hope, who was dangerously wounded, begged our American commodore to give him a lift by towing up a flotilla of barges filled with a reserve force. “Blood is thicker than water,” exclaimed Tatnall, in tones that have echoed round the globe, and Ward making no objection, he threw neutrality to the winds, and proceeded to tow up the barges. Our little steamer was commanded by Lieutenant Barker, now Admiral Barker of the New York Navy Yard.

Even this failed to retrieve the day, the tide having fallen too low for a successful landing. For the British admiral nothing remained but to withdraw his shattered forces, and prepare for another campaign. For the United States minister a dazzling prospect now presented itself,—that of intervening to prevent the renewal of war. From Peitang we proceeded by land two days. Then we continued our voyage for five days by boat on the Upper Peiho.

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At Peking, calling on the genial old Kweiliang, who had signed the treaty in 1858, Mr. Ward was astonished at his change of tone. “You wish to see the Emperor. That goes as a matter of course; but his Majesty knows you helped the British, and he requires that you go on your knees before the throne in token of repentance.” “Tell him,” said Mr. Ward to me, “that I go on my knees only to God and woman.” “Is not the Emperor the same as God?” replied the old courtier, taking no notice of a tribute to woman that was unintelligible to an Oriental mind. “You need not really touch the ground with your knees,” he continued; “but merely make a show of kneeling. There will be eunuchs at hand to lift you up, saying ‘Don’t kneel! Don’t kneel!’” The eunuchs, as Mr. Ward well knew, would be more likely to push us to our knees than to lift us up; and he wisely decided to decline the honor of an audience on such terms.

Displeased by his obstinacy, the Emperor ordered him to quit the capital without delay, and exchange ratifications at the sea-coast. A report was long current in Peking that foreigners have no joints in their knees; hence their reluctance to kneel. Thus vanished for Mr. Ward the alluring prospect of winning for himself and his country the beatitude of the peacemaker.

The summer of 1860 saw the Peiho forts taken, and an allied force of thirty thousand men advancing on Peking. The court fled to Tartary, and the summer palace was laid in ashes to punish the violation of a flag of truce, the bearers of which were bound hand and foot, and left to perish within its walls. For three days the smoke of its burning, carried by a northwest wind, hung like a pall over the devoted city, whose inhabitants were so terrified that they opened the gates half an hour before the time set for bombardment. No soldiers were admitted, but the demands of the Allies were all acceded to, and supplementary treaties signed within the walls by Lord Elgin and Baron Gros. Peking was opened to foreign residence. The French succeeded in opening the whole country to the labors of missionaries. Legations were established at the capital, and a new era of peace and prosperity dawned on the distracted empire.

VI.

THE WAR WITH FRANCE.

If the opening of Peking required a prolonged struggle, it was followed by a quarter-century of pacific intercourse. China had at her helm a number of wise statesmen,—-such as Prince Kung and Wensiang. The Inspectorate of Customs begun under Mr. Lay took shape under the skilful management of Sir Robert Hart, and from that day to this it has proved to be a fruitful nursery of reforms, political and social.

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Not only were students sent abroad for education at the instance and under the leadership of Yung Wing, but a school for interpreters was opened in the capital, which, through the influence of Sir Robert Hart, was expanded into the well-known Imperial College. On his nomination the present writer was called to the head of it, and Wensiang proposed to convert it into a great national university by making it obligatory on the members of the Hanlin Academy, the Emperor's "Forest of Pencils," to come there for a course of instruction in science and international law. Against this daring innovation, Wojin, a Manchu tutor of the Emperor, protested, declaring that it would be humiliating to China to have her choicest scholars sit at the feet of foreign professors. The scheme fell through, but before many years the Emperor himself had taken up the study of the English language, and two of our students were selected to be his instructors. One of them is at this present time (1902) Chinese minister at the Court of St. James. Several of our students have had diplomatic missions, and one, after serving as minister abroad, is now a leading member of the Board of Foreign Affairs in Peking. A press opened in connection with the college printed numerous text-books on international law, political economy, physics, and mathematics, translated by the president, professors, and students.

America was fortunate in the choice of the first minister whom she sent to reside at Peking. This was Anson Burlingame, who, after doing much to encourage the Chinese in the direction of progress, was by them made the head of the first embassy which they sent to foreign nations. His success in other countries was largely due to the sympathy with which he had been received in the United States by Secretary Seward, and to the advice and recommendations with which he was provided by that great statesman. So deep an interest did Mr. Seward take in China that he went in person to study its condition before the close of his career. In his visit to Peking he was accompanied by his nephew, George F. Seward, who was United States Consul at Shanghai. The latter has since that date worthily represented our country as minister at Peking; but it may be doubted whether in that high position he ever performed an international service equal in importance to one performed during his consulship, for which he has recently received the cross of the Legion of Honor. In laying out their new concession at Shanghai, the French had excited the hostility of the people by digging up and levelling down many of those graves that occupied so much space outside of the city walls, and where the Chinese who worshipped their ancestors were to be seen every day burning paper and heaping up the earth. A furious mob fell on the French police, chased them from the field, and menaced the French settlement with knife and firebrand. The consuls were appealed to for aid, but no one responded except Mr. Seward, who headed a strong force from one of our men-of-war, dispersed the mob, and secured the safety of the foreign settlement. But for his timely intervention who knows that the French consulate would not have been reduced to ashes? If the consulate had been burned down, a war would have been inevitable, with a chain of consequences that baffles the imagination.

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In 1871 a horrid atrocity was perpetrated by Chinese at Tientsin which certainly would have led to war with France if Napoleon III. had not at that very time been engaged in mortal combat with Germany. The populace were made to believe that the sisters at the French hospital had been seen extracting the eyeballs from their patients to use in the manufacture of magical drugs. They were set upon by a maddened multitude, a score or more of them slaughtered, and the buildings where they had cared for the sick and suffering turned to a heap of ruins. Count Rocheschouart, instead of reserving the case to be settled at a later day, thought best to accept from the Chinese government an apology, with an ample sum in the way of pecuniary compensation. That grewsome superstition has led to bloodshed in more than one part of China.

In the summer of 1885 I was called one day from the Western Hills to the Tsungli-Yamen, or Foreign Office, on business of great urgency. On arriving, I was informed that the Chinese gunboats in the river Min had been sunk by the French the day before; that they had also destroyed the Arsenal at the mouth of the river. “This,” said the Secretary, “means war, and we desire to know how non-combatants belonging to the enemy and resident in our country are to be treated according to the rules of International Law.” While I was copying out the principles and precedents bearing on the subject, the same Secretary begged me to hasten my report, “because,” said he, “the Grand Council is waiting for it to embody in an Imperial Decree.” True enough, the next day a decree from the throne announced the outbreak of war; but it added that non-combatants belonging to the enemy would not be molested. Two of our professors were Frenchmen, and they were both permitted to continue in charge of their classes without molestation.

Hostilities were brought to a happy conclusion by the agency of Sir Robert Hart. One of his customs cruisers employed in the light-house service having been seized by the French, Mr. Campbell was sent to Paris to see the French President and petition for its release. Learning that President Grevy would welcome the restoration of peace, and ascertaining what conditions would be acceptable, Sir Robert laid them before the Chinese government, putting an end to a conflict which, if suffered to go on, might have ruined the interests of more than one country. In this war and in those peace negotiations the conduct of the Chinese was worthy of a civilized nation. Yet the result of their experience was to make them more ready to appeal to arms in cases of difficulty.

Li’s connection with this war was very real, though not conspicuous. Changpeilun, director of the arsenal at Foochow, was his son-in-law. Not only was Li disposed to aid him in taking revenge, he was himself building a great arsenal in the north; and it was, no doubt, owing to efficient succor from this quarter that Formosa was able to hold out against the forces of the French.

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VII.

WAR WITH JAPAN.

Both in its inception and in its tragic ending the notable conflict with Japan connects itself with the name of Li Hung Chang. The Island Empire on the East had long been known to the Chinese, though until our times no regular intercourse subsisted between the two countries. It is recorded that a fleet freighted with youth and maidens was despatched thither by the builder of the Great Wall to seek in those islands of the blest for the herb of immortality; but none of them returned. It was to be a colony, and the flowery robe by which its object is veiled is not sufficient to hide the real aim of that ambitious potentate. Yet, through that expedition and subsequent emigrations, a pacific conquest was effected which does honor to both nations, planting in those islands the learning of China, and blending with their native traditions the essential teachings of her ancient sages.

For centuries prior to our age of treaties, non-intercourse had been enforced on both sides,—the Japanese confining their Chinese neighbors, as they did the Dutch, to a little islet in the port of Nagasaki; and China seeing nothing of Japan except an occasional descent of Japanese pirates on her exposed sea-coast.

To America belongs the honor of opening that opulent archipelago to the commerce of the world. Our shipwrecked sailors having been harshly treated by those islanders, a squadron was sent under Commodore Perry to Yeddo (now Tokio) in 1855, to punish them if necessary and to provide against future outrages. With rare moderation he merely handed in a statement of his terms and sailed away to Loochoo to give them time for reflection. Returning six months later, instead of the glove of combat he was received with the hand of friendship, and a treaty was signed which provided for the opening of three ports and the residence of an American charge d'affaires. In the autumn of 1859 it was my privilege to visit Yeddo in company with Mr. Ward and Commodore Tatnall. We were entertained by Townsend Harris and shown the sights of the city of the Shoguns when it was still clothed in its mediaeval costume. The long swaddling-garb of the natives had a semi-savage aspect, and the abject servility with which their todzies (interpreters) prostrated themselves before their officers excited a feeling of contempt.

Like the mayors of the palace in mediaeval France, the Shoguns or generals had relegated the Mikado to a single city of the interior; while for six hundred years they had usurped the power of the Empire, practically presenting the spectacle of two Emperors, one "spiritual" (or nominal), one "temporal" (or real). Little did we imagine that within five years the Shoguns would be swept away, and the Mikado restored to more than his ancient power. The conflagration was kindled by a spark from our engines. The feudal nobles, of whom there were four hundred and fifty,

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each a prince within his own narrow limits, were indignant that the Shogun had opened his ports to those aggressive foreigners of the West. Raising a cry of “Kill the foreigners!” they overturned the Shoguns and restored the Mikado. Their fury, however, subsided when they found that the foreigner was too strong to be expelled. A few more years saw them patriotically surrendering their feudal powers in order to make the central government strong enough to face the world. About the same time our Western costume was adopted, and along with it the parliamentary system of Great Britain and the school system of America. Some foreigners were shallow enough to laugh at them when they saw those little soldiers in Western uniform; and the Chinese despised them more than ever for abandoning the dress of their forefathers.

To protect themselves at once against China and Russia, the Japanese felt that the independence of Corea was to them indispensable. The King had been a feudal subject to China since the days of King Solomon; and when at the instance of Japan he assumed the title of Emperor, the Chinese resolved to punish him for such insolence. This was in 1894. The Japanese took up arms in his defence; and though they had some hard fighting, they soon made it evident that nothing but a treaty of peace could keep them out of Peking.

Li Hung Chang, who had long been Viceroy at Tientsin and who had built a northern arsenal and remodelled the Chinese army, had to confess himself beaten. For him it was a bitter pill to be sent as a suppliant to the Court of the Mikado. That China was beaten was not his fault. Yet he was held responsible by his own government and departed on that humiliating mission as if with a rope about his neck. Fortunately for him, during his mission in Japan an assassin lodged a bullet in his head, and the desire of Japan to undo the effect of that shameful act made negotiation an easy task, converting his defeat into a sort of triumph. Happily, too, he enjoyed the counsel and assistance of J.W. Foster, formerly United States Secretary of State. Formosa, one of the brightest jewels in the Chinese crown, had to be handed over to Japan, and lower Manchuria would have gone with it, had not Russia, supported by Austria and Germany, compelled the Japanese to withdraw their claims.

The next turn of the kaleidoscope shows us China seeking to follow the example of Japan in throwing off the trammels of antiquated usage. In 1898, when the tide of reform was in full swing, the Marquis Ito of Japan paid a visit to Peking, and as president of the University, I had the honor of being asked to meet him along with Li Hung Chang at a dinner given by Huyufen, mayor of the city, and the grand secretary, Sunkianai. It was a lesson intended for them when he told us how, on his returning from England in the old feudal days, his prince asked him if anything needed to be reformed in Japan. “Everything,” he replied. The lesson was lost on the three Chinese statesmen, progressive though they were, for China was then on the eve of a violent reaction which threatened ruin instead of progress.

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VIII.

WAR WITH THE WORLD.

The last summer of the century saw the forts at the mouth of the Peiho captured for the third time since the beginning of 1858. It was the opening scene in the last act of a long drama, and more imposing than any that had gone before, not in the number of assailants nor in the obstinacy of resistance, but in the fact that instead of one or two nations as hitherto, all the powers of the modern world were now combined to batter down the barriers of Chinese conservatism. Getting possession of Tientsin, not without hard fighting, they advanced on Peking under eight national flags, against the “eight banners” of the Manchu tribes.

What was the mainspring of this tragic movement? What unforeseen occurrence had effected a union of powers whose usual attitude is mutual jealousy or secret hostility? In a word, it was *humanity*. Spurning petty questions of policy, they combined their forces to extinguish a conflagration kindled by pride and superstition, which menaced the lives of all foreigners in North China.

In 1898, when the Emperor had entered on a career of progress, the Empress Dowager was appealed to by a number of her old servants to save the Empire from a young Phaeton, who was driving so fast as to be in danger of setting the world on fire. Coming out of her luxurious retreat, ten miles from the city, where she had never ceased to keep an eye on the course of affairs, she again took possession of the throne and compelled her adopted son to ask her to “teach him how to govern.” This was the *coup d’etat*. In her earlier years she had not been opposed to progress, but now that she had returned to power at the instance of a conservative party, she entered upon a course of reaction which made a collision with foreign powers all but inevitable. She had been justly provoked by their repeated aggressions. Germany had seized a port in Shantung in consequence of the murder of two missionaries. Russia at once clapped her bear’s paw on Port Arthur. Great Britain set the lion’s foot on Weihaiwei; and France demanded Kwang Chan Bay, all “to maintain the balance of power.” Exasperated beyond endurance, the Empress gave notice that any further demands of the sort would be met by force of arms.

The governor of Shantung appointed by her was a Manchu by the name of Yuhien, who more than any other man is to be held responsible for the outbreak of hostilities. He it was who called the Boxers from their hiding-places and supplied them with arms, convinced apparently of the reality of their claim to be invulnerable. For a hundred years they had existed as a secret society under a ban of prohibition. Now, however, they had made amends by killing German missionaries, and he hoped by their aid to expel the Germans from Shantung. On complaint of the German Minister he was recalled; but, decorated by the hands of the Empress Dowager, he was transferred to Shansi, where later on he slaughtered all the missionaries in that province.

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In Shantung he was succeeded by Yuen Shikai, a statesmanlike official, who soon compelled the Boxers to seek another arena for their operations. Instead of creeping back to their original hiding-place they crossed the boundary and directed their march toward Peking,—on the way not merely laying waste the villages of native Christians, but tearing up the railway and killing foreigners indiscriminately. They had made a convert of Prince Tuan, father of the heir apparent. He it was who encouraged their advance, believing that he might make use of them to help his son to the throne. Their numbers were swelled by multitudes who fancied that they would suffer irreparable personal loss through the introduction of railways and modern labor-saving machinery; and China can charge the losses of the last war to those misguided crowds.

Fortunately several companies of marines, amounting to four hundred and fifty men, arrived in Peking the day before the destruction of the track. The legations were threatened, churches were burnt down, native Christians put to death, and fires set to numerous shops simply because they contained foreign goods. Then it was that the foreign admirals captured the forts, in order to bring relief to our foreign community. That step the Chinese Foreign Office pronounced an act of war, and ordered the legations and all other foreigners to quit the capital. The ministers remonstrated, knowing that on the way we could not escape being butchered by Boxers. On the 20th of June, the German Minister was killed on his way to the Foreign Office. The legations and other foreigners at once took refuge in the British legation, previously agreed on as the best place to make a defence. Professor James was killed while crossing a bridge near the legation. That night we were fired on from all sides, and for eight weeks we were exposed to a daily fusillade from an enemy that counted more on reducing us by starvation than on carrying our defences by storm.

About midnight on August 13, we heard firing at the gates of the city, and knew that our deliverers were near. The next day, scaling the walls or battering down the gates, they forced their way into the city and effected our rescue. The day following, the Roman Catholic Cathedral was relieved,—the defence of which forms the brightest page in the history of the siege, and in the afternoon we held a solemn service of thanksgiving. The palaces were found vacant, the Empress Dowager having fled with her entire court. She was the same Empress who had fled from the British and French forty years before.

She was not pursued, because Prince Ching came forward to meet the foreign ministers, and he and Li Hung Chang were appointed to arrange terms of peace. Li was Viceroy at Canton. Had he been in his old viceroyalty at Tientsin, this Boxer war could not have occurred. That its fury was limited to the northern belt of provinces was owing to the wisdom of Chang[5] and Liu, the great satraps of Central China who engaged to keep their provinces in order, if not attacked by foreigners.

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[Footnote 5: Chang is regarded as the ablest of China's viceroys. He published, prior to the *coup d'etat*, a notable book, in which he argues that China's only hope is in the adoption of the sciences and arts of the West.]

I called on the old statesman in the summer of 1901, after the last of the treaties was signed. He seemed to feel that his work was finished, but he still had energy enough to write a preface for my translation of Hall's "International Law," and before the end of another month his long life of restless activity had come to a close at the age of seventy-nine. By posthumous decree, he was made a Marquis.

In the autumn the court returned to Peking, the way having been opened by Li's negotiations. Thanks to the lessons of adversity, the Dowager has been led to favor the cause of progress. Not only has she re-enacted the educational reforms proposed by the Emperor, but she has gone a step farther, and ordered that instead of mere literary finish, a knowledge of arts and sciences shall be required in examinations for the Civil Service.

The following words I wrote in an obituary notice, a few days after Li's death:—

"For over twenty years Earl Li has been a conspicuous patron of educational reform. The University and other schools at Tientsin were founded by him; and he had a large share in founding the Imperial University in Peking. During the last twenty years I have had the honor of being on intimate terms with him. Five years ago he wrote a preface for a book of mine on Christian Psychology,—showing a freedom from prejudice very rare among Chinese officials.

"Another preface which he wrote for me is noteworthy from the fact that it is one of the last papers that came from his prolific pencil. Having finished a translation of 'Hall's International Law' (begun before the siege), I showed it to Li Hung Chang not two weeks ago. The old man took a deep interest in it, and returned it with a preface in which he says 'I am now near eighty; Dr. Martin is over seventy. We are old and soon to pass away; but we both hope that coming generations will be guided by the principles of this book.'

"With all his faults—those of his time and country—Li Hung Chang was a true patriot. For him it was a fitting task to place the keystone in the arch that commemorates China's peace with the world."

DAVID LIVINGSTONE.

1813-1873.

AFRICAN DEVELOPMENT.

BY CYRUS C. ADAMS.

Africa is the most ancient and the most recent conquest of the human race. As far as the light of history can be projected into the past, we see Egypt among the first and foremost on the threshold of civilization. The continent discovered last and opened last to the enterprises of the world is still Africa. Why is it that we see there both the dawn of civilization and the tardiest development of human progress?

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The reasons are not far to seek. The physical conformation of no other continent is so unfavorable for exploration and development. Africa’s straight coast-lines, affording little shelter to the primitive ships of early mariners, repelled the enterprising Phoenicians and other seafarers in their eager search for new lands worth colonizing. Nor was it easy for explorers to penetrate into the interior. In its surface Africa has been compared to an inverted saucer,—the high plateaus occupying most of the interior descending to the sea by short, abrupt, and steep slopes, so that the wide and peaceful rivers of the plateaus are lashed into foam as they approach the ocean by many series of rapids and cataracts.

In all the other continents rivers have been the lines of least resistance to the advance of man. Civilization has developed first along the great rivers. The valleys were first settled, and up these valleys man carried his industries and commerce far inland. Thus the Euphrates and Tigris of Mesopotamia, the Ganges and Indus of India, and the Hoang and Yangtse of China, were the creators of history; but this is true in Africa only of the Nile. All the other rivers have been impediments instead of helpful factors in the formidable task of exploration and development.

The trying climate, also, gave Africa odious repute and delayed for centuries the study and utilization of the continent. When the British expedition under Captain Tuckey attempted to ascend the Congo, in 1816, to see if it were really the lower part of the Niger River, as had been conjectured, nearly all of its members perished miserably among the rapids less than two hundred miles from the sea. Such tragedies as this paralyzed enterprise in Africa until white men learned that the climate was not so deadly, after all, if they adhered to the manner of life, the hygienic rules, that should be observed in that tropical expanse.

In all the other continents, also, explorers have had the advantage of domestic animals to carry their food and camp equipment; but in large parts of tropical Africa the horse, ox, and mule cannot live. The bite of the little tsetse fly kills them. Its sting is hardly so annoying as that of the mosquito, but near the base of its proboscis is a little bag containing the fatal poison. Camels have been loaded near Zanzibar for the journey to Tanganyika, but they did not live to reach the great lake. The “ship of the desert” can never be utilized in the humid regions of tropical Africa.

The elephant is found from sea to sea, but he has not proved to be so amenable to domestication as his Asian brother. He may yet be reduced to useful servitude. The efforts in this direction in the German and French colonies are somewhat encouraging, though in 1901 only six elephants had thus far been broken to work and were daily used as beasts of burden. Explorers of tropical Africa have always been compelled to rely upon human porterage, the most expensive and unsatisfactory form of transportation, with the result that nearly all the great lines of exploration have been extended through the continent at enormous cost.

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So most other parts of the world were occupied, colonized, civilized, before Africa was explored. A continent one-fourth larger than our own was for centuries neglected and despised. “Nothing good can come out of Africa” became proverbial. Seventy years ago Africa, away from the coasts and the Nile, was almost a blank upon our maps, save for fanciful details that are ludicrously grotesque in the light of our present knowledge (1902).

Then dawned the era of David Livingstone. Sixty-two years ago this humble Scotchman went to South Africa as a missionary. It was not long before he became imbued with the idea that missionary service could not be projected on broad, economic, and effective lines till the field was known. The explorer, he said, must precede the teacher and the merchant. We can work best for Christianity and civilization after we learn what the people are and know the nature of their environment. This was the thought that took him into the unknown; that inspired him with unflagging courage and zeal throughout twenty years of weary plodding in the African wilderness among hundreds of tribes who never before had seen a white man. And all the years he was studying the country and winning the love of its people, his faith in Africa, in its abounding resources worth the world’s seeking, in the capacity of its people for development, steadily grew till it became the all-pervading impulse of his life. Livingstone’s faith converted the world to the belief that, after all, there was good in Africa.

“I shall never forget,” said Stanley, one day in New York, “the time when I stood with Livingstone on the shore of Lake Tanganyika, and he raised his trembling hand above his head, leaned towards me as he looked me in the eye, and said in a voice broken with emotion: ’The day is coming when the whole world will know that Africa is worth reclaiming, and that its people may be brought out of barbarism. The world needs Africa; and teachers, merchants, railroads, and every influence of civilization will be spread through this continent to fit it for the place in human interests that belongs to it.’ I thought then that Livingstone was an enthusiast and a visionary; but long ago I learned to believe that every word he said was true.”

Europe and America were thrilled by the simple narrative of those twenty-two thousand miles of wanderings that brought into the light of day millions of human beings who had been as much unknown to us as though they inhabited Mars. Livingstone did not live to know it, but it was he who kindled the great African Movement,—an outburst of zeal for geographic discovery and economic development such as was never seen before.

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Thirteen years ago (1889) a Frenchman named De Bissy completed the largest map yet made of Africa. In the preparation of this great work, which occupied much of his time for eight years, he used as his sources of information nearly eighteen hundred route and other maps, nearly all of which were the result of the work of explorers in the preceding quarter of a century. All that we know of the geography of over three-fourths of Africa is the work of the past half-century since Livingstone made his first journey in 1849; and we know far more of inner Africa to-day than was known of inner North America three hundred years after Columbus discovered the western world. A little over a century ago, our great-grandfathers were reading in their school geographies that North America had no conspicuous mountains except the Alleghanies; and these mountains and the Andes of South America were believed to be one and the same chain, interrupted by the Gulf of Mexico. Many men not yet bent with years can remember when the interior of Africa was a white space on the maps; but it is not possible to-day to make such a geographical blunder as we have mentioned, about any part of Africa.

It is because of the work he did in those twenty years, sowing all the while the seeds from which sprang the great African Movement, that “the gentle master of African exploration” is acclaimed to-day as one of the world’s great men, and that his body rests in Westminster Abbey among the illustrious dead of Britain.

The son of a worthy weaver in Blantyre, Scotland, Livingstone’s early life was that of a poor boy, working in a spinning-mill, quiet, sober, affectionate, and faithful in every relation of life. Moved at last by the thirst for knowledge that has distinguished many a humble Scotch boy, he entered the University at Glasgow, studying during the winter months and spending the summers at his trade in the factory, fitting himself all the while for the conquests he little dreamed he was to achieve over difficulties almost insurmountable. A classmate spoke of him as a pale, thin, retiring young man, but frank and most kind-hearted, ready for any good and useful work, even for chopping the University fuel and grinding wheat for the bread. In 1838, when he was twenty-five years old, he went to London to be examined as a candidate for the African missionary service. Two years later he was sent to South Africa, where for eight or nine years he labored among the natives earnestly and unostentatiously north of the place now famous as the site of the Kimberley diamond mines. It was here that he became intimately acquainted with the celebrated missionary, Robert Moffatt, whose daughter he married. His devoted wife accompanied him in some of his later travels, but long before he finished his work her body was laid to rest under the shade of a tree that for years was pointed out to all visitors to the Lower Zambesi.

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In 1849, began the series of explorations that continued till his death. “The end of geographical discovery is the beginning of missionary enterprise,” he wrote. Burning with zeal to reveal Africa to the world, Livingstone never forgot the main aim of his life,—to open ways for the planting of mission stations among all the scores of tribes he visited. “I hope God will in mercy permit me to establish the Gospel somewhere in this region,” he wrote from the land of the Barotse, on the Upper Zambesi. Does he now look down from his eternal home upon that very land whose churches and schools are the fruition of the labors of French Protestants; whose king, in London to attend the coronation of Edward VII., said he wanted more teachers and more men to train his people to build houses and work iron? He prayed that he might live to see “the double influence of the spirit of commerce and Christianity employed to stay the bitter fountain of African misery.” The glowing zeal of the Christian philanthropist and the untiring ardor of the born explorer were perfectly blended in the spirit of the great pioneer of modern African discovery.

Livingstone’s routes through Africa would extend about seven times between New York City and San Francisco; and in his almost endless marches over plain, through jungle, across mountains and wide rivers, the natives met him almost without exception in a generous and hospitable spirit. Love was the secret of his success. He won his way by kindness. Give the barbarous African time to see that you wish him well, that you would do him good in ways he knows are helpful, and his affection is evoked.

It was said that the British could never establish their rule over the great Wabemba tribe, southwest of Tanganyika, without a military campaign. In 1894, two humble Catholic fathers entered Lobemba, walked straight to the chief town, and were told that if they did not leave the country in one day they would be killed. As the stern message was delivered, they saw an old woman on the ground in great pain from a severe wound. The news soon spread that these unwelcome strangers had washed and dressed the wound, and made the old woman comfortable. “These people love men,” was the word that passed from lip to lip, as the sick and suffering came out from the town to be treated, while thousands of natives looked on. At nightfall the white men were told they might remain another day; they ministered for eleven days to those who needed help, and were then invited to remain the rest of their lives. The mission stations of the White Fathers are to-day scattered all over Lobemba; the country is open in every corner to the whites, and in 1899 British rule was established. The victory was won, not with guns, but by gentle, helpful kindness.

Livingstone never believed that the sympathies of our common humanity are extinct even in the bosom of a savage. Enfolded in the panoply of Christian kindness, he passed unscathed among the most warlike tribes. No memory of wrong or pain rankled in the heart of any man, woman, or child he ever met. He is known to-day as “the good old man” wherever his path led him in those twenty years.

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When explorers began to study the healthful highlands of the Akikuyu tribe in East Africa a few years ago, the natives rushed to arms. “Keep away from us,” they said. “One of your white men came through the land, stealing food from our gardens, and killing all who said he ought to pay us for our vegetables. We want nothing to do with thieves and murderers like you.”

But no vengeance fell on the head of any white traveller who ever followed in the footsteps of Livingstone. Those explorers have achieved most who adhered to his example of unfailing kindness, mercy, and justice. The brutal German, whose crimes made the Akikuyu hostile to all whites, marked his path with blood from the Indian Ocean to Victoria Nyanza. Serpa Pinto, renowned for the scientific value of his work, aroused condemnation and disgust because he fought his way through many tribes, among whom Livingstone and Arnot had wandered almost alone and in perfect safety. Fortunately, there have not been many explorers militant. The brilliant discoveries of Grenfell, Delcommune, Lemaire, and others, who are in the first rank of African pioneers, were made without harming a native.

Let us glance at a few of Livingstone’s discoveries and form our own conclusions as to whether his sublime faith in the future of Africa has thus far been justified by events. In the depths of the wilderness he discovered the large lake, Mweru, through which the Upper Congo flows. Though white influences have reached that remote region only within the past two or three years, a little steamboat now plies those waters. A photograph of Mpweto, one of the white settlements on the lake, shows the commodious quarters of the Europeans, two long lines of cabins in which the native workmen live, and well-tilled gardens extending for a half-mile along the shore. Livingstone brought to light the coal fields of the Zambesi, the only coal yet known in tropical Africa. While these lines are being written, the British of Rhodesia are preparing to open mines along these deposits. He told the world of the Victoria Falls of the Zambesi, the largest known, a mile wide and twice as high as Niagara. The installation of an electrical plant at this great source of power is now in progress, and it is hoped within three years to transmit electrically all the power required to work the large copper mines in the north, the coal fields in the east, and to move trains on the Cape to Cairo Railroad for a distance of three hundred miles. The recent improvements in long-distance transmission of power encourages the belief that the Victoria Falls may some day possess large industrial utility for a wide region around them. Coffee plantations on the hills overlooking the long expanse of Nyassa, the splendid freshwater sea which Livingstone revealed in its setting of mountains, are selling their superior product in London at a high price. The town of Blantyre, among the Nyassa highlands which Livingstone first described, has a

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newspaper, telegraphic and cable communication with all the world, and industrial schools in which the manual arts are taught to hundreds of natives. Here is the large brick church, now famous, built by native craftsmen, who before Livingstone's time had never seen a white man, and lived in a state of barbarism; an edifice that would adorn the suburbs of any American city, and of which the explorer, Joseph Thomson, said: "It is the most wonderful sight I have seen in Africa." The natives made the brick, burned the lime, sawed and hewed the timbers, and erected the building to the driving of the last nail. They had the capacity, and it was evoked by the genius of one of the most remarkable men in Africa, Missionary Scott of Blantyre. Steamboats are afloat on five of the six important seas of the great lake region of Central Africa; on two of the three which Livingstone discovered. Only a beginning has been made, for the field stretches from ocean to ocean; but the man who, in 1873—the year of Livingstone's death,—-should have predicted one-half of the achievement of the present generation would have been laughed at as a crack-brained visionary.

Even the surface of Africa is changing, and the truth of Livingstone is not always the truth of to-day. In his first journey, in which he braved the perils of the South African thirst lands, he reached the broad and placid expanse of Lake Ngami, covering an area of three hundred square miles. In the gradual desiccation of that region, the lake has now entirely disappeared. Its place is wholly occupied by a partly marshy plain covered with reeds, and no vestige of water surface is to be seen. He found the little Lake Dilolo so exactly balanced on a flat plain between two great river systems that one stream from the lake flowed north to the Congo and another south to the Zambesi; but for years past there has been no connection between the lake and the Congo. He sought in vain, like many explorers after him, for the outlet to Lake Tanganyika. The mystery was not solved till, more than twenty years after, Burton discovered the lake; the solution came when the explorer Thomson and Missionary Hore found the waters of Tanganyika pouring in a perfect torrent down the valley of the Lukuga to the Congo. The explanation of the strange phenomenon is that for a series of years the evaporation exceeds the water receipts, the level of the lake steadily falls, and the valley of the Lukuga becomes choked with grass; then a period follows when the water receipts exceed the evaporation, and the waters rise, burst through the barriers of vegetation in the Lukuga, and are carried to the Congo once more.

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It was his second and third journeys that established Livingstone's fame as a great explorer. In those journeys (1853-56) his routes were from the Upper Zambesi to Loanda in Portuguese West Africa, and then from Loanda to the mouth of the Zambesi, nearly twelve thousand miles of travel. The third journey was the first crossing of the continent; and while traversing the wide savannas of the uplands and revealing the Zambesi, the fourth largest river of Africa, from source to delta, he was able to verify one of the most brilliant generalizations ever made by a geologist. Sir Roderick Murchison, President of the Royal Geographical Society, in 1852, deducing his conclusions from the very fragmentary and imperfect knowledge of Africa then extant, evolved his striking hypothesis as to the physical conformation of the continent, which has been briefly mentioned above and is the accepted fact of to-day. Livingstone was able to prove the accuracy of this hypothesis, and he dedicated his "Missionary Travels" to its distinguished author.

The Makalolo chief, Sekeletu, on the Zambesi River, supplied Livingstone with men, ivory, and trading commissions, that helped the humble and unknown white man, lacking all financial resources except his slender salary, to make the two great journeys which kindled the world's interest and led to the wonderful achievements of our generation. In this noteworthy incident we see the human agencies through which Africa will attain the full stature allotted to her. The Caucasian and the Negro each has his onerous part in the work of bringing the civilized world and Africa into touch and accord.

When Livingstone went home, after his third journey, his fellow-countrymen crowded to see and hear the explorer, who had added more facts to geographical knowledge than any other man of his time. They saw a person of middle age, plainly and rather carelessly dressed, whose deep-furrowed and well-tanned face indicated a man of quick and keen discernment, strong impulses, inflexible resolution, and habitual self-command. They heard a speaker whose command of his mother tongue was imperfect, and who apologized for his broken, hesitating speech by saying that he had not spoken the English language for nearly sixteen years. In no public place did he ever allude to his personal sufferings, though fever had brought him to death's door and the years had been crowded with the most harrowing cares. The work he had done and would carry on to the end, the new Africa he alone could describe, the faith that had grown and strengthened in every week of his long pilgrimage that the world needed Africa, its resources and peoples, were the burden of every utterance. The great London meeting where he first appeared took practical measures to support him in the work he had begun unaided; and one of the resolutions adopted, declaring that "the important discoveries of Dr. Livingstone will tend hereafter greatly to advance the interest of civilization, commerce, and freedom among the numerous tribes and nations of that vast continent," was prophetic of all the best fruits of the colossal work that has been done to the present time.

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During his two years at home, Livingstone wrote his “Missionary Travels.” He returned to England once more (1864-65), when he published “A Narrative of an Expedition to the Zambesi,” and in 1866 went back to Africa to resume the explorations which ended only with his death. Between 1849 and 1873 he was four years in Europe and twenty years in the field, eating native food, sleeping in straw huts (in one of which he died), lost to view for many years at a time because he had no means of communication with the coasts. It was this fact that led to Stanley’s successful search for Livingstone in 1871. Perhaps no other explorer ever gave so many years to continuous field-work. In this respect he far surpassed the record of any other of the African pioneers.

The discoveries in his last journeys, covering the periods from 1858 to 1864, and from 1866 to 1873, were as brilliant and fruitful as his earlier work, but not so astonishing, because his first years were given to revealing the broader aspects of Africa and its tribes, while his later labors were devoted to more detailed research in a smaller field. This region, about as large as Mexico and Central America, extends north and south, from Tanganyika to the Zambesi, and covers the wide region of the Congo sources between Nyassa and Lake Bangweolo. The greatest results were the discovery of Lake Nyassa and the Shire River, now the water route into East Central Africa; Lakes Bangweolo and Mwero; and the mapping of the eastern part of the sources of the Upper Congo, which Livingstone believed to the day of his death were the ultimate fountains of the Nile. Livingstone’s “Last Journeys” was published from the manuscript which his faithful servants brought to the seacoast with the mortal remains of their gentle master.

Not far from the south coast of Bangweolo stands a wooden construction to which is affixed a bronze tablet bearing the simple inscription, “Livingstone died here. Ilala, May 1, 1873.” It has taken the place of the tree under which he died, and where his heart, which had been so true to Africa, was buried. As the tree was nearly dead, the section bearing the rude inscription cut by one of his servants was carefully removed and is now in London.

Livingstone’s geographical delineations were remarkably accurate, considering the inadequate surveying instruments with which he worked. Dr. Ravenstein, one of the greatest authorities on African cartography, has said: “I should be loath to reject Livingstone’s work simply because the ground which he was the first to explore has since his death been gone over by another explorer.” It would be marvellous, however, if in the course of twenty years of exploration he had not made some blunders. His map of Lake Bangweolo, for example, was very inaccurate. The Lokinga Mountains, which he mapped to the south of the lake, have not been found by later explorers. These imperfections resulted from the fact that his map

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of Bangweolo and its neighborhood was largely based upon native information. He knew that his map was inadequate, and as soon as he was able to travel he returned to Bangweolo to complete his survey. He was making straight for the true outlet of the lake, and was within thirty-five miles of it when one morning his servants found him in his lowly straw hut, dead on his knees. If Livingstone had lived a few weeks longer and been able to travel, he and not Giraud would have given us the true map of Bangweolo.

As a whole, Livingstone's work in geography, anthropology, and natural history, stands the test of time. No river in Africa has yet been laid down with greater accuracy than the Zambesi as delineated by this explorer.

The success of Livingstone was both brilliant and unsullied. The apostle and the pioneer of Africa, he went on his way without fear, without egotism, without desire of reward. He proved that the white man may travel safely through many years in Africa. He observed richness of soil and abundance of natural products, the guarantees of commerce. He foretold the truth that the African tribes would be brought into the community of nations. The logical result of the work he began and carried so far was the downfall of the African slave-trade, which he denounced as "the open sore of the world." What eulogy is too great for such a work and such a man?

In 1898, twenty-one journeys had been made by explorers from sea to sea. Livingstone completed the first journey, from Loanda to the mouth of the Zambesi, in one year, seven months, and twenty-two days. Nineteen years elapsed before Central Africa was crossed again, when Cameron gave two years and nearly eight months to the journey. It took Stanley two years and eight months to cross Africa, when he solved the great mystery, the course of the Congo; and when he went to the relief of Emin Pasha, in 1887, he was almost exactly the same time on the road. When Trivier crossed from the Atlantic to the Indian Ocean, in 1888-89, in nine days less than a year, the event was held as a remarkably rapid performance. A little later the journey was made by several travellers in from twelve to fifteen months. In 1898, the Englishman, Mr. Lloyd, crossed from Lake Victoria to the mouth of the Congo in three months, about thirteen hundred miles of the journey being by Congo steamboat and railroad. In 1902, the journey from the Indian Ocean to Lake Victoria is made by rail in two and one-half days,—a journey that occupied Speke for nine, and Stanley for eight months. With the present facilities, the continent may be crossed by way of the lake region and the Congo in about three months. The era of long and weary foot-marches has nearly ended; now succeeds travel by steam.

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No influence has been so potent in improving the art of the explorer, or in raising the standard of the work required of him, as the enormous interest that for thirty years past has centred in African exploration. The larger part of the best achievements of the explorers of the present generation in scientific investigation, and in an approach to scientific map-making, are found in tropical Africa. Many of the hundreds of the route surveys are not unworthy to be compared with those of Pogge and Wissmann, when they laid down on their map every cultural and topographic feature for two miles on both sides of their route, from Angola to the Upper Congo. The extreme care with which some of the best explorers have performed their tasks is illustrated by the remarkable achievement of the late Dr. Junker along the Mobangi River. After years of service, his scientific equipment had become practically worthless. He started on his four-hundred-mile journey down the river through the jungle, with absolutely no instrument except a compass to aid him in determining his positions. Endeavoring, by the most scrupulous care, to make up as far as possible for his lack of scientific outfit, he trudged through the grass, compass in hand, counting every step. Every fifteen minutes he jotted in his notebook the distance and the mean direction travelled. At night he used these accumulated data to lay down on his route map the journey of the day. For many weeks he kept up this trying routine till he reached his furthest west, and again till he had returned to his starting-point, whose latitude and longitude he had previously determined. When he returned to Europe, Dr. Hassenstein and he made a map from the data Junker had collected, and fixed the position of his furthest west. This position was found later by the astronomical observations of Lieutenant Le Marinel to be less than two miles out of the way.

One of the latest to win a large prize in African discovery is Dr. A. Donaldson Smith, a young physician of Philadelphia, in the northeastern region known as Somaliland and Gallaland. His method may be mentioned here as an illustration of the kind of work that geographers now require. Before he began his explorations, he took a thorough course in the use of surveying instruments and the methods of accurately laying down his positions and making a route map. Many a cartographer, burning with desire to draw a good map of a newly explored region, has been driven to despair by the inadequacy of the route surveys in his hands. Not a few of these surveys have been unworthy of reproduction in the books of the explorers who made them, and the best that could be done was to generalize their information on maps of comparatively small scale. But Donaldson Smith's route-maps appear in his book on the comparatively large scale of 1:1,000,000 (about sixteen statute miles to the inch), and they are worthy of that treatment, for his surveys and observations for geographical positions

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were recorded in such a way that their value might be easily ascertained by any one familiar with such computations. His route-maps have been found to be admirable map-making material; thus, he has not only traversed a new region of great extent, but has given in his map ample materials which may be employed by any atlas-maker in the production of good maps of all the territory that came under his observation. When Sir Clements Markham presented to Dr. Smith the Patrons' Medal of the Royal Geographical Society, he said: "You have not, like an ordinary explorer, made a common route survey, but you have made a scientific survey, a triangulation frequently checked by astronomical observations with theodolite and chronometer."

Most African explorers have been painstaking, conscientious workers, eager in their quest for the truth, desirous to report nothing but the truth, and treating the lowly and ignorant they have met as men, with sensibilities like their own, capable of gratitude for a kindness and keenly sensitive to an outrage. The world has recognized and applauded such heroes of discovery,—the men who faced hardship and peril, enduring and sacrificing much that knowledge might grow; who had to conquer not only unkind Nature, but to overcome the ignorant violence of man. And not a few of the leaders in this work have carried it out with a degree of tactfulness, humanity, gentleness, and kindliness of spirit amounting to genius. Some of them spent months in disguise, collecting facts of the highest scientific value among fanatical Mohammedans who would have killed them if they had known their secret. Such men were Burton in Harrar, Dr. Lenz in Timbuctoo, and De Foucauld and Harris in Morocco, who, in stained skins and borrowed costumes, personated merchants and devotees and doctors and Jews; and most of whom have enriched the literature of discovery with valuable books. Men also such as Dr. Junker, who, rich as he was, left his home to spend eight years alone among the savages of the Welle Makua basin in Central Africa, living on their food and in their huts that he might minutely study the people in their country; or Grenfell, who has travelled far more widely in the Congo basin than Stanley or any of his followers except Delcommune, and revealed to the world more river systems and unknown peoples than they, and who, in his long career as an explorer, never fired a shot upon a native, though his life was often threatened. These men, and others like them, have exemplified the manysidedness of human resources against a great variety of peril and obstacle, as no other explorers in any other part of the world have had an opportunity to do in equal measure. Their work, with its environment of almost overwhelming difficulty, should be known to our youth as most forceful illustrations of what good men may dare and do in good causes and in a worthy manner.

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There have been some exceptions to this rule. A few men have been less anxious to perform useful service than to figure in the newspapers and pose before their public. One day a man stood on the north shore of Victoria Nyanza, and looking south he saw land. When he returned to London he published a sensational book, in which he said it was ridiculous for Speke to assert that he had discovered a lake as large as Scotland, one of the greatest lakes in the world. “Why,” said the writer, “I have stood on the north shore of the Victoria Nyanza and looked south and seen the southern shore. Lake Victoria is only an insignificant sheet of water, after all the talk of its being second only to Lake Superior.”

What he really saw was the chain of the Sesse Islands extending far out into the lake. His book was scarcely off the press when the letters describing Stanley’s boat journeys around the shores of Victoria Nyanza began to be published in London and New York; and the foolish fellow was compelled to recall all the copies of his book that had not passed beyond his reach, and eliminate the statements that made him so ridiculous. Fortunately, there are not many explorers of this stripe.

All who watched the progress of African discovery were constantly reminded that geographical progress is usually made only by slow and painful steps. They saw an explorer emerge from the unknown with his notebooks and route maps replete with most interesting facts for the student and the cartographer. Then another explorer would enter the same region, discover facts that had escaped the notice of the pioneer, correct blunders his predecessor had made and perpetrate blunders of his own; so explorer followed explorer, each adding something to geographical knowledge, each correcting earlier misconceptions, till the total product, well sifted by critical geographers, gave the world a fair idea of the region explored; but not the best attainable idea, for scientific knowledge of a region comes only with its detailed exploration by trained observers, equipped with the best appliances for use in their special fields of research. This is the advanced stage of geographical study, which is now being reached in many parts of Africa. It was Livingstone’s task, in 1859, to inform us that there was a great Lake Nyassa. It was Rhoades’s task, in 1897-1901, to make a careful and accurate survey of its coast-lines, and to sound its depths, so that we now have an excellent idea of the conformation of the lake bottom. Between Livingstone and Rhoades came many explorers, each adding important facts to our knowledge of this great sheet of water nearly twice as large as New Jersey.

As each explorer came from the wilds, our maps were corrected to conform with the new information he supplied; and if we should examine the maps of Africa in school geographies, atlases, and wall maps, from the time of Livingstone to the present day, we should see that, as relates to nearly every part of Africa, they have been in a continual state of transition.

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For years our only map of Victoria Nyanza was that which Speke made on his second journey to the lake, in 1860-62; but Speke saw the great lake only at one point on its south shore, and along its northwest and north central coasts. His map, being based very largely upon native information, was in many respects most incomplete and erroneous.

Then came Stanley's survey of the lake, made in a boat journey around its coasts, and for years his map supplanted that of Speke. But he was not able to follow the shore-line in all its intricate details. His mapping was a great advance upon that of Speke, but it was necessarily rough and imperfect. He missed entirely the deep indentation of Baumann Gulf and the southwestern prolongation of the lake, surveyed by Father Schynse, in 1891. Stanley's map, modified by the partial surveys of various explorers, is still our mapping of the lake; but if the reader will watch the maps for the next year or so, he will doubtless observe important changes in the contours of Victoria Nyanza; for all the maps, from Speke to those of 1902, will be placed on the shelf to serve only as the historical record of the good, honest work which a number of explorers have done. Commander Whitehouse has recently spent thirteen months surveying with infinite pains these coasts and islands. "I seem to see," writes Stanley of this important service, "the sailor, with his small crew and his little steel boat, wandering from point to point, crossing and recrossing, going from some island to some headland, taking his bearings from that headland back again to the island, and to some point far away."

Commander Whitehouse has made a new delineation of the entire 2,200 miles of coasts, and the results of his survey will be used in making all the maps of the lake. His map in turn will undoubtedly be replaced some day by detailed topographic surveys of the best quality, such as the British already contemplate making of that entire region.

A wall map recently in use in one of the public schools of New York City was a curious example of ignorant compilation. It exhibited the Victoria Nyanza of Speke, the Bangweolo of Livingstone, and the Upper Congo of Stanley, all obsolete for practical purposes years before this map was printed. Most of our home map-makers were very slow in availing themselves of the rich materials constantly supplied for the maps by the army of explorers in Africa. But the most alert cartographers, particularly between 1880 and 1895, could not keep their maps abreast of the news of discovery as it came to Europe. More men and energy and money were utilized in those fifteen years of African discovery than in the first century and a half of American exploration. The route or mother-maps, some covering a wide extent of country, others devoted to a small area, or a short line of travel, were going to Europe for the improvement of atlas sheets by nearly every steamer. Father Schynse's chart of the southwest extension of Victoria Nyanza had hardly been utilized in European map-houses before it was replaced by Dr. Baumann's more accurate survey. Mr. Wauters of Belgium withdrew his large map of the Congo Basin from the printer four times, in order to include fresh information before it was finally issued to the public.

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This process is still going on, though more slowly. The mapping we see of Lake Tanganyika, one of the longest lakes in the world, has been in use for seventeen years since missionary Hore made his boat journey of one thousand miles around its coasts, but the new map of the Moore expedition now being introduced gives the main axis of the lake a more northeast and southwest direction. The Hore map has met the fate that usually overtakes the early surveys of every region. It rendered good service as long as it was the best map; but the Moore expedition had first-rate appliances for computing longitudes, and as Captain Hore lacked these, it is not strange that his map has been found to be defective.

The world has been treated to many geographical surprises in the course of this incessant transformation of the map of the continent. Many of us may remember in our school geographies, the particular blackness and prominence of the Kong Mountains, extending for two hundred miles parallel with the Gulf of Guinea. They were accepted on the authority of Mungo Park, Caillie, and Bowditch, all reputable explorers who had not seen the mountains, but believed from native information that they existed. The French explorer, Binger, in 1887 sought in vain for them. Later explorers have been unable to find them. They are, in fact, a myth, and will be remembered chiefly as a conspicuous instance of geographic delusion. It had long been supposed that the navigation of the Niger River, the third largest river in Africa, was permanently impaired by the Bussa Rapids, about one hundred miles in length, where Mungo Park was wrecked and drowned. But Major Toutee, a few years ago, when assailed by hostile natives, made a safe journey with his boats through the rapids; and Captain Lenfant, in 1901, carried 500,000 pounds of supplies up the river and through the rapids to the French stations between Bussa and Timbuktu. He had a small, flat-bottomed steamboat and a number of little boats propelled by fifty black paddlers. He says that by the land route he would have required 12,000 porters, and they would have been one hundred and thirty days on the road.

It was believed that a land portage would always be necessary between the sea and the Zambesi, above the delta, till 1889, when Mr. Rankin discovered the Chinde branch of the delta, so broad and so deep that ocean vessels may ascend it and exchange freight with the river craft.

It has been found that more water pours into the ocean through the Congo's mouth, which is six miles wide, than from all the other rivers in Africa together. It is second among the world's rivers, and the dark detritus it carries to the Atlantic has been distinctly traced on the ocean bed for six hundred miles from the land. Some geographers still believed thirty years ago that all the waters of its upper basin might be tributary to the Nile. Map-makers have been kept very busy recording discoveries on the Congo. About one hundred explorers, some of them missionaries and many employees of the Congo Free State, have mapped the whole basin along its water-courses, and discovered the ultimate source of its main stream. Our ideas of the hydrography of this great basin have been revolutionized since Stanley, second only to

Livingstone among the great African explorers, in 1877 revealed the course of the main river.

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On his map, for example, he showed the southern tributaries as probably flowing nearly due north; but all except one of these rivers rise in the east and flow far to the west. When Wissmann was sent to the Upper Kassai to follow it to the Congo, he was greatly surprised to find himself floating westward week after week. When he reached the Congo a steamboat was waiting for him at Equatorville, two hundred miles further up the river, where he was expected to emerge. Schweinfurth believed the Welle Makua flowed north to Lake Chad on the edge of the Sahara; seventeen years later, after six or seven explorers had tried to solve the problem, the river was found to be the upper part of the Mobangi tributary of the Congo, larger than any rivers of Europe, excepting the Volga and Danube. While Stanley was for five years planting his stations on the Congo, he knew nothing of this great tributary, 1,500 miles long, whose mouth was hidden by a cluster of islands which his steamers repeatedly passed. Missionary Grenfell, on his little steamer, was ascending the Congo one day, when accidentally he got into the mouth of the Mobangi and went on for one hundred miles before he discovered that he had left the main river. Few explorers have unwittingly stumbled upon so rich a geographical prize.

While exploratory enterprises have been centred largely in tropical Africa, no part of the continent has been neglected. We now know that large areas of the Sahara are underlaid by waters which need only be brought to the surface to cover the desert around them with verdure; that most of the rain falling on the south slopes of the Atlas Mountains sinks into the earth to impermeable strata of rock, along which it makes its way far out into the desert; that where the surface is depressed so that these waters come near to it, there are wells for the refreshment of the camel caravans, and oases, blooming islands of green, in the sterile wastes; and that artesian wells bring inexhaustible supplies of water within reach, so that millions of date palms have been planted along the northern edge of the desert in southern Algiers and Tunis, making these regions the largest sources of the world’s supply of dates.

It has also been discovered why there are very large areas of dry or desert lands in Africa. The Sahara and the southwest of Africa are deserts because the prevailing winds, the carriers of moisture, blow towards the sea instead of away from it, and consequently are always dry. The winds from the Indian Ocean crossing the highlands of Abyssinia are wrung nearly dry while passing the mountains, and so Somaliland and the lowlands to the south of Abyssinia are parched.

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It has been found that the most of South Africa stands so high above the sea that the influences of a temperate climate are projected far towards the Equator; so that many white men, women, and children are living and thriving on farms in Mashonaland, seven degrees of latitude nearer the equator than the south end of Florida. This fact will profoundly influence the development of South Africa. It is to be the home of millions of the white race, the seat of a highly civilized empire, whose business relations with the rest of the world will be to the advantage of every trading nation. The presence of these millions of toilers will vitally affect the work of developing tropical Africa which is now absorbing such enormous treasure and energy; for South Africa is to be brought by railroads to the very doors of the tropical zone.

It is hoped that such facts as these, even though very briefly stated, may convey broadly a correct impression of the magnitude of African exploration, since its revival about the time that Livingstone died. It is impossible in brief space to signalize the good work that many of the most conspicuous pioneers have done. The world rendered tardy tribute to the notable achievements of some of them. When Rebmann discovered Kilimanjaro, not far from the equator, and told of the snows that crown the loftiest of African summits, it was decided by British geographers that Rebmann's snow was probably an imaginary aspect. The snow was there, and plenty of it, but Rebmann died before justice was done to his faithful labors. When Paul du Chaillu described the Obongo dwarfs of West Africa, his narrative was discredited; but four or five groups of dwarfs, probably numbering many thousands, are now known to be scattered from the lower border of Abyssinia to the Kalahara desert in the far south. The ancients had heard of the dwarfs, but the geographers of the eighteenth century expunged from the maps of Africa about all that the geographers of Greece and Rome, as well as those of later times, placed on them; and the nineteenth century was slow in crediting the early investigators even with statements that were wholly or approximately accurate.

A curious history is connected with the discovery of the northeastern group of pygmies, a little south of Abyssinia. No white man had ever seen them, but about fifteen years ago Dr. Henry Schlichter, of the British Museum, collected all the information which natives had given to missionaries, traders, and explorers of the existence of these little people some hundreds of miles from the sea. Sifting all this evidence, he concluded that these dwarfs really existed, and that they lived in a region which he marked on the map north of Lake Stefanie. Donaldson Smith had not heard of Schlichter's paper, and knew nothing of these dwarfs, but he found them in 1895 in the region which Schlichter had indicated as their probable habitat.

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The broadest generalization with regard to the African tribes is that which separates most of the peoples south of the Sahara Desert into two great groups,—the Negro tribes, whose habitat may be roughly indicated as extending between the Atlantic and Gallaland in East Africa, with the Sahara as their northern, and the latitude of the Cameroons as their southern, boundaries; and the Bantu tribes, occupying nearly all of Africa south of the Negroes. The distinction between these two great groups is not based upon special differences as to physical structure, mental characteristics, habits, or development, but depends solely upon philological considerations, the languages of the Negroes and the Bantus forming two distinct groups. Most of the slaves who were brought to our country were Negroes, while most of those transported to Latin America were from the Bantu tribes.

One fact that stood out above all others in the study of the African natives, was the remarkable prevalence of cannibalism in the Congo basin. In all his wanderings, Livingstone met only one cannibal tribe,—the Manyema living between Tanganyika and the Upper Congo; but though they are not found near the sources of the river, nor near its mouth, they occupy about one-half of the Congo basin. They are regarded with fear and abhorrence by all tribes not addicted to the practice. They number several millions. Instead of being the most debased of human creatures, many of them, in physical strength and courage, in their iron work, carving, weaving, and other arts, are among the most advanced of African tribes. The larger part of the natives in the service of the Congo Free State are from the cannibal tribes. The laws now impose severe penalties for acts of cannibalism, and the evil is decreasing as the influence of the state is extended over wider areas. A few isolated tribes along the Gulf of Guinea are also cannibals.

There is no doubt that the helpful influences of the Caucasian in every part of Africa so far outweigh his harmful influences that the latter are but a drop in the bucket in comparison. It is most unfortunate that a certain admixture of blundering, severity, brutality, and wickedness seems inseparable from the development of all the newer parts of the world. The demoralizing drink traffic, the scandalous injustice and cruelty of some of the agents of civilized governments, are not to be belittled or condoned. But there is also a very bright side to the story of the white occupancy of Africa.

The family of a deceased chief in Central Africa recently preserved his body unburied for fourteen months, in the hope that they might prevail upon the British Government to permit the sacrifice of women and slaves on his grave, that he might have companions of his own household in the other world. He was buried at last, without shedding a drop of blood. Human sacrifices are now punishable with death throughout a large part of barbarous Africa, and the terrible

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evil is being abated as fast as the influence of the European governments is extended over new regions. The practice of the arts of fetichism, a kind of chicanery, most injurious in its effects upon the superstitious natives, is now punishable throughout the Congo Free State and British Rhodesia. Arab slave-dealers no longer raid the Congo plains and forests for slaves, killing seven persons for every one they lead into captivity. Slave-raiding has been utterly wiped out in all parts of Africa, except in portions of the Sudan and other districts over which white rule has not yet been asserted. The Arabs of the Congo, who went there from East Africa solely that they might grow rich in the slave trade, are now settled quietly on their rice and banana plantations. The sale of strong drink has been restricted by international agreement to the coast regions, where the traffic has long existed, and its evils are somewhat mitigated there by the regulations now enforced. Fifty thousand Congo natives who would not carry a pound of freight for Stanley in 1880, are now in the service of the white enterprises, many of them working, not for barter goods, but for coin. Many of the missionary fields are thriving, and wonderful results have been achieved in some of them. In Uganda, where Stanley in 1875 saw King Mtesa impaling his victims, there are now ninety thousand natives professing Christianity, three hundred and twenty churches, and many thousands of children in the schools. Fifty thousand of the people can read. Between 1880 and 1882 Stanley carried three little steamboats around 235 miles of rapids to the Upper Congo. Eighty steamers are now afloat there, plying on nearly 8,000 miles of rivers, and connected with the sea by a railroad that has paid dividends from the day it was opened. At the end of 1890 there were only 5,813 miles of railroad in Africa. About 15,000 miles are now in operation, and the end of this decade is certain to see 25,000 miles of railroads. Trains are running from Cairo to Khartum, the seat of the Mahdist tyranny, in the centre of a vast region which, until recently, had been closed for many years to all the world.

These wonderful results are the fruits of the partition of Africa among the European states. With the exception of some waste regions in the Libyan desert, which no one has claimed, Morocco, Abyssinia, and Liberia, every square mile of African territory has been divided among European powers, either as colonies or as spheres of influence. The scramble of twenty years for African lands is at an end, there now being no valuable areas that are not covered by the existing agreements. It is no mere love of humanity that has impelled the European countries to divide these regions among themselves. We can scarcely realize the intensity of the struggle for existence in many of the overcrowded parts of Europe. Their factories are enormously productive, but their people will suffer for food unless they can export manufactures. The crying need for new markets, for new sources of raw material, drove these states into Africa. And we should be glad, for Africa's sake, that they have gone there, even though the desire to make money is one of the most powerful incentives.

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It is under the protective aegis of these governments that explorers are settling down in smaller areas to see what may be found between the explored water-courses, to study the continent in detail, to give to our knowledge of Africa the scientific quality now required. The greatest geographical work there in recent years is the extension of a line of stations across tropical Africa by Commander Lemaire, each position astronomically fixed by the most careful methods, constituting a base-line east and west through Africa to which the scientific mapping of a very large area will be referred.

The day of the minuter study of the whole continent has now dawned, and we are witnessing a most notable work. All the colonial powers, and the Germans most conspicuously, are studying the economic questions relating to their African possessions. The suitability of climates for colonists, the essential rules of hygiene, the development of agriculture, labor supplies, transportation and commercial facilities, and many other problems are receiving the most careful attention. Experiment stations are maintained in the colonies and colonial schools at home, to fit young men for service in the field. The Germans have already proved that cotton and tobacco are certain to become profitable export crops.

The mine-owners of the Witwatersrand, on which Johannesburg stands, have begun a movement which they hope will result in the immigration of 100,000 white laborers to the mining field. We may look for remarkable development in South Africa, whose promise is larger than that of any other part of the continent. Whatever may be said of some of the methods by which the British have enlarged their empire, their rule has blessed the barbarous peoples whose countries they have absorbed. The task of improving the few millions of blacks in South Africa, and of developing the large and in some respects wonderful resources of that region, will be greatly assisted by the incoming of hundreds of thousands of Europeans, bringing with them the arts and other blessings of civilization. The future of none of the newer parts of the world is brighter with the hope of great development than the region between the Zambesi and the Cape of Good Hope.

In order to observe intelligently the progress of South Africa in coming years, the limitations as well as the advantages of the country must be kept in view. More than half of it, including the entire western half, is deficient in rainfall and can never be the home of a dense white population. Some mining will develop on those broad, dry plains and sandy wastes; some agriculture where irrigation is possible; and great wool-growing wherever thrive the nutritious grasses on which 13,000,000 sheep, scattered over the Karroo of Cape Colony, and 4,000,000 in the little Orange Free State, were grazing before the recent war. Wool-growing will always be the greatest grazing industry, though cattle and horses are raised in large numbers, and the fine, soft hair of the Angora goat is second only to wool in export importance.

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A narrow strip of fine farm lands across the south end of Africa, another along the southern border of the former Boer republics, and a large area among the highlands of Mashonaland, far towards the equator, produce nearly all the crops of the temperate zones. It is not yet certain, however, that South Africa will ever raise enough wheat for a great white population. On the northern slopes of the hills, east and northeast of Cape Town, are thousands of acres of grapes. Cape Colony is becoming one of the important wine countries; and in February and March, large quantities of grapes, peaches, nectarines, and plums are placed in cool rooms on steamships and sent fresh to British markets almost before English fruit trees are in bloom.

East of the grape region is an area peculiarly adapted for the cultivation of tobacco; and east of the tobacco district, north of the coastal belt of wheat in a region of sandy scrub, the bush country, are the ostrich farms, in the hands mainly of men of considerable capital, who supply nearly all the feathers derived from the domesticated ostrich. The plumes are sometimes worth as much as $200 a pound, the ordinary feathers bringing from $5 to $7 a pound. Natal is unique in two of its agricultural industries, being the only colony that is producing tea and important quantities of cane sugar.

But gold, widely scattered over the country on the interior plateau, exceeds in value all the other exports together. The world never saw such a development of gold mining in a small area as has occurred on the Witwatersrand, where Johannesburg stands. The Witwatersrand (White River Slope) is a slight elevation, the water parting between rivers, about one and a half miles wide and 125 miles long. On twenty-five miles of the rand, at and near Johannesburg, more gold was produced in the year before the Boer war than was yielded by any other country in the world, The other rich mining regions of the Transvaal and other parts of South Africa have been completely dwarfed by the wonderful product of the rand. The surveys in Matabeleland and Mashonaland show gold-bearing areas 5,000 square miles in extent, which as yet have practically no development. The mining companies on the rand and elsewhere are now preparing for far larger operations than ever before.

The Kimberley diamond mines, turning out more than $20,000,000 worth of rough stones a year, supply nearly all the diamonds of commerce. Two other diamond centres in the Orange River Colony have scarcely been touched, and diamonds are found on the Limpopo River and in other regions where no mining has been undertaken. The minerals of South Africa, including iron and coal, bid fair to be for many years the largest sources of wealth; and in wool, hides, mohair, fresh fruits, and some other products, South Africa may rival other parts of the world.

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There are no good natural harbors except Delagoa Bay in Portuguese East Africa, but by great expenditure the harbors of Cape Town, Port Elizabeth, East London, and Durban have been adapted for great commerce. Many persons mistakenly regard Cape Town as the chief commercial centre of South Africa. It is so only in respect of the export of gold and diamonds. As it is not centrally situated for business with the interior, more of the things that South Africa sells to and buys from the rest of the world, excepting gold and diamonds, pass through Port Elizabeth than through any other port. Here is centred the largest wholesale trade.

What South Africa needs is more railroads and more white labor. Manufacturing industries on an important scale are yet to come, for as yet the white population is too sparse to develop anything but the natural products of the country.

The broad summing up of the future work in Africa is that the native will be taught to help himself. The destiny of the continent depends largely upon his development, for great parts of Africa may never be adapted to become the home of many white men. The most powerful motives, philanthropic and selfish, incite and will sustain the work of helping these millions to rise to a higher plane of humanity. This work, now well begun, is the great task which in the present century will call for all the knowledge, patience, humanity, and justice that may be brought to bear upon the problem of reclaiming Africa.

AUTHORITIES.

Livingstone’s “Missionary Travels,” “A Narrative of an Expedition to the Zambesi,” and “Last Journeys;” Blaikie’s “Livingstone’s Personal Life;” Stanley’s “How I found Livingstone.”

Stanley’s “Through the Dark Continent,” “The Congo and the Founding of its Free State,” “In Darkest Africa;” Schweinfurth’s “The Heart of Africa;” Burton’s “The Lake Regions of Central Africa;” Speke’s “Journal of the Discovery of the Source of the Nile;” Thomson’s “To the Central African Lakes and Back;” Barth’s “Travels and Discoveries in Central Africa;” Theal’s “Compendium of South African History;” Greswell’s “Geography of Africa South of the Zambesi”; Noble’s “The Redemption of Africa” (A History of African Missions).

No comprehensive compendium of the history of African exploration has yet been written. Our knowledge of the geography, peoples and resources of Africa is treated with considerable detail in a number of works such as Reclus’s “Africa” (in “The Earth and Its Inhabitants”) and Sievers’s “Afrika” (German). A very large part of the exploratory enterprises in Africa have not been described in books, but only in the reports of the explorers, printed with their original maps in the publications of many geographical and missionary societies.

SIR AUSTEN HENRY LAYARD.

1817-1894.

MODERN ARCHAEOLOGY.

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BY WILLIAM HAYES WARD, D.D., LL.D.

It was twenty-three long centuries ago that a Greek soldier of fortune, who had the honor to be also a disciple of Socrates, was leading ten thousand mercenaries back to their native land after their famous failure to set the Younger Cyrus on the throne of Persia. Clearchus and the other generals had been treacherously murdered. Dispirited, almost hopeless, on their way to the longed-for Black Sea, in anticipation of the perilous and tedious journey, past wild mountains and wilder Kurds, they toiled up the valley of the Tigris River. Of one incident of their journey their historian and leader makes no record. They reached the spot where now stands the city of Mosul. On the bank of the river their eyes fell on a bare and lofty hill. They did not know, they never suspected,—Xenophon wrote no word of it,—that under that hill lay buried the ruins of one of the mightiest conquering cities that had ever ruled the world. From the palaces of that hill, Ninus and Semiramis and Sardanapalus had led their conquering armies, all now covered with silence.

Two centuries earlier, in 606 B.C., there had occurred one of the most tremendous catastrophes recorded in all the grim annals of war. After a thousand years of primacy in the East, but twenty years after the death of Sardanapalus (the Greek name of Asshurbanapal), who had carried his armies to Egypt and had made his capital the centre of the world’s culture and magnificence, as it was of its cruel and hated power, Nineveh was captured, buried, and utterly desolated by a horde of savage Scythians from the mountains of the north and east, such people as we now call the Kurds. Its palaces had no lofty Greek columns to stand for memorials, as at Palmyra or Persepolis; and when the outer casings of brick and alabaster were cracked away, and the ashes of the upper stories and the clay of the inner constructions, soaked by the rains, covered the ruins of temple and palace, nothing was left to mark the site but the grass-covered hill. No wonder that the learned scholar of Socrates saw nothing, knew nothing of the city, most glorious and most detested of all the cities of the earth. But in its day the overthrow of Nineveh and the destruction of the Assyrian Empire had been the most terrible event in the world’s history. How the Hebrew prophets gloated over it! “Where now is the den of the lions, and the feeding-place of the young lions, where the lion and the lioness walked, the lion’s whelp, and none made them afraid? Wo to the bloody city; it is all full of lies and rapine; the prey departeth not. The noise of the whip, and the noise of the rattling of wheels, and prancing horses, and bounding chariots, the horsemen mounting, and the flashing sword, and the glittering spear, and a multitude of slain, and a great heap of corpses, and there is no end of the bodies. There is no assuaging of the hurt; thy wound is grievous; all that hear the report of thee clap their hands

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over thee: for upon whom hath not thy wickedness passed continually?” And another prophet had uttered the curse: “The pelican and the porcupine shall lodge in the capitals thereof; their voice shall sound in the windows; desolation shall be in the thresholds; for he hath laid bare the cedar-work. This is the joyous city that dwelt carelessly, that said in her heart, ‘I am, and there is none besides me!’ How is she become a desolation, a place for beasts to lie down in! Every one that passeth by her shall hiss, and wag his hand.”

Thus fell Nineveh, amid the universal rejoicing of the nations, and thus, seventy years later, fell Babylon also, which, in the short interval, Nebuchadnezzar had made more magnificent than even Nineveh had been, beautified for its capture by Cyrus. But before Babylon was the capital of Chaldea, or Nineveh the capital of Assyria, the city of Calah had been the seat of its kings, and a mighty mound—they call it Nimroud now—-“as high as St. Paul’s steeple,” old travellers loved to say—marks the place on the east bank of the Tigris, twenty miles south of Nineveh; and, before Calah, Assyria had an earlier capital forty miles still nearer the Babylonian border, at Asshur, now Kalah-Shergat, on the west of the Tigris; and each capital had its palaces and records, and all are now equally buried in clay and utter oblivion. And before the Babylon of Nebuchadnezzar, and long centuries before Nineveh or Calah or Asshur, there had been mighty kingdoms in Babylonia, of which the world had quite forgot the names, only vague rumors remaining in song or legend of Nimrod and Chedorlaomer and Ur of the Chaldees,—only what was preserved in the dimmest records of the Hebrew Scriptures. Empires were lost, buried in chiliads of forgetfulness; would they ever be recovered?

And how much else was lost, what kingdoms, what empires buried before Hebrew or Greek history began to take notice of the world outside and put them in books, no one knew, no one knows even yet, although so much has been found. The fame of Egypt was never quite forgotten, nor all its history, for Egypt was the world’s granary, and closely accessible to the ships of Corinth and Rome; and Egypt never lost her civilization in all her long succession of enslavement. But what memory had been kept of the Ionia and Greece of the days before Homer? What of the early civilization of Cyprus and Crete? Only the name of Minos, a judge in Hell. What of Persia and Elam? Were they uninhabited before the times of Xerxes and Cyrus? And who were these kings, Cyrus and Xerxes, whose names burst upon us with dim light out of a black antiquity? Even they were but shadows on a screen, just seen and disappearing. What kings and kingdoms came before them and passed away? Has history no record? Not a word. Only black vacuity has been left behind them. And there was that other empire of the East, that of the Hittites, which we now know ruled Asia Minor and Syria and contested

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the rule of the world with Assyria and Egypt centuries before Agamemnon and Achilles, but so utterly buried and forgotten that not a line of its history was left, not even enough to let the sharpest scholar ask a question or suspect that it ever built capitals and fought victories and produced a civilization the harvest of which we still enjoy. Nothing was left of them but their names in a Hebrew list of tribes,—"Amorites and Jebusites and Hivites and Hittites."

Yet all these lost tribes, nay, lost nations, had left their records behind them, only they were buried under ground and out of sight. What a travesty it is on history and civilization, what an impeachment of the glory of these later Christian centuries, that the lands which these old empires crowded with a busy population should now be among the most desolate and inaccessible on the face of the earth! There we see the curse of the Moslem religion, and still more of the Turkish government. Wherever the Turk has carried the sword and the Koran, there is blight and death. Only as soldiers and scholars of Europe have forced their way into these seats of ancient empires has it been possible to ask and learn what is buried beneath their gray desolation.

The man who did more than any other to awaken the interest of the world in the search for forgotten empires was Sir Henry Layard, the excavator of Nineveh. But before his day another man had startled the world with what we may call the discovery of Egypt. That man was Napoleon Bonaparte, the man whose sword was a ploughshare turning up the fallow fields of Europe, and sowing strange crops of tyranny and liberty, and whose ambition it was to set up a new throne in the land of the Pharaohs and Ptolemies. The mighty ruins of Karnak and the imperishable pyramids filled him with amazement, and he set the scholars of France at work to publish in massive folios the wonders of that most ancient land. Then was found the Rosetta Stone, with its inscription in two languages,—Greek, which any scholar could read, and the Egyptian hieroglyphics, which no living man could read. But here was the key. The words *Ptolemy* and *Cleopatra* were in the Greek text, and it was not hard to find what were the combinations of characters that stood for these words in the Egyptian. The letters *p, t*, and *l* were in both names. The hieroglyphic signs found in both names must be these three letters. That beginning gave all the other signs in both words, and the rest of the alphabet soon followed. Justly great is the fame of the Frenchman Champollion, who has the honor of having first deciphered and read this lost language, and opened to us the secret treasures of its history and religion.

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But with the exploration of Egypt the scholarship of the world was satisfied for fifty years. No one seemed to think to ask what might be hid under the soil of nearer Palestine and Syria and Asia Minor; much less did they seek to uncover the buried capitals of Assyria and Babylonia. Scholarship was devoted to books, to old manuscripts in convent libraries, to recovering what the wise men of Greece and Rome had written, and trying to wrest new facts out of their blundering old compilations of ancient history. It did not occur to them that a hundred kings and ten thousand merchants and priests might have left the stories of their conquests or contracts or liturgies, unrotted in the wet soil, imperishably preserved to be the record of commerce and empires as old and as great as those of Egypt, but far deeper covered with oblivion. But there they were, kept safe for twenty, thirty, fifty centuries, until the man should come whose mission it was to find them.

More than one such man came in the middle of the last century, but one man is pre-eminent, and typical of all the rest, Sir Austen Henry Layard. Before him one Frenchman, M. Paul Emile Botta, had made a fine dash on a palace city a dozen miles north of Nineveh, and had opened wonders such as the world had never seen before. But the man whose energy was fullest of impulse, whose enthusiasm compelled British Ambassadors and Ministers and Parliaments to do his bidding, who aroused the world to the importance of the exploration and disinterment of the monuments of Babylonia and Assyria, was the Englishman Layard.

He had a youthful passion for adventure, and slender means to gratify it. I wish you could see him as he is pictured in the volume which gives the story of his early adventures, before he had settled on his life-work of exploration. There he stands clad in his Bakhtiyari costume, the dress of a mountain tribe in Persia which asserted its independence of Teheran. It is a well-knit frame, fit to endure hardships. He stands holding the tall matchlock, the curved scimetar by his side, and the long pistol and the dagger in his belt. Above the yellow shoes and parti-woven stockings a red silk robe falls to his ankles, and over that a green silk garment reaches to his knees, and yet over that a shorter and richly embroidered coat, with open sleeves, is held close about the body by a wide silken sash woven in the brightest of red and gold, and holding the weapons attached to his waist. On his head is a low flat cap, visorless in front, but with a broad bow in place of a feather, all striped with the richest embroidery, and with a wide tassel of the same material falling far down his back. But the face, with its short beard dyed dark with henna, and its blue eyes, is not that of a warrior, but of a serious scholar or diplomatist. And he needed all the force of courage and all the arts of diplomacy for the work he had to do.

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Layard’s early training was in the line of preparation for his life’s work. Much of his boyhood was spent in Italy, where he acquired a taste for the fine arts, and as much knowledge of them as a child could obtain who was constantly in the society of artists and connoisseurs. At about the age of sixteen he was sent to England to study the law, for which he was destined by his parents. After six years in the office of a solicitor, and in the chambers of an eminent conveyancer,—for that is the way that lawyers were educated then,—he determined to leave England and seek a career elsewhere. He had a relative in Ceylon, who gave him hopes of securing a position there, and for Ceylon he started. A friend of his, ten years older, was bound for the same destination, both fond of adventure, and they agreed to go together, and to go as far as they could by land instead of taking the long sea journey around the Cape of Good Hope. Across Europe they passed to Constantinople, through Austria, Dalmatia, Montenegro, Albania, and Bulgaria; thence across Asia Minor to Syria and Palestine; thence to Aleppo and down the Tigris to Baghdad. It was an extraordinary and adventurous journey, often dangerous; but greater danger was to follow. Layard had learned some Turkish, and now he spent the long weeks in Baghdad in the study of Persian; his companion was quite familiar with Arabic. Before they left England they had received good advice from Sir John MacNeill, the British representative at the court of the Shah: “You must either travel as important personages, with a retinue of servants and an adequate escort, or alone, as poor men, with nothing to excite the cupidity of the people amongst whom you will have to mix. If you cannot afford to adopt the first course, you must take the latter.” The latter they were forced to take.

Many a young man has the gift to acquire languages—almost any Oriental can talk three or four—and the ability to rough it and live on the fare of the people, though barbarous; and many a man has the spirit of adventure; but this young man had one peculiar and unusual qualification that directed him to his future career. As a child, he had read the “Arabian Nights” with intense delight, with their stories centred about Baghdad. Then every book of Eastern adventure, every bit of travel in Syria, Arabia, or Persia that he could find he had eagerly devoured. It was his day and night’s longing that he might visit strange lands of history and make explorations and discoveries. So wherever he was, he visited every ruin and tried to copy every inscription. If his companion would not turn aside to visit some region of renown and danger, he would go alone and join him later. As they came down the river Tigris in their boat, they passed the immense mound of Nimroud, and so impressed was Layard by it that he then, scarce twenty-three years old, resolved that some day he would search and learn what was hidden under it; but little did he imagine what wonderful monuments he was to find there only a few years later.

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Without a servant, as poor men, in a caravan of fanatical and hostile Persian pilgrims returning from the shrines, just travellers trying to go by land through Persia and Afghanistan to India and Ceylon, they left Baghdad. It was a time of unusual danger, for the British Minister had been recalled from the Persian Court, and war with England was threatened. They were taken for spies, and sent to the presence of the Shah, and forbidden to follow the route they had chosen and which had been marked out for them by the Council of the Royal Geographical Society, to report on rivers and mountains and ruins not yet explored. They were insulted and robbed, and their lives were often in danger; but at last they received from the Shah their firmans. Now they separated. His companion felt that he must go by the quickest route to his destination; but Layard had no definite date before him, and he was anxious to perform the commissions of the Geographical Society, and so he plunged alone into fresh dangers.

But there is no space to tell the rest of the story of his adventures among the Bakhtiyari, of his copying of inscriptions, of his return to Baghdad and his decision to give up the plans of life in Ceylon, and of his return from Baghdad again to Shuster and Persepolis and other ancient cities of Persia, and his exploration of the Karun River and his geographical paper on the subject, his opening of British trade, and his return to Constantinople. At Mosul he found that M. Botta was planning to explore the mounds across the Tigris that covered ancient Nineveh, and he warmly encouraged his plans. At Constantinople he visited Sir Stratford Canning and delivered to him despatches that had been confided to his care, in view of a threatened war between Persia and Turkey. Here he was kept in the service of the British Embassy, and intrusted with important and delicate negotiations and investigations which were so highly appreciated by Sir Stratford that he kept him as his attache.

Meanwhile M. Botta had begun his excavations of a palace of King Sargon at Khorsabad and was sending his reports and drawings to Paris. They were all sent by way of Constantinople, and, by M. Botta’s generosity, were all seen by Mr. Layard. So deeply was he interested in them, and so intense was his desire to carry on excavations himself, that he secured his release from the Embassy, and also a grant of three hundred dollars from Sir Stratford’s own purse, which, with what he could spare from his own money, would, he hoped, suffice to begin the work, when, if anything of value appeared, it was trusted that funds would be secured from English friends of Oriental learning. Thus, six years after leaving England, Mr. Layard, well equipped in knowledge of the people and in diplomatic experience, was ready to launch on his great career, which brought him fame and earned him the post in later years of British Ambassador at the Porte, which Sir Stratford had held, and—what is far greater—gave to the world the larger part of its knowledge of the lost empires of Assyria and Babylonia.

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With these few hundred dollars, and contributing every penny of his own income, in October of 1845, he left Constantinople without companion or servant, went by steamer to Samsoun, and then as fast as post-horses could climb or gallop over mountains and plains, he reached Mosul in twelve days.

Here at last he was fitted for his task, supplied for the accomplishment of his passion. The Arabs say: "I had a horse, but no desert; I had a desert, but no horse; now I have a desert and a horse, and shall I not ride?" His boyhood, with the artists of Italy, and learning the languages of the continent, had fitted him for his task; then his study of all the books of Eastern travel, then half a year wandering with a trained companion through Asia Minor and Syria, scarcely leaving untrod one spot hallowed by tradition, or unvisited one ruin consecrated by history, with no protection but his arms, living with the people and learning their prejudices and customs. Then an irresistible desire had brought him to the regions beyond the Euphrates, and the mystery of Assyria, Babylonia, and Chaldea had fascinated him, so that he had visited the land of Nimrod, seen the site of their old buried capitals, had been the guest in the tents of Shammar and Aneyzah Arabs, and even passed on to see the famous forty columns of Chilminar, old Persian Persepolis, and to penetrate the mountain fastnesses where the Bakhtiyari maintained a perilous freedom. Never was man better trained by enthusiasm and experience for his task, and the late discoveries of M. Botta had inflamed his desire to surpass what his French friend had done.

His plan was not to begin excavations at Nineveh, opposite Mosul, but twenty miles south, at the great mound of Nimroud, which bore the name of the mighty hunter Nimrod. Xenophon and his Ten Thousand had seen and wondered at its pyramid. There he would be free from the army of mischievous spectators that would swarm from Mosul, had he selected the site of Nineveh, and from the constant interference of the Turkish governor. The Pasha at Mosul was a cruel scoundrel, who was robbing and killing the people as his whim or greed prompted, and had reduced the tribes of the neighborhood to a state of terror. Accordingly, Mr. Layard, who was armed with protecting letters from the British Ambassador and the Porte, thought it wise to conceal his purpose, let it be reported that he was going on a hunting expedition; and with a few tools and a supply of guns and spears, on the 8th of November, 1845, accompanied only by his cawass, the soldier attendant detailed for the protection of travellers, a servant, and one laborer, he floated down the Tigris, and in four hours reached the bourne of his long hopes. He had the mound, he had the money, and now he would dig.

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The Arabs have strange stories of this ruin. The palace, they say, was built by Athur, the vizier of Nimrod. There Abraham brake in pieces the idols worshipped by the unbelievers. Nimrod was angry and waged war on the holy patriarch. Abraham prayed to God: “Deliver me, O God, from this man who worships stones, and boasts himself to be lord of all kings;” and God said to him, “How shall I punish him?” and the prophet answered, “To thee armies are as nothing, and the strength and power of men likewise. Before the smallest of thy creatures will they perish.” And God was pleased at the faith of his servant, and he sent a gnat that vexed Nimrod day and night, so that he built himself a room of glass in that palace that he might dwell therein and shut out the insect. But the gnat entered also, and passed by his ear into his brain, upon which it fed, and increased day by day, so that the servants of Nimrod beat his head continually with a mallet that he might have some ease from his pain; but he died after suffering these torments four hundred years. And after him the mound was named Nimroud.

It was dark when Layard and his little company reached the place. They found near by a few huts occupied by poor Arabs, who had been harried by the Turkish Pasha. There they slept, or tried to sleep. But the explorer could not sleep. Hear him:—

“Hopes, long cherished, were now to be realized, or were to end in disappointment. Visions of palaces under ground, of gigantic monsters, of sculptured figures, and endless inscriptions, floated before me. After forming plan after plan for removing the earth and extricating these treasures, I fancied myself wandering in a maze of chambers from which I could find no outlet. Then, again, all was reburied, and I was standing on the grass-covered mound. Exhausted, I was at length sinking into sleep, when, hearing the voice of Awad, I rose from my carpet and joined him outside the tent. The day already dawned. The lofty cone and broad mound of Nimroud broke like a distant mountain on the morning sky.”

Awad, his host, was a little chief among the Arabs, and was engaged to take charge of the diggers. The first morning he had six Arabs at work, and found alabaster slabs with cuneiform inscriptions. He was now sure he would succeed.

It is not necessary to give the diary of his work. To be sure, the villanous Pasha forbade him to continue, and recalled him to Mosul, but a new governor was sent from Constantinople, under whom he had no difficulty. A great palace had been found, and chamber after chamber was excavated, the walls covered with bas-reliefs and inscriptions. Then came strange, gigantic lions with human heads, that had been placed by the old Assyrian king to guard the entrances to his court. What was the amazement of the Arabs and Turks cannot be told. First, the head was uncovered. It stood out from the earth, placid and vast. Hear Layard tell the story. He had been away to visit a neighboring chief:—

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“I was returning to the mound, when I saw two Arabs urging their mares to the top of their speed. ‘Hasten, O Bey,’ exclaimed one of them, ’hasten to the diggers, for they have found Nimrod himself. By Allah! it is wonderful, but it is true! We have seen him with our eyes! There is no God but God!’ And both joining in this pious exclamation, they galloped back to the tent.”

Layard hastened to the trench, and there saw what he knew to be the head of a gigantic lion or bull, such as Botta had uncovered at Khorsabad. It was in admirable preservation. The expression was calm, yet majestic, and the outline of the features showed a freedom and knowledge of art that was scarcely to be looked for at so early a period. Says the explorer:—

“I was not surprised that the Arabs had been amazed and terrified at this apparition. It required no stretch of imagination to conjure up the most strange fancies. This gigantic head, blanched with age, thus rising from the bowels of the earth, might well have belonged to one of those fearful beings which are pictured in the traditions of the country as appearing to mortals, slowly ascending from the regions below. ’This is not the work of men’s hands,’ exclaimed Sheikh Abdurrahman, who had galloped to the mound on the first news, ’but of those infidel giants of whom the Prophet, peace be with him! has said that they were higher than the tallest date-tree; this is one of the idols which Noah, peace be with him! cursed before the flood!’ In this opinion all the bystanders concurred.”

The Arabs have a ready explanation for every fresh discovery. When some years later Mr. Layard’s assistant and successor in the work of excavation, Mr. Rassam, uncovered, at Abu-habba, a remarkable bas-relief with the figure of the seated Sun-god and three approaching worshippers, the Arab diggers rushed to him, declaring that they had found Noah and his three sons, Shem, Ham, and Japhet, and demanded a sheep to make a feast.

The report of the wonderful discovery of a royal palace, evidently older than those of Nineveh, with magnificent decorations in alabaster and cuneiform inscriptions, reached beyond Mosul to Constantinople. Sir Stratford Canning was delighted with the result of his expedition. He had a passion for discovery as well as diplomacy, and it is to him that the British Museum is indebted for the priceless marbles of Halicarnassus. He now obtained for Mr. Layard a firman, permitting him to make what excavations he wished. Then the news reached London, and the British Museum made a grant to support the work. All difficulties were now removed. Conditions were even more favorable for him than they are now. There was then no Imperial Museum in Constantinople to which all objects found must be taken, but those that dug had the right to carry off their prizes to London or Paris.

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To tell the story of the further excavations is unnecessary. It is all given in Layard's two splendid volumes, "Nineveh and its Remains," and "Babylon and Nineveh;" and the bas-reliefs, statues, bronzes, ivories, and inscriptions are magnificently reproduced in great folio volumes. From Nimroud he went back to Mosul, and there opened the two mounds opposite of Kuyunjik and Neby-Yunus, the site of old Nineveh. There more palaces and friezes were found of other kings. Then he went back to London, closing his successful campaign, more profitable if not more glorious than those of war, and published the story of his work. Its effect was marvellous. No such popular book of travels had ever appeared; for it was a story of adventure, and also of strange discovery. Mr. Layard had not suspected that he had the literary gift, but he had it in rare measure. He had gained an inner view of the heart of tribes, Moslem and Christian and semi-pagan, by his sympathy with them and his knowledge of their tongues. He had lived in their tents and huts. He had saved them from persecution by Turkish governors. Their gratitude to him was beyond words, and he told their story with affection and enthusiasm. Then his discoveries were in the lands made historic not only by the campaigns of Xenophon and Alexander, but made almost sacred by the Bible history. These were the lands whence came the armies that fought with Israel. These were the kings whose wars are told in the Jewish records; and the annals of these kings were found in their palaces, and they gave full accounts of wars of which the Bible had given the outline. Piety and learning joined to give extraordinary interest to these discoveries and to this report of them. Mr. Layard found himself famous, and the monuments he was bringing to the British Museum were, and still are, the most extraordinary and fascinating in all its corridors.

Of course, a new grant was made in behalf of the British Museum, and of course he went back to continue and extend his researches. Now he wished to go further south, beyond Nimroud to Kalah Shergat, the yet earlier capital of Assyria; and yet further to Babylon, that he might see and test the multitude of mounds of ancient Chaldea, the real land of Nimrod, the seat of Eden, and the Tower of Babel, far more ancient than any one of the three capitals of Assyria. While he did scarce more than to visit and report on the Babylonian mounds, his diggings in Nineveh itself were of vast importance, for there he found the library of Asshurbanabal, on clay tablets, which has given us our chief knowledge of the literature and learning of the ancient East. In 1852 he returned to England to publish his "Monuments of Nineveh," and left the further exploration to his able lieutenant, Mr. Rassam, and to a noble succession of explorers who should follow, and to a no less noble line of scholars who should interpret the inscriptions and recover the history of the nations; so that we now know more exactly the history of Babylonian and Assyrian kings, and from more authentic records, and more completely the social condition and business life of the countries, than we do the history of Greece, or the life of the Greeks even of the time of Pericles, and that, too, for a period of three thousand years.

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To illustrate this fact, let us take the black obelisk of Shalmaneser II., found by Layard at Nimroud. It is a column of basalt seven feet high and about two feet wide at the base, from which it narrows slightly, until near the top it is reduced by three steps. On the four sides is engraved in five rows of bas-reliefs, twenty in all, the pictured history of the royal conquests, the submission of kings, and the presentation of tribute. Above and below, and between, in two hundred and ten lines, was cut an inscription which explained the figures, and gave a full historical and, of course, contemporary and official account of the glorious events of the royal reign. Not a line was defaced; at the British Museum it can be seen to-day as perfect as when engraved twenty-seven centuries ago. Other monuments of Shalmaneser have been found. One is a great monolith with a portrait of the king in all his fine array, and with one hundred and fifty-six lines of text. Another is a series of splendid bronze plates that covered great wooden gates, on which, in repousse work, were pictures of the royal victories, and inscriptions explaining them. The Bible tells us of the rivalries and jealousies of Ahab and Jehu, kings of Israel, and Benhadad and Hazael, kings of Damascus. How surprising it is to find here not only the story of the successive campaigns of Shalmaneser against these same kings, the number of their chariots and soldiers, but to see pictured before us the tribute sent by Jehu. We learn that Shalmaneser reigned from 859 to 825 B.C., and we have the record of all his successive campaigns, the first twenty-six of which he led in person. There is not another country of which, before the invention of printing, we have so minute a history; and all had been lost, except the mention of a name or two, whether historical or legendary we hardly knew, until Layard and his fellow-explorers opened the mounds of Assyria.

But enough for Layard. He is only one, though the principal one, of all the explorers of the buried records of the empires of the Tigris and Euphrates. And Babylonia and Assyria are not the only countries that history required us to explore. Greece and its neighboring states and islands have not even yet been fairly investigated. Much of Asia Minor is still a virgin field. Syria and Palestine have hardly been scratched with the spade. More has been done in Egypt, but more yet is to be done. And when we go into the further east of Persia and Old Elam, not to speak of the yet farther east of Central Asia, now just beginning to yield strange treasures to daring travellers, and ancient India and China,—how ancient we know not at all,—there is field for centuries of further research. For we must go back past empires and kingdoms and tribal conditions to the very beginning of the human race on the earth, even if so it be, to the first *Pithecanthropus* which men of science tell us was the link which connected *Homo sapiens* with the race of primitive simians. And all this, it may well be, is preserved in undecaying records just a few feet under the ground, if one only knew where to dig for it; nay, we now know where to dig for the most and best of it, and we only await the Stratford Cannings, who will give the money, and the Austen Layards, who have the enthusiasm for the work.

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After Layard and Rassam, after Rawlinson and Botta, George Smith took flying trips to the site of Nineveh twice that he might gather the remaining fragments of the great library of Asshurbanabal, and he died in the field far from home. It was he that found among Layard's tablets the Babylonian account of the Deluge, so much like that in the Bible. He was the first of a second generation who, following Rawlinson and Oppert, decipherers as well as explorers, were able to read as they found. I can only mention the names of the Englishmen Taylor and Loftus; of the Frenchmen, Place and De Sarzec; and, later, the Americans, Peters, Hilprecht, and Haynes, who have so faithfully explored the extremely archaic mound of Niffer, which I had the honor to recommend for excavation after I had visited the mounds of Southern Babylonia in the winter of 1884-85. And now the Germans, with scientific as well as commercial and political purpose, with their railroad to pass down the valley through Baghdad to the Persian Gulf, which gives them predominant influence, have sent expeditions well equipped with scholars and engineers to the choicest sites in Babylonia, to Warka, the ancient Erech, and to Babylon itself; and with Teuton thoroughness they are excavating the most famous of ancient ruins and gathering fresh treasures of archaeological research. Nor have they left the land of the Hittites unexplored, for Germany claims the first rights, politically, in all Anatolia, the right of succession and possession when the Turk is expelled, and German archaeological science is bound to be first on that field.

And now what have we found as the fruit of all this labor of exploration? Is it worth the labor and the expense?

Let us look first—it can be only a glance—at Egypt, for Egypt was the land first and most persistently explored. The French Government for scores of years has been at work there. Germans and Italians have explored the ruins; two English societies have for years kept expeditions in the field; and just now a Californian university sends an American Egyptologist to uncover the tombs and read the hieroglyphs of the kings. Not only are the figured monuments of Egypt published in princely folios, but its records have been translated and its lost history recovered to the world's knowledge. Instead of the bare "Pharaoh" of the Bible, a common designation for all the kings, and in place of a bare list of names and dynasties copied from Manetho, and so altered and corrupted in the copying as to be neither Greek nor Egyptian, we have, on scarab, or gravestone, or pyramid, or rock-sepulchre wall, in his own spelling, the name of almost every king from the latest time of the Ptolemies back to the first king of the first dynasty, five thousand—or was it six thousand?—years before Christ. And not their names only, but the very pictures of their wars. We see how they went up the Nile and fought the blacks of Abyssinia, and brought back the spoils of Punt We see them sending

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their squadrons into Syrian Asia, and waging a dubious battle with the Hittites before the walls of Hamath, where Rameses in his lion-guarded chariot performs prodigies of valor, and from which he returns not only to paint on sacred walls the picture of his victory, but also to inscribe a copy of the treaty of peace with the Hittite king, the earliest treaty in the preserved annals of diplomacy. Well wrought that Rameses the Great for eternal fame in the sixty years of his reign, fifteen centuries before the birth of our Lord. But what fame had been his, had not explorers and excavators and scholars dug and found and copied and translated what the sands had covered for centuries? And to-day the curious traveller stops in sight of the pyramids on the banks of the Nile, and enters the Bulaq Museum, and there he sees set up before him the very mummy of Rameses himself and of a dozen other royal personages, rifled from their tombs and displayed for your amazement and mine. There is the very Pharaoh—you can see his features, you can touch his coffin—who chased the Children of Israel out of Egypt. There are the household implements, the furniture of their homes, the jewelry their queens wore,—-queens who were also sisters of the kings, as Sarah was the sister of Abraham.

Or would you know of some great revolution in Egypt? These decipherers of the inscriptions will tell you how the Shepherd Kings overthrew the native dynasty, coming with their armies from Asia long before Rameses, and changed religion and customs; under whom Jacob and his sons found hospitable welcome, until their hated race was expelled by a stronger native dynasty that knew not Joseph. Or they will tell you of the royal reformer Khuenaten, son of a famous Eastern mother, a queen from the banks of the Euphrates. Taught by her, perhaps, a purer religion, he attempted to replace the worship of Egypt’s bestial gods by the worship of the one only great God, whose symbol was the sun. But the priestly clan was too strong for him, and the succeeding Pharaohs destroyed his records and chiselled out his name where it had been cut in stone that no memory of his sacrilege might be preserved. A royal Moses there could not be. The worshipper of one God, whether king or son of Pharaoh’s daughter, could bring no reformation to Egypt.

Or would you learn how Egypt ruled its subject territory? You can read the correspondence of a dozen local Egyptian governors in Palestine and Syria in the century before Moses led the Hebrew slaves out of Egypt. There is the letter of the King of Jerusalem, where Melchizedek reigned in the times of Abraham; and they tell of rebellions against the fading power of Egypt, and of the fear of the advancing Hittites. The earliest kings, those that built the pyramids, appear before us real in their personality, emerging out of misty legend or myth, and, earlier still, even the prehistoric races that antedated the very beginning of civilization.

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Whence came that first dynasty? Who invented writing? Were they autochthons? Hardly. These are questions left for further explorers to answer. Probably those first messengers of civilization came from the East, perhaps from Arabia, perhaps from Babylonia, or perhaps the first Babylonians and Egyptians formed a common stock somewhere near the mouth of the Euphrates. Perhaps the Bible is right in saying that the first seat of civilized man was in Eden, and that the Euphrates was the chief river of Paradise. Or was it from Arabia, the immemorial home of the Semitic tribes, that land of sand and mountain and fertile valley, land of changeless culture and tradition, so near the centres of civilization, and yet still the most inaccessible, the least known portion of the inhabited earth,—was it from Arabia that the wiser, stronger multitude came that first overran the valleys of both the Nile and the Euphrates, bringing to Egypt and Chaldea arts and letters? We do not know. Some future explorer must teach us. But the German Glaser has within these few years brought back from hazardous journeys a multitude of inscriptions that tell of kingdoms that fringed its southern coast and extended we know not how far into the interior in those early days when one of the queens of Sheba brought presents to Solomon, and when, earlier still, we are told there were dukes of Edom before there was any king in Israel. They say that a railroad is to be built to Mecca; Arabia is not to be always a closed land, neighbor as it is to Egypt. We shall know one of these days whether, as scholars suspect, out of Arabia and across the Straits of Bab-el-Mandeb, where, at the southern end of the Red Sea, Africa almost touches Asia, there came that mighty flood of more forceful men, bred in the deserts and hills, who, passing down the Nile, first brought history to Egypt; and whether it was this same Semitic people, as scholars suspect again, that spread resistlessly eastward to the Euphrates valley, and did an equal service in conquering and assimilating the black aborigines of these swamps and lagoons. The spade will tell us.

Or was it still further east, in the highlands of Persia, that men first learned how to write and record history? We cannot go back so far in the history of Babylonia—Professor Hilprecht dares to carry us seven thousand years before Christ—that we do not find its kings fighting against Elam. And only in the last decade of the Nineteenth century the Frenchman De Morgan has made marvellous discoveries in the Elamite lands. What a noble passion those Frenchmen have for discovery! For Egypt did not Napoleon provide the most elephantine books of monuments and records that printing-presses have yet issued? And from that time to this have not Frenchmen held the primacy in excavations until, even while England holds and rules Egypt, she leaves, by special convention, the care of its monuments and their exploration to French savants? And before Layard removed a basketful

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of the earth that covered the palace of Shalmaneser at Nimroud, had not the Frenchman Botta disclosed the friezes and sphinxes of Sargon at Khorsabad; and in these late years is it not the Frenchman De Sarzec who has brought from Telloh to the Louvre the statues of Chaldean kings that lived almost five thousand years ago? And so to France was given the right, for the honor and enrichment of the Louvre, to explore Persia; and De Morgan went to Susa, to Shushan, the palace of Xerxes and Darius, of Ahasuerus and Esther, in search of what was far earlier than they, for another Frenchman and his wife, M. and *Mme*. Dieulafoy, had already excavated the noble palace of these Persian kings. Far below the palace of Xerxes he has found vastly earlier remains. There is the column set up, if we can believe the Assyriologists who trust the chronology of Nabonidus, the last king of Babylon,—and it is not incredible,—-three thousand eight hundred years before Christ, by Naram-Sin, a Babylonian king, to commemorate one of his raids into the land of what were perhaps his stronger enemies. It is a noble composition, with archaic writing, and a stately figure of the king climbing the mountains and slaying his enemies; it shows an art that might well have developed into the best that Greece has produced. But De Morgan has only begun to scratch the surface of the mounds of Elam, and a multitude of scholars believe that out of Elam came the first civilization of Chaldea. We shall find out yet; for the record is in the earth, and only waits the man who will dig it out, and then the man who will read it.

We are tempted to go further east and recall that in India, the land where Alexander made his most distant conquests, a multitude of English scholars have been searching the ruins of old temples for the earliest memorials of the worship of Buddha. Just now they have found his birthplace and precious relics. But that takes us too far afield, and would tempt us to further excursions in Burmah and China. We must come back to Western Asia and the shores of Europe.

As has been indicated, the greatest puzzle of ancient history is that of the Hittite empire, which seems to have ruled all Asia Minor at some uncertain time, and to have extended over Syria and Palestine. No sooner had the greatest Egyptian kings, Thothmes and Rameses, ventured their armies into Asia, perhaps in vengeance on the incursions of Ionian pirates, perhaps in requital of the tyrannies of the hated Shepherd Kings, than they learned of the Hittites on the shores of the Euphrates. Then, a century or two later, a mass of official correspondence sent by the Kings of Palestine and Syria, dug up in Egypt, reports that the Hittites had appeared as invaders from the north and beseeches military aid. But the power of Egypt had waned, and the Hittites were supreme until the Assyrians began and carried on for five centuries the uncertain war which ended in the utter overthrow

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of the Hittites and all their allies in a great battle at Carchemish. That great mound of Carchemish needs to be thoroughly explored. Already an English expedition has very carelessly just opened the hill and exposed, but not fairly published, some few as fine friezes as are to be found in the Assyrian capitals, with unread Hittite inscriptions, and a fine statue of the Hittite Venus; but much remains to reward the student of Oriental history and art. At Senjirli a German expedition under Von Luschan has done more and better work, handsomely published, but this was a smaller Syrian town, and less was to be expected; and yet here, and near by, were found what was not expected, steles (upright slabs or pillars) with the portraits of kings in high relief, covered over with long inscriptions in Aramaic, the oldest and longest as yet discovered anywhere in that language. It was a magnificent result of very moderate labor,—Hittite friezes, Assyrian and Aramean inscriptions all in one little mound. But for the most part we know the art and writing of the Hittites from what we have found above ground, in their towns and fortresses in the hills, for little digging has been done. At Pterium was a principal sacred capital, and there, on a natural corridor of rock, they carved a procession of gods and kings and soldiers that excites the wonder of scholars. As I write, the announcement comes that Professor Sayce has at last discovered the secret of the Hittite hieroglyphs, and we may hope that very soon it will be possible to read them. But there is vastly more of their records yet to be disinterred.

And there remain the two lands most sacred and beloved in poetry and history,—the land of Israel and the land of Homer. It is amazing that so little search has been made to find out what is hidden under the soil of Palestine. Scholars in plenty have walked over the top of it, and have told all that is on the surface, but almost nothing has been done underground, no such excavations as in Egypt or Assyria. I do not forget that the English Palestine Exploration Fund has followed out, with trenches and tunnels, the walls of Jerusalem, nor that one or two old mounds have been partly explored. But what is this to the great work that needs to be done? There has been found on the surface the Moabite Stone, at the old capital of Dibon, a wonderful record of early kings mentioned in the Bible. And there is the short account in the rock-cut conduit of Siloam, of the success of the workmen in the time of Hezekiah, who, beginning at the two ends, did the fine engineering feat of having their tunnels meet correctly in the solid rock. But when Jerusalem is fully explored, and the northern capitals of Bethel and Tirzah and Samaria, and a hundred other mounds that mark the site of Jewish, Israelite, Philistine, and Amorite cities, we may expect marvellous discoveries that will illumine our Holy Scriptures.

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And one region yet remains to be considered, the scattered coasts and islands that owned the Greek speech, and that created the Greek civilization. It is not the Greece of the Parthenon and Pericles that we wish to discover, for that we fairly know; but the arts and the history of those earlier Greeks and Trojans that Homer tells of, the age of Agamemnon and Ulysses, of Helen and Hector and Priam, and of the yet earlier tribes that sailed the Aegean, and settled the Mediterranean islands, and sent their ships to the Egyptian coasts, and sought golden fleeces on the Euxine Sea. All about the coast of Asia Minor they lived, while that Hittite power was ruling the interior; and, intermixed with Phoenician trading-posts, they held the great islands of Crete and Cyprus and the shores of Sicily and Italy. What shall we call them? Were they Dorians, or Heraclidae, Achaeans or Pelasgi? Were they of the same race as the mysterious Etruscans, or shall we name them simply Mycenaeans, as we call the art Mycenaean that ruled the islands and coasts down to the Homeric age, and we know not how many centuries earlier, but certainly as far back as the conquering period of the Eighteenth Egyptian Dynasty of Thothmes? Their soldiers and merchants and their fine vases are pictured on the walls of Egypt, and their pottery has long been studied; but we knew little of them until Dr. Schliemann, the Greek merchant who achieved wealth in the United States, bravely opened the great ruins of Troy, in the full patriotism of his assurance that Homer’s story of the Trojan war was history as well as poetry. As he found one burnt and buried city under another,—for many times was Troy destroyed,—and extended his investigations to Tiryns and other ancient cities, one volume of splendid research followed another, until the trader had compelled the unwilling scholar to confess that he must dig for both history and art. To be sure, his interpretations were quite too literal at first, but the whole world of classical scholarship has learned from him the new method of research. Splendid have been the results. If we are not sure which stratum represents the city of Priam, we do learn how the people lived, and how fine was their work in silver and gold, and how slight their knowledge of letters. Dr. Schliemann has now a multitude of imitators. France and Germany and England and the United States each maintain a school of archaeology in Athens, and each conducts careful explorations. Our American School lost to the French, for lack of money at the right time, the chance to explore Delphi, but it has carried on careful explorations at Corinth and other places. How wonderful was the discovery, not long ago, of a shipload of bronze and marble statues wrecked while being transported as spoil of war from Corinth to Rome!

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But the most surprising discoveries in the realm of old Greek history and art are those that have been made in these last two or three years in Crete. Crete was a famous centre of ancient Greek legend. Jupiter was born and reared on Mount Ida. From another mountain summit in Crete the gods watched the battle on the plains of Troy. There ruled Minos, who first gave laws to men, and who at his death was sent by the gods to judge the shades as they entered the lower world. There was the famous Labyrinth, and there the Minotaur devoured his annual tale of maidens until he was slain by Theseus. Was there such a real palace of Minos as the Greek poets sung? The magnificent palace of the Cretan kings at Cnossus has been found, by Mr. Evans, with its friezes, its spiral ornaments, its flounce-petticoated women, its treasuries, and its tablets written in a script so old that it cannot yet be read, but which will be read as surely as scholarship leaves none of its riddles unsolved. The childhood of Greece, its mighty infancy, out of which it grew to be the creator and the example of all the world's culture, is even now being exposed to our view, safely kept to be recovered by the scholars of our generation.

Of interest rather to the student of the curiosities of history are the mounds and pyramids and temples built by the aborigines of America; for these tribes have had absolutely no part in creating our dominant civilization or developing its art. China and Japan are, at this late day, giving something to the world's store of beauty and utility; but the mound-builders and cliff-dwellers, the Mayas and Toltecs and Incas, have given absolutely nothing which the world cared to accept. But this does not argue that it is not worth while to learn what we can of the rude civilization of the races whom we have displaced. Their arrowheads and hatchets are in every little museum. Their mounds, sometimes shaped like serpents or tortoises or lizards, are scattered over all the central States, and many of them have been carefully explored with scanty results. The cliff-dwellers have left somewhat richer remains, more baskets and parched corn, yet nothing of artistic value. We have to go to Mexico and Yucatan and further south to Peru, to find the majestic capitals of the Mayas and Incas, who had really reached a fair degree of such civilization as stone and copper, without iron, and the beginnings of picture symbols, without letters, could provide. Humboldt and Stephens, and Lord Kingsborough, and Squier, and Tchudi, and Charnay have made explorations and found vast and wonderful cities, some of them deserted and overgrown before Cortez and Pizarro took possession of the lands for Spain and enslaved the people. Where the city of Mexico now stands was a famous capital, from whose ruins were taken the great Calendar stone and the double statue of the god of war and the god of death. In Palenque and Uxmal, capitals of Yucatan, were immense

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palaces and temples, with the weird ornamentation of Mayan imagination; and equal wonders exist in the high uplands where the Incas ruled Peru. Even their barbaric art and their unrecorded history must be recovered, to satisfy the curiosity of the more fortunate races whose boasted Christianity visited on them nothing better than cruel slaughter. At least we can give them museums and publish magnificent pictures of their ruins.

So we may bless the ashes and sand that seemed to destroy and bury the monuments of the mighty empires of the ancient world, but which have kindly covered and preserved them, just as we put our treasures away in some safety-vault while absent on a long journey. The fire burned the upper wooden walls of the city, and it fell in ruins, but under those ruins, covered by that ashes, were preserved for two thousand, three thousand, five thousand years uninjured, the choicest sculpture and the most precious records of ancient nations,—retained beyond the reach of vandal hands, until scholarship had grown wise enough to ask questions of forgotten history, and had sent Layard and Schliemann and De Sarzec and Evans and a hundred other men to dig with their competitive spades. But in all the long list of enthusiasts not one deserves a higher honor or has reaped a richer harvest than Sir Henry Layard.

AUTHORITIES.

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MICHAEL FARADAY.

1791-1867.

ELECTRICITY AND MAGNETISM.

BY EDWIN J. HOUSTON, PH.D.

“No man is born into the world whose work
Is not born with him. There is always work,
And tools to work withal, for those who will.”

LOWELL

A man was born into the world, on the 22d of September, 1791, whose work was born with him, and who did this work so well that he became one of its greatest benefactors. Indeed, much of the marvellous advance made in the electric arts and sciences, during the last half-century, can be directly traced to this work.

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It was in Newington Butts, in London, England, that the man-child first opened his eyes on the wonders of the physical world around him. To those eyes, in after years, were given a far deeper insight into the mysteries of nature than often falls to the lot of man. This man-child was Michael Faraday, who has been justly styled, by those best capable of judging him, “The Prince of Experimental Philosophers.”

The precocity so common in the childhood of men of genius was apparently absent in the case of young Faraday. The growing boy played marbles, and worried through a scant education in reading, writing, and arithmetic, unnoticed, and most probably, for the greater part, severely left alone, as commonly falls to the lot of nearly all boys, whether ordinary or extraordinary. At the early age of thirteen, he was taken from school and placed on trial as errand-boy in the book-shop of George Ribeau, in London. After a year at this work, he was taken as an apprentice to the book-binding trade, by the same employer, who, on account of his faithful services, remitted the customary premium. At this work he spent some eight years of his life.

But far be it from us even to hint at the absence of genius in the young child. Genius is not an acquired gift. It is born in the individual. Apart from the marvellous achievements of the man, a mere glance at the magnificent head, with its high intellectual forehead, the firm lips, the intelligent inquiring eyes, and the bright face, as seen in existing pictures, assures us that they portray an unusual individuality, incompatible with even a suspicion of belonging to an ordinary man. Doubtless the growing child did give early promise of his future greatness. Doubtless he was a formidable member of that terrible class of inquiring youngsters who demand the why and the wherefore of all around them, and refuse to accept the unsatisfactory belief of their fathers that things “are because they are.” In its self-complacency, the busy world is too apt to fail to notice unusual abilities in children,—abilities that perhaps too often remain undeveloped from lack of opportunities. But whether young Faraday did or did not, at an early age, display any unusual promise of his life-work, all his biographers appear to agree that he could not be regarded as a precocious child.

Faraday disclaimed the idea that his childhood was distinguished by any precocity. “Do not suppose that I was a very deep thinker, or was marked as a precocious person,” says Faraday, when alluding to his early life. “I was a very lively, imaginative person, and could believe in the ‘Arabian Nights’ as easily as the ‘Encyclopaedia,’ but facts were important to me, and saved me. I could trust a fact and always cross-examined an assertion. So when I questioned Mrs. Marcet’s book [he is alluding to her ’Conversations on Chemistry’], by such little experiments as I could find means to perform, and found it true to the facts as I could understand them, I felt that I had got hold of an anchor in chemical knowledge, and clung fast to it.”

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But while there may be a question as to the existence of precocity in the young lad, there does not appear to be any reason for believing that his unusual abilities were the result of direct heredity. His father, an ordinary journeyman blacksmith, never exhibited any special intellectual ability, though possibly poverty and poor health may have been responsible for this failure. His mother, too, it appears, was of but ordinary mentality.

The environment of those early years—that is, from 1804 to 1813, while in the book-binding business—was far from calculated to develop any marked abilities inherent in our young philosopher. What would seem less calculated to inspire a wish to obtain a deeper insight into the mysteries of the physical world than the trade of book-binding, especially in the case of a boy whose scholastic education ceased at fourteen years and was limited to the mere rudiments of learning? But, fortunately for the world, the inquiring spirit of the lad led him to examine the inside of the books he bound, and thus, by familiarizing himself with their contents, he received the inspiration that good writing is always ready to bestow on those who properly read it. Two books, he afterwards informs us, proved of especial benefit; namely, “Marcet’s Conversations on Chemistry,” already referred to, and the “Encyclopaedia Britannica.” To the former he attributes his grounding in chemistry, and to the latter his first ideas in electricity, in both of which studies he excelled in after years. As we have seen, even at this early age he followed the true plan for the physical investigator, cross-questioned all statements, only admitting those to the dignity of facts whose truth he had established by careful experimentation.

But our future experimental philosopher has not as yet fairly started on the beginnings of his life-work. The possibilities of the book-binding trade were too limited to permit much real progress. A circumstance occurred in the spring of 1812 that shaped his entire after-life. This was the opportunity then afforded him to attend four of the last lectures delivered at the Royal Institution, by the great Sir Humphry Davy. Faraday took copious notes of these lectures, carefully wrote them out, and bound them in a small quarto volume. It was this volume, which he afterwards sent to Davy, that resulted in his receiving, on March 1, 1813, the appointment of laboratory assistant in the Royal Institution. His pay for this work was twenty-five shillings a week, with a lodging on the top floor of the Institute, a very fair compensation for the times.

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Very congenial were the duties of the young assistant. They were to keep clean the beloved apparatus of the lecturers, and to assist them in their demonstrations. The new world thus opened was full of bright promise. He keenly felt the deficiencies of his early education, and did his best to extend his learning, so that he might be able to make the most of his opportunities. But what he perhaps appreciated the most was the inspiration he received from the great teacher Davy, who was then Professor of Chemistry and Director of the Laboratory of the Royal Institution; for Faraday assisted at Davy's lectures, and in an humble way even aided his investigations, sharing the dangers arising from the explosion of the unstable substance, chloride of nitrogen, that Davy was then investigating. Faraday has repeatedly acknowledged the debt owed to the inspiration of this teacher. Davy also, in later life generously recognized, in his former assistant, a philosopher greater than himself. As the renowned astronomer, Tycho Brahe, discovered in one of his pupils, John Kepler, an astronomer greater than the master, and as Bergman, the Swedish chemist, in a similar manner, discovered the greater chemist Scheele, so when Davy, in after years, was asked what he regarded as his greatest discovery, he briefly replied, "Michael Faraday."

The task of the scientific historian, who endeavors honestly to record the progress of research, and to trace the influence of the work of some individual on the times in which he lived, is by no means an easy one; for, in scientific work one discovery frequently passes so insensibly into another that it is often difficult to know just where one stops and the other begins, and much difficulty constantly arises as to whom the credit should be given, when, as is too often the case, these discoveries are made by different individuals. It is only when some great discovery stands alone, like a giant mountain peak against the clear sky, that it is comparatively easy to determine the extent and character of its influence on other discoveries, and justly to give the credit to whom the credit is due. Such discoveries form ready points of reference in the intellectual horizon, and mark distinct eras in the world's progress. This is true of all work in the domain of physical science, but it is especially true in that of electricity and magnetism, in which Faraday was pre-eminent. The scope of each of these sciences is so extended, the number of workers so great, and the applications to the practical arts so nearly innumerable, that it is often by no means an easy task correctly to trace their proper growth and development.

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Faraday's investigations covered vast fields in the domain of chemistry, electricity, and magnetism. It is to the last two only that reference will here be made. Faraday's life-work in electricity and magnetism began practically in 1831, when he made his immortal discovery of the direct production of electricity from magnetism. His best work in electricity and magnetism was accomplished between 1831 and 1856, extending, therefore, over a period of some twenty-five years, although it is not denied that good work was done since 1856. Consequently, it was at so comparatively recent a date that most of Faraday's work was done that some of the world's distinguished electricians yet live who began their studies during the latter years of Faraday's life. The difficulties of tracing, at least to some extent, the influence that Faraday's masterly investigations have had on the present condition of the electrical arts and sciences will, therefore, be considerably lessened.

The extent of Faraday's researches and discoveries in magnetism and electricity was so great that it will be impossible, in the necessarily limited space of a brief biographical sketch, to notice any but the more prominent. Nor will any attempt be made, except where the nature of the research or discovery appears to render it advisable, to follow any strict chronological order; for, our inquiry here is not so much directed to a mere matter of history as to the influence which the investigation or discovery exerted on the life and civilization of the age in which we live.

There is a single discovery of Faraday that stands out sharply amidst all his other discoveries, great as they were, and is so important in its far-reaching results that it alone would have stamped him as a philosophical investigator of the highest merits, had he never done anything else. This was his discovery of the means for developing electricity directly from magnetism. It was made on the 29th of August, 1831, and should be regarded as inspired by the great discovery made by Oersted in 1820, of the relations existing between the voltaic pile and electro-magnetism. It was in the same year that Ampere had conducted that memorable investigation as to the mutual attractions and repulsions between circuits through which electric currents are flowing, which resulted in a theory of electro-magnetism, and finally led to the production of the electro-magnet itself. Ampere had shown that a coil of wire, or helix, through which an electric current is passing, acted practically as a magnet, and Arago had magnetized an iron bar by placing it within such a helix.

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In common with the other scientific men of his time, Faraday believed that since the flow of an electric current invariably produced magnetism, so magnetism should, in its turn, be capable of producing electricity. Many investigators before Faraday's time had endeavored to solve this problem, but it was reserved to Faraday alone to be successful. Since success in this investigation resulted from some experiments he made while endeavoring to obtain inductive action on a quiescent circuit from a neighboring circuit through which an electric current was flowing, we will first briefly examine this experiment. All his experiments in this direction were at first unsuccessful. He passed an electric current through a circuit, which was located close to another circuit containing a galvanometer,—a device for showing the presence of an electric current and measuring its strength,—but failed to obtain any result. He looked for such results only when the current had been fully established in the active circuit. Undismayed by failure, he reasoned that probably effects were present, but that they were too small to be observed owing to the feeble inducing current employed. He therefore increased the strength of the current in the active wire; but still with no results.

Again and again he interrogates nature, but unsuccessfully. At last he notices that there is a slight movement of the galvanometer needle at the moment of making and breaking the circuit. Carefully repeating his experiments in the light of this observation, he discovers the important fact that it is only at the moment a current is increasing or decreasing in strength—at the moment of making or breaking a circuit—that the active circuit is capable of producing a current in a neighboring inactive circuit by induction. This was an important discovery, and in the light of his after-knowledge was correctly regarded as a solution of the production of electricity from magnetism.

Observing that the galvanometer needle momentarily swings in one direction on making the circuit, and in the opposite direction on breaking it, he establishes the fact that the current induced on making flows in the opposite direction to the inducing current, and that induced on breaking flows in the same direction as the inducing current.

Having thus established the fact of current induction, he makes the step of substituting magnets for active circuits; a simple step in the light of our present knowledge, but a giant stride at that time. Remembering that current induction, or, as he called it, voltaic current induction, takes place only while some effect produced by the current is either increasing or decreasing, he moves coils of insulated wire towards or from magnet poles, or magnet poles towards or from coils of wire, and shows that electric currents are generated in the coils while either the coils or the magnets are in motion, but cease to be produced as soon as the motion ceases. Moreover, these magnetically induced currents differ in no respects from other currents,—for example, those produced by the voltaic pile,—since, like the latter, they produce sparks, magnetize bars of steel, or deflect the needle of a galvanometer. In this manner Faraday solved the great problem. He had produced electricity directly from magnetism!

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With, perhaps, the single exception of the discovery by Oersted, in 1820, of the invariable relation existing between an electric current and magnetism, this discovery of Faraday may be justly regarded as the greatest in this domain of physical science. These two master minds in scientific research wonderfully complemented each other. Oersted showed that an electric current is invariably attended by magnetic effects; Faraday showed that magnetic changes are invariably attended by electric currents. Before these discoveries, electricity and magnetism were necessarily regarded as separate branches of physical science, and were studied apart as separate phenomena. Now, however, they must be regarded as co-existing phenomena. The ignorance of the scientific world had unwittingly divorced what nature had joined together.

In view of the great importance of Faraday's discovery, we shall be justified in inquiring, though somewhat briefly, into some of the apparatus employed in this historic research. Note its extreme simplicity. In one of his first successful experiments he wraps a coil of insulated wire around the soft iron bar that forms the armature or keeper of a permanent magnet of the horse-shoe type, and connects the ends of this coil to a galvanometer. He discovers that whenever the armature is placed against the magnet poles, and is therefore being rendered magnetic by contact therewith, the deflection of the needle of the galvanometer shows that the coiled wire on the armature is traversed by a current of electricity; that whenever the armature is removed from the magnet poles, and is therefore losing its magnetism, the needle of the galvanometer is again deflected, but now in the opposite direction, showing that an electric current is again flowing through the coiled wire on the armature, but reversed in direction. He notices, too, that these effects take place only while changes are going on in the strength of the magnetism in the armature, or when magnetic flux is passing through the coils; for, the galvanometer needle comes to rest, and remains at rest as long as the contact between the armature and the poles remains unbroken.

In another experiment he employs a simple hollow coil, or helix, of insulated wire whose ends are connected with a galvanometer. On suddenly thrusting one end of a straight cylindrical magnet into the axis of the helix, the deflection of the galvanometer needle showed the presence of an electric current in the helix. The magnet being left in the helix, the galvanometer needle came to rest, thus showing the absence of current. When the bar magnet was suddenly withdrawn from the helix, the galvanometer needle was again deflected, but now in the opposite direction, showing that the direction of the current in the helix had been reversed.

The preceding are but some of the results that Faraday obtained by means of his experimental researches in the direct production of electricity from magnetism. Let us now briefly examine just what he was doing, and the means whereby he obtained electric currents from magnetism. We will consider this question from the views of the present time, rather than from those of Faraday, although the difference between the two are in most respects immaterial.

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Faraday knew that the space or region around a magnet is permeated or traversed by what he called magnetic curves, or lines of magnetic force. These lines are still called “lines of magnetic force,” or by some “magnetic streamings” “magnetic flux,” or simply “magnetism.” They are invisible, though their presence is readily manifested by means of iron filings. They are present in every magnet, and although we do not know in what direction they move, yet in order to speak definitely about them, it is agreed to assume that they pass out of every magnet at its north-seeking pole (or the pole which would point to the magnetic north, were the magnet free to move as a needle), and, after having traversed the space surrounding the magnet, reenter at its south-seeking pole, thus completing what is called the magnetic circuit. Any space traversed by lines of magnetic force is called a magnetic field.

But it is not only a magnet that is thus surrounded by lines of magnetic force, or by ether streamings. The same is true of any conductor through which an electric current is flowing, and their presence may be shown by means of iron filings. If an active conductor—a conductor conveying an electric current, as, for example, a copper wire—-be passed vertically through a piece of card-board, or a glass plate, iron filings dusted on the card or plate will arrange themselves in concentric circles around the axis of the wire. It requires an expenditure of energy both to set up and to maintain these lines of force. It is the interaction of their lines of force that causes the attractions and repulsions in active movable conductors. These lines of magnetic force act on magnetic needles like other lines of magnetic force and tend to set movable magnetic needles at right angles to the conducting wire.

The setting up of an electric current in a conducting wire is, therefore, equivalent to the setting up of concentric magnetic whirls around the axis of the wire, and anything that can do this will produce an electric current. For example, if an inactive conducting wire is moved through a magnetic field; it will have concentric circular whirls set up around it; or, in other words, it will have a current generated in it as a result of such motion. But to set up these whirls it is not enough that the conducting wire be moved along the lines of force in the field. In such a case no whirls are produced around the conductor. The conductor must be moved so as to cut or pass through the lines of magnetic force. Just what the mechanism is by means of which the cutting of the lines of force by the conductor produces the circular magnetic whirls around it, no man knows any more than he knows just what electricity is; but this much we do know,—that to produce the circular whirls or currents in a previously inactive conductor, the lines of force of some already existing magnetic field must be caused to pass through the conductor, and that the strength of the current so produced is proportional to the number of lines of magnetic force cut in a given time, say, per second; or, in other words, is directly proportional to the strength of the magnetic field, and to the velocity and length of the moving conductor.

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Or, briefly recapitulating: Oersted showed that an electric current, passed through a conducting circuit, sets up concentric circular whirls around its axis; that is, an electric current invariably produces magnetism; Faraday showed, that if the lines of magnetic force, or magnetism, be caused to cut or pass through an inactive conductor, concentric circular whirls will be set up around the conductor; that is, lines of magnetic force passed across a conductor invariably set up an electric current in that conductor.

The wonderful completeness of Faraday’s researches into the production of electricity from magnetism may be inferred from the fact that all the forms of magneto-electric induction known to-day—namely, self-induction, or the induction of an active circuit on itself; mutual induction, or the induction of an active circuit on a neighboring circuit; and electro-magnetic induction, and magneto-electric induction, or the induction produced in conductors through which the magnetic flux from electro and permanent magnets respectively is caused to pass—were discovered and investigated by him. Nor were these investigations carried on in the haphazard, blundering, groping manner that unfortunately too often characterizes the explorer in a strange country; on the contrary, they were singularly clear and direct, showing how complete the mastery the great investigator had over the subject he was studying. It is true that repeated failures frequently met him, but despite discouragements and disappointments he continued until he had entirely traversed the length and breadth of the unknown region he was the first to explore.

Let us now briefly examine Faraday’s many remaining discoveries and inventions. Though none of these were equal to his great discovery, yet many were exceedingly valuable. Some were almost immediately utilized; some waited many years for utilization; and some have never yet been utilized. We must avoid, however, falling into the common mistake of holding in little esteem those parts of Faraday’s work that did not immediately result either in the production of practical apparatus, or in valuable applications in the arts and sciences, or those which have not even yet proved fruitful. Some discoveries and devices are so far ahead of the times in which they are produced that several lifetimes often pass before the world is ready to utilize them. Like immature or unripe fruit, they are apt to die an untimely death, and it sometimes curiously happens that, several generations after their birth, a subsequent inventor or discoverer, in honest ignorance of their prior existence, offers them to the world as absolutely new. The times being ripe, they pass into immediate and extended public use, so that the later inventor is given all the credit of an original discovery, and the true first and original inventor remains unrecognized.

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We will first examine Faraday's discovery of the relations existing between light and magnetism. Though the discovery has not as yet borne fruit in any direct practical application, yet it has proved of immense value from a theoretical standpoint. In this investigation Faraday proved that light-vibrations are rotated by the action of a magnetic field. He employed the light of an ordinary Argand lamp, and polarized it by reflection from a glass surface. He caused this polarized light to pass through a plate of heavy glass made from a boro-silicate of lead. Under ordinary circumstances this substance exerted no unusual action on light, but when it was placed between the poles of a powerful electro-magnet, and the light was passed through it in the same direction as the magnetic flux, the plane of polarization of the light was rotated in a certain direction.

Faraday discovered that other solid substances besides glass exert a similar action on a beam of polarized light. Even opaque solids like iron possess this property. Kerr has proved that a beam of light passed through an extremely thin plate of highly magnetic iron has its plane of polarization slightly rotated. Faraday showed that the power of rotating a beam of polarized light is also possessed by some liquids. But what is most interesting, in both solids and liquids, is that the direction of the rotation of the light depends on the direction in which the magnetism is passing, and can, therefore, be changed by changing the polarity of the electro-magnet.

Faraday did not seem to thoroughly understand this phenomenon. He spoke as if he thought the lines of magnetic force had been rendered luminous by the light rays; for, he announced his discovery in a paper entitled, "Magnetization of Light and the Illumination of the Lines of Magnetic Force." Indeed, this discovery was so far ahead of the times that it was not until a later date that the results were more fully developed, first by Kelvin, and subsequently by Clerk Maxwell. In 1865, two years before Faraday's death, Maxwell proposed the electro-magnetic theory of light, showing that light is an electro-magnetic disturbance. He pointed out that optical as well as electro-magnetic phenomena required a medium for their propagation, and that the properties of this medium appeared to be the same for both. Moreover, the rate at which light travels is known by actual measurement; the rate at which electro-magnetic waves are propagated can be calculated from electrical measurements, and these two velocities exactly agree. Faraday's original experiment as to the relation between light and magnetism is thus again experimentally demonstrated; and, Maxwell's electro-magnetic theory of light now resting on experimental fact, optics becomes a branch of electricity. A curious consequence was pointed out by Maxwell as a result of his theory; namely, that a necessary relation exists between opacity and conductivity, since, as he showed, electro-magnetic

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disturbances could not be propagated in substances which are conductors of electricity. In other words, if light is an electro-magnetic disturbance, all conducting substances must be opaque, and all good insulators transparent. This we know to be the fact: metallic substances, the best of conductors, are opaque, while glass and crystals are transparent. Even such apparent exceptions as vulcanite, an excellent insulator, fall into the law, since, as Graham Bell has recently shown, this substance is remarkably transparent to certain kinds of radiant energy.

In 1778, Brugmans of Leyden noticed that if a piece of bismuth was held near either pole of a strong magnet, repulsion occurred. Other observers noticed the same effect in the case of antimony. These facts appear to have been unknown to Faraday, who, in 1845, by employing powerful electro-magnets rediscovered them, and in addition showed that practically all substances possess the power of being attracted or repelled, when placed between the poles of sufficiently powerful magnets. By placing slender needles of the substances experimented on between the poles of powerful horse-shoe magnets, he found that they were all either attracted like iron, coming to rest with their greatest length extending between the poles; or, like bismuth, were apparently repelled by the poles, coming to rest at right angles to the position assumed by iron. He regarded the first class of substances as attracted, and the second class as repelled, and called them respectively paramagnetic and diamagnetic substances. In other words, paramagnetic substances, like iron, came to rest axially (extending from pole to pole), and diamagnetic substances, like bismuth, equatorially (extending transversely between the poles). He reserved the term magnetic substances to cover the phenomena of both para and dia-magnetism. He communicated the results of this investigation to the Royal Society in a paper on the “Magnetic Condition of All Matter,” on Dec. 18, 1845.

The properties of paramagnetism and diamagnetism are not possessed by solids only, but exist also in liquids and gases. When experimenting with liquids, they were placed in suitable glass vessels, such as watch crystals, supported on pole pieces properly shaped to receive them. Under these circumstances paramagnetic liquids, such as salts of iron or cobalt dissolved in water, underwent curious contortions in shape, the tendency being to arrange the greater part of their mass in the direction in which the flux passed; namely, directly between the poles. Diamagnetic liquids, such as solutions of salts of bismuth and antimony, in a similar manner, arranged the greater part of their mass in positions at right angles to this direction, or equatorially.

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At first Faraday attributed the repulsion of diamagnetic substances to a polarity, separate and distinct from ordinary magnetic polarity, for which he proposed the name, diamagnetic polarity. He believed that when a diamagnetic substance is brought near to the north pole of a magnet, a north pole was developed in its approached end, and that therefore repulsion occurred. He afterwards rejected this view, though it has been subsequently adopted by Weber and Tyndall, the latter of whom conducted an extended series of experiments on the subject. The majority of physicists, however, at the present time, do not believe in the existence of a diamagnetic polarity. They point out that the apparent repulsion of diamagnetic substances is due to the fact that they are less paramagnetic than the oxygen of the air in which they are suspended.

During this investigation Faraday observed some phenomena that led him to a belief in the existence of another form of force, distinct from either paramagnetic or diamagnetic force, which he called the magne-crystallic force. He had been experimenting with some slender needles of bismuth, suspending them horizontally between the poles of an electro-magnet. Taking a few of these cylinders at random from a greater number, he was much perplexed to find that they did not all come to rest equatorially, as well-behaved bars of diamagnetic bismuth should do, though, if subjected to the action of a single magnetic pole, they did show this diamagnetic character by their marked repulsion. After much experimentation, he ascribed this phenomenon to the crystalline condition of the cylinder. By experimenting with carefully selected groups of crystals of bismuth, he believed he could trace the cause of the phenomenon to the action of a force which he called the magne-crystallic force.

Extended experiments carried on by Pluecker on the influence of magnetism on crystalline substances led him to believe that a close relation exists between the ultimate forms of the particles of matter and their magnetic behavior. This subject is as yet far from being fully understood.

There was another series of investigations made by Faraday between the years 1831 and 1840, that has been wonderfully utilized, and may properly be ranked among his great discoveries. We allude to his researches on the laws which govern the chemical decomposition of compound substances by electricity. The fact that the electric current possesses the power of decomposing compound substances was known as early as 1800, when Carlisle and Nicholson separated water into its constituent elements, by the passage of a voltaic current. Davy, too, in 1806, had delivered his celebrated discourse “On Some Chemical Agencies of Electricity,” and in 1807, had announced his great discovery of the decomposition of the fixed alkalies.

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Faraday showed that the amount of chemical action produced by electricity is fixed and definite. In order to be able to measure the amount of this action, he invented an instrument which he called a voltameter, or a volta-electrometer. It consisted of a simple device for measuring the amount of hydrogen and oxygen gases liberated by the passage of an electric current through water acidulated with sulphuric acid. He showed, by numerous experiments, that the decomposition effected is invariably proportional to the amount of electricity passing; that variations in the size of the electrodes, in the pressure, or in the degree of dilution of the electrolyte, had nothing to do with the result, and that therefore a voltameter could be employed to determine the amount of electricity passing in a given circuit. He also demonstrated that when a current is passed through different electrolytes (compound substances decomposed by the passage of electricity), the amount of the decompositions are chemically equivalent to each other.

The extent of Faraday's work in the electro-chemical field may be judged by considering some of the terms he proposed for its phenomena, most of which, with some trifling exceptions, are still in use. It was he who gave the name electrolysis to decomposition by the electric current; he also proposed to call the wires, or conductors connected with the battery, or other electric source, the electrodes, naming that one which was connected with the positive terminal, the anode, and that one connected with the negative terminal, the cathode. He called the separate atoms or groups of atoms into which bodies undergoing electrolysis are separated, the radicals, or ions, and named the electro-positive ions, which appear at the cathode, the kathions, and the electro-negative radicals which appear at the anode, the anions.

There were many other researches made by Faraday, such as his experiments on disruptive electric discharges, his investigations on the electric eel, his many researches on the phenomena both of frictional electricity and of the voltaic pile, his investigations on the contact and chemical theories of the voltaic pile, and those on chemical decomposition by frictional electricity; these are but some of the mere important of them. Those we have already discussed will, however, amply suffice to show the value of his work. Rather than take up any others, let us inquire what influence, if any, the various groups of discoveries we have already discussed have exerted on the electric arts and sciences in our present time. What practical results have attended these discoveries? What actual, useful, commercial machines have been based on them? What useful processes or industries have grown out of them?

And, first, as to actual commercial machines. These researches not only led to the production of dynamo-electric machines, but, in point of fact, Faraday actually produced the first dynamo. A dynamo-electric machine, as is well known, is a machine by means of which mechanical energy is converted into electrical energy, by causing conductors to cut through, or be cut through by, lines of magnetic force; or, briefly, it is a machine by means of which electricity is readily obtained from magnetism.

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Faraday's invention of the first dynamo is interesting because at the same time he made the invention he solved a problem which up to his time had been the despair of the ablest physicists and mathematicians. This was the phenomenon of Arago's rotating disc. It was briefly as follows: If a copper disc be rotated above a magnet, the needle tends to follow the plate in its rotation; or, if a copper plate be placed at rest above or below an oscillating magnet, it tends to check its oscillations and bring the needle quickly to rest. Faraday investigated these phenomena and soon discovered that a copper disc rotated below two magnet poles had electric currents generated in it, which flowed radially through the disc between its circumference and centre. By placing one end of a conducting circuit on the axis of the disc, and the other end on its circumference, he succeeded in drawing off a continuous electric current generated from magnetism, and thus produced the first dynamo. This was in 1831. Faraday produced many other dynamos besides this simple disc machine.

Although the disc dynamo in its original form was impracticable as a commercial machine, yet it was not only the forerunner of the dynamo, but was, in point of fact, the first machine ever produced that is entitled to be called a dynamo. He generously left to those who might come after him the opportunity to avail themselves of his wonderful discovery. "I have rather, however," he says, "been desirous of discovering new facts and new relations dependent on magneto-electric induction than of exalting the force of those already obtained, being assured that the latter would find their development hereafter." How profoundly prophetic! Could the illustrious investigator see the hundreds of thousands of dynamos that are to-day in all parts of the world engaged in converting millions of horse-power of mechanical energy into electric energy, he would appreciate how marvellously his successors have "exalted the force" of some of the effects he had so ably shown the world how to obtain.

Faraday lived to see his infant dynamo, the first of its kind, developed into a machine not only sufficiently powerful to maintain electric arc lights, but also into a form sufficiently practicable to be continuously engaged in producing such light, in one of the lighthouses on the English coast. Holmes produced such a machine in 1862, or some years before Faraday's death. It was installed under the care of the Trinity House, at the Dungeness Lighthouse, in June, 1862, and continued in use for about ten years. When this machine was shown to Faraday by its inventor, the veteran philosopher remarked, "I gave you a baby, and you bring me a giant."

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The alternating-current transformer is another gift of Faraday to the commercial world. As is well known, this instrument is a device for raising or lowering electric pressure. The name is derived from the fact that the instrument is capable of taking in at one pressure the electric energy supplied to it, and giving it out at another pressure, thus transforming it. Faraday produced the first transformer during his investigations on voltaic-current induction. The modern alternating-current transformer, though differing markedly in minor details from Faraday's primitive instrument, yet in general details is essentially identical with it. The enormous use of both step-up and step-down transformers—transformers which respectively induce currents of higher and of lower electromotive forces in their secondary coils than are passed through their primaries—-shows the great practical value of this invention. The wonderful growth of the commercial applications of alternating currents during the past few decades would have been impossible without the use of the alternating-current transformer.

It is an interesting fact that it was not in the form of the step-down alternating-current transformer that Faraday's discovery of voltaic-current induction was first utilized, but in the form of a step-up transformer, or what was then ordinarily called an induction coil. As early as 1842, Masson and Breguet constructed an induction coil by means of which minute sparks could be obtained from the secondary, in vacuo. In 1851, Ruhmkorff constructed an induction coil so greatly improved, by the careful insulation of its secondary circuit, that he could obtain from it torrents of long sparks in ordinary air. The Ruhmkorff induction coil has in late years been greatly improved both by Tesla and Elihu Thomson, who, separately and independently of each other, have produced excellent forms of high-frequency induction coils.

Induction coils have long been in use for purposes of research, and in later years have been employed in the production both of the Roentgen rays used in the photography of the invisible, and the electro-magnetic waves used in wireless telegraphy.

Roentgen's discovery was published in 1895. It was rendered possible by the prior work of Geissler and Crookes on the luminous phenomena produced by the passage of electric discharges through high vacua in glass tubes. Roentgen discovered that the invisible rays, or radiation, emitted from certain parts of a high-vacuum tube, when high-tension discharges from induction coils were passing, possessed the curious property of traversing certain opaque substances as readily as light does glass or water. He also discovered that these rays were capable of exciting fluorescence in some substances, —that is, of causing them to emit light and become luminous,—and that these rays, like the rays of light, were capable of affecting a photographic plate. From these properties two curious possibilities arose; namely, to see through opaque bodies, and to photograph the invisible. Roentgen called these rays X, or unknown rays. They are now almost invariably called by the name of their distinguished discoverer.

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Let us briefly investigate how it is possible both to see and to photograph the invisible. Shortly after Roentgen's discovery, Edison, with that wonderful power of finding practical applications for nearly all discoveries, had invented the fluoroscope,—a screen covered with a peculiar chemical substance that becomes luminous when exposed to the Roentgen rays. Suppose, now, between the rays and such a screen be interposed a substance opaque to ordinary light, as, for example, the human hand. The tissues of the hand, such as the flesh and the blood, permit the rays to readily pass through them, but the bones are opaque to the rays, and, therefore, oppose their passage; consequently, the screen; instead of being uniformly illumined, will show shadows of the bones, so that, to an eye examining the screen, it will seem as though it were looking through the flesh and blood directly at the bones. In a similar manner, if a photographic plate be employed instead of the screen, a distinct photographic picture will be obtained.

Both the fluoroscope and the photographic camera have proved an invaluable aid to the surgeon, who can now look directly through the human body and examine its internal organs, and so be able to locate such foreign bodies as bullets and needles in its various parts, or make correct diagnoses of fractures or dislocations of the bones, or even examine the action of such organs as the liver and heart.

About 1886, Hertz discovered that if a small Leyden jar is discharged through a short and simple circuit, provided with a spark-gap of suitable length, a series of electro-magnetic waves are set up, which, moving through space in all directions, are capable of exciting in a similar circuit effects that can be readily recognized, although the two circuits are at fairly considerable distances apart. Here we have a simple basic experiment in wireless telegraphy, which, briefly considered, consists of means whereby oscillations or waves, set up in free space by means of disruptive discharges, are caused to traverse space and produce various effects in suitably constructed receptive devices that are operated by the waves as they impinge on them.

At first a doubt was expressed by eminent scientific men as to the practicability of successfully transmitting wireless messages through long distances, since these waves, travelling in all directions, would soon become too attenuated to produce intelligible signals; but when it was shown, from theoretical considerations, that these waves when traversing great distances are practically confined to the space between the earth's surface and the upper rarified strata of the atmosphere, the possibility of long-distance wireless telegraphic transmission was recognized. To increase the distance, it was only necessary either to increase the energy of the waves at the transmitting station, or to increase the delicacy of the receiving instruments, or both.

It has been but a short time since both the scientific and the financial worlds were astounded by the actual transmission of intelligible wireless signals across the Atlantic, and the name of Marconi will go down to posterity as the one who first accomplished this great feat.

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The principal limit to the distance of transmission lies in the delicacy of the receiving instruments. The most sensitive are those in which a telephone receiver forms a part of the receiving apparatus. The almost incredibly small amount of electric energy required to produce intelligible speech in an ordinary Bell telephone receiver nearly passes belief. The work done in lifting such an instrument from its hook to the ear of the listener, would, if converted into electric energy, be sufficient to maintain an audible sound in a telephone for 240,000 years! Even extremely attenuated waves may therefore produce audible signals in such a receiver.

The electric motor was another gift of Faraday to commercial science, although in this case there are others who can, perhaps, justly claim to share the honor with him. Faraday's early electric motor consisted essentially in a device whereby a movable conductor, suspended so as to be capable of rotation around a magnet pole, was caused to rotate by the mutual interaction of the magnetic fields of the active conductor and the magnet. The magnet, which consisted of a bar of hardened steel, was fixed in a cork stopper, which completely closed the end of an upright glass tube. A small quantity of mercury was placed in the lower end of the tube, so as to form a liquid contact for the lower end of a movable wire, suspended so as to be capable of rotating at its lower extremity about the axis of the tube. On the passage of an electric current through the wire, a continuous rotary motion was produced in it, the direction of which depends both on the direction of the current, and on the polarity of the end of the magnet around which the rotation occurs.

The great value of the electric motor to the world is too evident to need any proof. The number of purposes for which electric motors are now employed is so great that the actual number of motors in daily use is almost incredible, and every year sees this number rapidly increasing.

The above are the more important machines or devices that have been directly derived from Faraday's great investigation as to the production of electricity from magnetism. Let us now inquire briefly as to what useful processes or industries have been rendered possible by the existence of these machines.

Apparently one of the most marked requirements of our twentieth-century civilization is that man shall be readily able to extend the day far into the night. He can no longer go to sleep when the sun sets, and keep abreast with his competitors. Of all artificial illuminants yet employed, the arc and the incandescent electric lights are unquestionably the best, whether from a sanitary, aesthetic, or truest economical standpoint. Now, while it is a well-known matter of record that both arc and incandescent lights were invented long before Faraday's time, yet it was not until a source of electricity was invented, superior both in economy and convenience to the voltaic battery,

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that either of these lights became commercial possibilities. Such an electric source was given to the world by Faraday through his invention of the dynamo-electric machine, and it was not until this machine was sufficiently developed and improved that commercial electric lighting became possible. The energy of burning coal, through the steam-engine, working the dynamo, is far cheaper and more efficient for producing electricity than the consumption of metals through the voltaic pile.

It is characteristic of the modesty of Faraday that when, in after-life, he heard inventors speaking of their electric lights, he refrained from claiming the electric light as his own, although, without the machine he taught the world how to construct, commercial lighting would have been an impossibility.

The marvellous activity in the electric arts and sciences, which followed as a natural result of Faraday giving to the world in the dynamo-electric machine a cheap electric source, naturally leads to the inquiry as to whether at a somewhat later day a yet greater revolution may not follow the production of a still cheaper electric source. In point of fact such a discovery is by no means an impossibility. When a dynamo-electric machine is caused to produce an electric current by the intervention of a steam-engine, the transformation of energy which takes place from the energy of the coal to electric energy is an extremely wasteful one. Could some practical method be discovered by means of which the burning of coal liberates electric energy, instead of heat energy, an electric source would be discovered that would far exceed in economy the best dynamo in existence. With such a discovery what the results would be no one can say; this much is certain, that it would, among other things, relegate the steam-engine to the scrap-heap, and solve the problem of aerial navigation.

What is justly regarded as one of the greatest achievements of modern times is the electrical transmission of power over comparatively great distances. At some cheap source of energy, say, at a waterfall, a water-wheel is employed to drive a dynamo or generator, thus converting mechanical energy into electrical energy. This electricity is passed over a conducting line to a distant station, where it is either directly utilized for the purpose of lighting, heating, chemical decomposition, *etc*., or indirectly utilized for the purpose of obtaining mechanical power for driving machinery, by passing it through an electric motor. The electric transmission of power has been successfully made in California over a distance of some 220 miles, at a pressure on transmission lines of 50,000 volts.

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The high pressures required for the economical use of transmission lines necessitates the employment of transformers at each end of the line; namely, step-up transformers at the transmitting end, to raise the voltage delivered by the generators, and step-down transformers, at the receiving end, to lower it for use in the various translating devices. These transformers are employed in connection with alternating-current dynamos. Faraday not only gave to the world the first electric generator, but also the first transformer, and one of the first electric motors, and without these gifts the electric transmission of power over long distances, which has justly been regarded as one of the most marvellous achievements of our age, would have been an impossibility.

In high-tension circuits over which such pressures as 50,000 volts is transmitted, no little difficulty is experienced from leakage and consequent loss of energy. This leakage occurs both between the line conductors and at the insulators placed on the pole lines forming the line circuit. The insulators are made either of glass or porcelain, and are of a peculiar form known as triple petticoat pattern. The loss on such lines, due to leakage between wires, is greater than that which takes place at the pole insulators, and is diminished by keeping the circuit wires as far apart as possible.

In the early history of the art, electric transmission of power was effected by means of direct-current generators and motors,—generators and motors through which the current always passed in the same direction. Such generators and motors, however, possessed inconveniences that prevented extensive commercial transmission of power, since, as we have seen, high pressure was necessary for efficiency in such transmission, and the collecting-brushes and commutators employed in all direct-current generators and motors to carry the current from the machine or to the motor, were a constant source of trouble and danger.

When the alternating-current motor first same into general use, it was employed, in connection with the alternating-current generator, in electric transmission systems; but such motors also possess the inconvenience of not readily starting from a state of rest, with their full turning power, or torque, and of therefore being unsuitable where the motor requires to be frequently stopped or started. Had these difficulties remained unsolved, long-distance electric transmission of power, so successful in operation to-day, and which bids fair to be still more successful in the near future, would have been impossible. Fortunately, these difficulties were overcome by the genius of Nikola Tesla, in the invention of the multiphase alternating-current motor, or the induction motor, as it is now generally called. Although Baily, Deprez, and Ferraris had accomplished much before Tesla’s time, yet it was practically to the investigations and discoveries made by Tesla, between 1887 and 1891, that the induction motor of to-day is due.

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Another requirement of our twentieth-century civilization is rapid transit, either urban or inter-urban, and this is afforded by various systems of electric street railways or electric traction generally, including electric locomotives and electric automobiles. The wonderful growth in this direction which has been witnessed in the last few decades would have been impossible without the electric generator and motor, both gifts of Faraday to the world. Their application in this direction must, therefore, go to swell the debt our civilization owes to the labors of this great investigator.

In the system of electric street-car propulsion very generally employed to-day, a single trolley wheel is employed for taking the driving current from an overhead conductor, suspended above the street. The trolley wheel is supported by a trolley pole, and is maintained in good electric contact with the trolley wire, or overhead conductor. By this means the current passes from the wire down the conductor connected with the trolley pole, thence through the motors placed below the body of the car, and from them, through the track or ground-return, back to the power station. A small portion of the current is employed for lighting the electric lamps in the car. In some systems an underground trolley is employed.

An important device, called the series-parallel controller, is employed in all systems of electric street-car propulsion. It consists of means by which the starting and stopping of the car, and changes, both in its speed and direction, are placed under the control of the motorman. A separate controller is placed on both platforms of the car. The series-parallel controller consists essentially of a switch by means of which the several motors, that are employed in all street cars, can be variously connected with each other, or with different electric resistances, or can be successively cut out or introduced into the circuit, so that the speed of the car can be regulated at will, as the handle of the controller is moved by the motorman to the various notches on the top of the controller box. As generally arranged, the speed increases from the first notch or starting position to the last notch, movements in the opposite direction changing connections in the opposite order of succession, and, therefore, slowing the car. There is, however, no definite speed corresponding to each notch, for this will vary with the load on each car, and with the gradient upon which it may be running.

But there is another valuable gift received by the world as a result of this great discovery of Faraday; namely, that most marvellous instrument of modern times, the speaking telephone. This instrument was invented in 1861, by Philip Ries, and subsequently independently reinvented in 1876, by Elisha Gray and Alexander Graham Bell.

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As is well known, it is electric currents and not sound-waves that are transmitted over a telephone circuit. The magneto-electric telephone in its simplest form consists of a pair of instruments called respectively the transmitter and the receiver. We talk into the transmitter and listen at the receiver. Both transmitter and receiver consist of a permanent magnet of hardened steel around one end of which is placed a coil of insulated wire. In front of this coil a diaphragm, or thin plate, of soft iron, is so supported as to be capable of freely vibrating towards and from the magnet pole.

The operation of the transmitting instrument is readily understood in the light of Faraday's discovery. It is simply a dynamo-electric machine driven by the voice of the speaker. As the sound-waves from the speaker's voice strike against the diaphragm, which has become magnetic from its nearness to the magnet pole, electric currents are generated in the coil of wire surrounding such pole, since the to-and-fro motions cause the lines of electro-magnetic force to pass through the wire on the moving coil. The operation of the receiving instrument is also readily understood. It acts as an electric motor driven by the to-and-fro currents generated by the transmitter. As these currents are transmitted over the wire, they pass through the coil of wire on the receiving instrument, and reproduce therein the exact movements of the transmitting diaphragm, since, as they strengthen or weaken the magnetism of the pole, they cause similar motions in the diaphragm placed before it. Consequently, one listening at the receiving diaphragm will hear all that is uttered into the transmitting diaphragm. It was thus, by the combination of the dynamo and motor, both of which were given by Faraday to the world, that we have received this priceless instrument, which has been so potent in its effects on the civilization of the Twentieth century.

The electric telegraph had its beginnings long before Faraday's time. As early as 1847, Watson had erected a line some two miles in length, extending over the housetops in London, and operated it by means of discharges from an ordinary frictional electric machine. In 1774, Lesage had erected in Geneva an electric telegraph consisting of a number of metallic wires, one for each letter of the alphabet. These wires were carefully insulated from each other. When a message was to be sent over this early telegraphic line an electric discharge was passed through the particular wire representing the letter of the alphabet to be sent; this discharge, reaching the other end, caused a pithball to be repelled and thus laboriously, letter by letter, the message was transmitted. How ludicrously cumbersome was such an instrument when contrasted with the Morse electro-magnetic telegraph of to-day, which requires but a single wire; or with the harmonic telegraph of Gray, which permits the simultaneous transmission of eight or more separate

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messages over a single wire; or with the wonderful quadruplex telegraphic system of Edison which permits the simultaneous transmission of four separate and distinct messages over a single wire, two in one direction, and two in the opposite direction at the same time; or with the still more wonderful multiplex telegraph of Delaney, which is able to simultaneously transmit as many as seventy-two separate messages over a single wire, thirty-six in one direction and thirty-six in the opposite direction. These achievements have been possible only through the researches and discoveries of Oersted, Faraday, and hosts of other eminent workers; for, it was the electro-magnet, rendered possible by Oersted, together with the magnificent discoveries of Faraday, and others since his time, that these marvellous advances in electro-telegraphic transmission of intelligence have become possibilities.

Before completing this brief sketch of some of the effects that Faraday's work has had on the practical arts and sciences, let us briefly examine the generating plants that are either in operation or construction at Niagara Falls.

Some idea of the size of the Niagara Falls generating plant on the American side may be gained from the fact that there have already been installed eleven of the separate 5,000 horse-power generators. The remaining capacity of the tunnel will permit of the installation of 50,000 additional horse-power, or 105,000 horse-power in all.

On the Canadian side of the Falls another great plant is about to be erected with an ultimate capacity of several hundred thousand horse-power. Here, however, the size of the generating unit will be double that on the American side, or 10,000 horse-power. These generators will be wound to produce an electric pressure of 12,000 volts, raised by means of step-up transformers to 22,000, 40,000, and 60,000 volts, according to the distance of transmission. Each of the revolving parts of these machines will weigh 141,000 pounds. To what gigantic proportions has the little infant dynamo of Faraday grown in this short time since its birth!

The low rates at which electric power can be sold in the immediate neighborhood of the Niagara generating plant have naturally resulted in an enormous growth of the electro-chemical industries, for these industries could never otherwise develop into extended commercial applications. Of the total output of, say, 55,000 horse-power at the Niagara Falls generating plant, no less than 23,200 horse-power is used in various electrolytic and electro-thermal processes in the immediate neighborhood. Some of the more important consumers of the electric power, named in the order of consumption, are for the manufacture of the following products: calcium carbide, aluminium, caustic soda and bleaching salt, carborundum, and graphite.

Calcium carbide, employed in the production of acetylene gas, either for the purposes of artificial illumination, or for the manufacture of ethyl alcohol, is produced by subjecting a mixture of carbon and lime to the prolonged action of heat in an electric furnace.

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Aluminium, the now well-known valuable metal, present in clay, bauxite, and a variety of other mineral substances, is electrolytically deposited from a bath of alumina obtained by dissolving bauxite either in potassium fluoride or in cryolite. Aluminium is now coming into extended use in the construction of long-distance electric power transmission lines.

Caustic soda and bleaching salt are produced by the electrolytic decomposition of brine (chloride of sodium). The chlorine liberated at the anode is employed in the manufacture of bleaching-salt, and the sodium is liberated at a mercury cathode, with which it at once enters into combination as an alloy. On throwing this alloy into water the sodium is liberated as caustic soda.

Carborundum, a silicide of carbon, is a valuable substance produced by the action of the heat of an electric furnace on an intimate mixture of carbon and sand. It has an extensive use as an abrasive for grinding and polishing.

Artificial graphite is another product produced by the long-continued action of the heat of the electric furnace on carbon under certain conditions.

According to reports from the United States Geological Survey, the graphite works at Niagara Falls produced in 1901, 2,500,000 lbs. of artificial graphite, valued at $119,000. This was an increase from 860,270 lbs., valued at $69,860 for 1900, and from 162,382 lbs., valued at $10,140, in 1897, the first year of its commercial production. In 1901, more than half of the output was in the form of graphitized electrodes employed in the production of caustic soda and bleaching salt, and in other electrolytic processes.

The Niagara Falls power transmission system stands to-day as a magnificent testimonial to the genius of Faraday, and as a living monument of the varied and valuable gifts his researches have bestowed upon mankind. For here we have not only the dynamo, motors, and transformers that he gave freely to the world, not only the alternating-current transformer, and the system of transmission of power, but we even find that the principal consumers of the enormous electric power produced are employing it in carrying on some of the many processes in electro-chemistry, a science that he had done so much to advance.

Among some of the surprises electro-chemistry may have in store for the world in the comparatively near future, may be a nearer approach to a mastery of the laws which govern the combination of elementary substances when under the influence of plant-life. If these laws ever become so well known that man is able to form hi his laboratory the various food products that are now formed naturally in plant organisms, such a revolution would be wrought that the work of the agriculturist would be largely transferred to the electro-chemist. Some little has already been done in the direct formation of some vegetable substances, such as camphor, the peculiar flavoring substance present in the vanilla bean, and in many other substances. Should such discoveries ever reach to the direct formation of some food staple, the wide-reaching importance and significance of the discovery would be almost beyond comprehension.

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But, while the direct electro-synthetic formation of food products is yet to be accomplished on a practical scale, the problem appears to be nearing actual solution in an indirect manner. It has been known since the time of Cavendish, in 1785, that small quantities of nitric acid could be formed directly from the nitrogen and oxygen of the atmosphere by the passage of electric sparks; but heretofore, the quantity so found has been too small to be of any commercial value. Quite recently, however, one of the electro-chemical companies at Niagara Falls has succeeded in commercially solving the important problem of the fixation of the nitrogen of the atmosphere; it being claimed that the cost of thus producing one ton of commercial nitric acid, of a market value of over eighty dollars, does not greatly exceed twenty dollars. Since sodium nitrate can readily be produced by the process, and its value as a fertilizer of wheat-fields is too well known to need comment, there would thus, to a limited extent, be indirectly solved the electro-chemical production of food staples.

Faraday's high rank as an investigator in the domain of natural science was fully recognized by the learned societies of his time, by admission into their fellowships. As early as 1824, he was honored by the Royal Society of London by election as one of its Fellows, and in 1825 he had become a member of the Royal Institution. It is recorded of the great philosopher that the membership in the Royal Institution was the only one which he personally sought; all others came unsought, but they came so rapidly from all portions of the globe that in 1844 he was a member of no less than seventy of the leading learned societies of the world. Ries, the German electrician, so well known in connection with his invention of the speaking telephone, addressed Faraday as "Professor Michael Faraday, Member of all the Academies." Besides his membership in the learned societies, Faraday received numerous degrees from the colleges and universities of his time. Among some of these are the following: The University of Prague, the degree of Ph.D.; Oxford, the degree of D.C.L.; and Cambridge, the degree of LL.D. He also received numerous medals of honor, and was offered the Presidency of the Royal Society, which, however, he declined, as he did also a knighthood proffered by the government of England. Faraday died on the 25th of August, 1867, after a long, well-spent, useful life.

We have thus briefly traced some of the more important discoveries of Michael Faraday. Many have necessarily been passed by, but what we have given are more than sufficient to stamp him as a great philosopher and investigator. Speaking of Faraday in this connection, Professor Tyndall says: "Take him for all in all, I think it will be conceded that Michael Faraday is the greatest experimental philosopher the world has ever seen; and I will add the opinion that the progress of future research will tend not to diminish or decrease, but to enhance and glorify, the labors of this mighty investigator."

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RUDOLF VIRCHOW.

1821-1902.

MEDICINE AND SURGERY.

BY FRANK P. FOSTER, M.D.

Stagnation was the state of medicine when the Nineteenth Century opened. It was only three years before that Jenner had announced and demonstrated the protective efficacy of vaccination against small-pox. His teaching, in spite of the vehement cavillings of the "antis" of his day, gained credence readily, and vaccination speedily became recognized and was constantly resorted to, but hardly any attempt at perfecting the practice was made until after more than fifty years had elapsed. His discovery—or, rather, his proof of the truth of a rustic tradition—fell like a pebble into the doldrums; the ripple soon subsided, and nobody was encouraged to start another. At the present time such an announcement would be promptly followed by investigations leading up to such doctrines as that of the attenuation of viruses and that of antitoxines. But the times were not ripe for anything of that sort; medicine reposed on tradition, or at best gave itself only to such plausibilities in the way of innovation as were cleverly advocated. Physicians strove not to advance the healing art; as individuals, they were content to rely on their manners, their tact, and their assumption of wisdom. In short, the body medical was in a state of suspended animation, possessed of a mere vegetative existence.

The Humoral pathology, or that doctrine of the nature of disease which ascribed all ailments to excess, deficiency, or ill "concoction" of some one of the four humors (yellow and black bile, blood, and phlegm), had not yet lost its hold on men's convictions, or at least not further than to make them look upon exposure to cold and errors of diet as amply explanatory of all diseases not plainly infectious.

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The medical writers who were most revered were those who busied themselves with nosology; that is to say, the naming and classifying of diseases. Wonderful were the onomatological feats performed by some of these men, and most diverse and grotesque were the data on which they founded their classifications. To label a disease was high art; to cure it was something that Providence might or might not allow. In the treatment of “sthenic” acute diseases (meaning those accompanied by excitement and high fever), blood-letting, mercury given to the point of salivation, antimony, and opium, together with starvation (all included under the euphemism of “lowering measures"), were the means universally resorted to and reputed “sheet anchors.” Some advance had been made from the times when disease had been looked upon as an entity to be exorcised, but it was still so far regarded as a material thing that it was to be starved out.

But the century was not out of its second decade when signs of an awakening from this lethargy began to show themselves. The first steps, naturally, were along preparatory lines, and for those we are largely indebted to the physicists, the chemists, and the botanists. Gross anatomy became better known, owing for the most part to more enlightened legislation on the subject of the dissection of the human body; minute anatomy (histology) sprang into existence as the result of improvements of the compound microscope. Physiology took on something of the experimental; and medication was rendered far less gross and repulsive by the isolation of the active principles of medicinal plants. But it was long after all this that the telling strides were taken. Up to within the memory of many men who are now living, “peritonitis” tortured its victims to death, said “peritonitis” being often interpreted as a manifestation of rheumatism, for example, and no well-directed interposition was attempted against it, whereas we now know perfectly well that the vast majority of cases of peritonitis are due to local septic poisoning and for the most part quite readily remediable by the removal (with a minimum of danger) of the organ from which such poisoning arises—almost always the vermiform appendix. “Appendicitis,” of which we hear so much nowadays, is no new disease; it is simply the “peritonitis” that killed so many people in former times. But while no well-informed person would now maintain that this disease was a new one, there are many, and those, too, among the best instructed, who find it difficult to avoid the conclusion that, if not new, it must at least be of far more frequent occurrence than formerly. It must be borne in mind, however, that in the great majority of instances in past years it ended spontaneously in recovery and was forgotten.

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Two features of the progress in medicine in the Nineteenth Century, negative as they may seem to have been, were undoubtedly potent in the promotion of advance. They were the recognition of the fact that many dangerous diseases are self-limited, and the experiment of the so-called “expectant treatment.” The result of the first of them was to teach men to desist from futile attempts to *cure* the self-limited diseases, in the sense of cutting them short in their course, and the “expectant treatment” followed as a natural consequence. It was a method of managing disease rather than attempting to cure it. There was no interference save to promote the patient’s comfort, to nourish him as thoroughly as might be without unduly taxing his powers, and to meet complications as they arose. It was stooping to conquer, perhaps, but it was a policy that conduced greatly to the well-being of the sick, improved their chances of recovery, and enabled physicians to study disease more accurately by reason of its course not being rendered irregular by meddlesome medication. It has never been dropped, and it never will be, save as such directly curative agents as the antitoxines are made available.

In the early part of the century, except for gross anatomy and operative surgery, medicine was taught almost wholly, so far as the schools were concerned, by means of didactic lectures. The “drawing” capacity of a professor was proportionate rather to his rhetorical powers and to the persuasiveness with which he inculcated the views peculiar to himself than to the amount of real information that he conveyed to the students. Although the apprentice system—for that was what the practice of students’ attaching themselves to individual practitioners, whom they called their preceptors, virtually amounted to—in many instances made up more or less completely for the lack of systematic clinical teaching, yet in the great majority of cases it amounted to little more than the preceptor’s allowing the student the use of his library and occasionally examining into the latter’s diligence and intelligence, in return for which he, the preceptor, required an annual fee and exacted from the student such minor services as his proficiency enabled him to render. It is true the students “walked” the hospitals, drinking in some great man’s utterances, but they did it in droves, not a moiety of them being able to get a good look at a patient, unless it was such a passing glance as might tell them that the patient was jaundiced. By clinical teaching we understand teaching, not in glittering generalities, but in the concrete, either at the bedside, as the word *clinical* originally implied, or at least with the patient actually present to illustrate in his person the professor’s descriptions and the success or failure of the treatment employed. The clinic is now firmly established, and has been for years, but it was long before this grand result was attained.

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Experimental methods of study gradually came into vogue, particularly in the domain of physiology. In this sphere Dr. William Beaumont, of the United States Army, was a pioneer. His historic experiments on Alexis St. Martin, a soldier who had been wounded in the stomach and recovered with a permanent opening into that organ, will ever rank among the most important of the early experimental studies of digestion. It was not long before Claude Bernard extended similar inquiries to the other functions of the body, notably those of the nervous system; and since his time there has been a long array of brilliant investigators of physiology and of other branches of science tributary to medicine. Experiments on living animals were almost the only means of carrying on these researches. In the early days the animals employed were doubtless put to a great deal of pain—perhaps in many instances to unnecessary suffering—and an altogether laudable feeling of humanity has led good people to band themselves together for the purpose of putting a stop to vivisection, or at least of greatly restricting the practice and of freeing it from all avoidable infliction of pain. These praiseworthy efforts have in some instances been carried so far, unfortunately, as to seriously hamper scientific investigation—investigation which has for its object the alleviation of human suffering and the saving of human life. We may earnestly deprecate and strive to prevent wanton reiteration of painful experiments for purposes of demonstrating anew that which is unquestioned, and we may resort to all possible means to render necessary experiments free from actual pain (from the anguish of trepidation we can seldom relieve the poor animals), but let us not block the wheels of scientific progress.

At the dawn of the Nineteenth Century, to examine a sick person’s pulse, to inspect his tongue, to observe his breathing, to interrogate his skin by our sense of touch, and to try to make his statements and those of his friends fit in with some tenable theory of the nature of his ailment, were about all we could do. Possibly it was because he realized to an uncommon degree the tremendous impediment of this narrow limitation that Samuel Hahnemann, the founder of Homoeopathy, cut the Gordian knot in sheer rebelliousness, and proclaimed, as he virtually did, that a diagnosis was not necessary to the successful treatment of disease, but that one only needed to know empirically how to subdue symptoms, meaning mainly, if not solely, what we term “subjective” symptoms—those of which the patient complains, as opposed to those that we ourselves discover. But the physical examination of the sick, before extremely meagre in its sphere and restricted in its possibilities, was destined to expand before many years into the minute and positive physical diagnosis of the present day.

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In the year 1816 a French physician, Rene Theophile Hyacinthe Laennec, achieved undying fame by publishing to the world an account of his labors in the application of mediate auscultation and of percussion to the diagnosis of the diseases of the chest. It is true that no less a personage than the “Father of Medicine,” Hippocrates, is reputed to have practised succussion as a means of diagnosis; that is, the shaking of a patient, as one would shake a cask, to ascertain by the occurrence or non-occurrence of a splashing sound if the person’s pleural cavity was distended partly with water and partly with air. It is probable that Hippocrates and many others after him carried the physical examination of the chest still further, for it is difficult to imagine, for example, that so simple a device as that of thumping a partition to make out the situation of a joist by the sound evoked should not early have been applied to the human chest. But, be this as it may, to Laennec belongs the great credit of having laid a substantial foundation for the physical diagnosis of the present time, and, more than for laying a foundation, for constructing a fairly complete edifice. He who should now undertake to practise general medicine without having first made himself proficient in the detection and interpretation of the sounds elicited by auscultation and percussion in diseases of the heart and lungs would foredoom himself to failure.

It was not until many years later, early in the second half of the century, that the clinical thermometer came into general use, but it soon showed most strikingly the superiority of the “instrument of precision” to the unaided senses of man. Who would think now of trying to estimate the height of a fever by laying his hand on the patient’s skin, or who, even among the laity, would be satisfied with such a procedure? “Doubtless,” said the present writer in a former publication ("New York Medical Journal,” Dec. 29, 1900), “the use of the thermometer has occasionally given rise to needless alarm, but almost invariably it may be interpreted with great certainty. Often it dispels unnecessary anxiety as in a twinkling by its negative indication, and surely it is to be credited with being distinctly diagnostic in those diseases of which it has itself established the ‘curve.’” By the thermometric “curve” of a disease is understood the general visual impression made by the graphic chart of a temperature record—the course of a zigzag line connecting the points indicated by the various individual observations.

Numerous other instruments of precision are now in constant use, among the most wonderful of which perhaps is the ophthalmoscope, whereby we are enabled to subject the retina and the intervening media of the eye to minute visual examination. There is not an organ of the body that is not now interrogated daily in the way of physical diagnosis, and we even examine separately the secretion of each of the two kidneys.

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In addition, there are multitudinous specific signs of which we were not long ago in complete ignorance. To cite only one of these, there is Widal's agglutination test, by which the bacteriologist can usually make a diagnosis of typhoid fever far in advance of the time at which it could otherwise be distinguished. The use of the Roentgen rays in diagnosis was one of the crowning achievements of the century, and now we seem about to enter upon a course of their successful employment in the treatment of disease —even some forms of cancer—as well as in its detection.

Beyond the vermin that infest the skin and the hair, tapeworm, and a few other intestinal worms, little if anything was known of morbific parasites before the Nineteenth Century; but the labors of Van Beneden, Kuechenmeister, Cobbold, Manson, Laveran, and others have now established the causal relationship between great numbers of animal parasites—gross and microscopic—and certain definite morbid states. This has led to a great increase in our knowledge of the connection between the parasites of the lower animals and grave disease in human beings, and on this knowledge rest many of the precautions that we are now able to take against the spread of such disease. From the consideration of animal parasites as the direct causes of disease, we naturally come to the contemplation of the subject of insects as the carriers of disease. The later years of the century have witnessed the demonstration of the fly's agency in the transmission of malignant pustule and typhoid fever, and that of certain mosquitoes in the conveyance of yellow fever and malarial disease. We now know that bad air (the original meaning of the word *malaria*) has nothing to do with fever and ague, and that swamps are not unwholesome if they are free from infected mosquitoes. The mosquito does not originate the malarial infection; it simply serves as the temporary host of the micro-organism (*Plasmodium malarioe*) which is the cause of the disease, having obtained its transient "guest" from some human being. Consequently, marshy districts that are full of mosquitoes are not malarious unless the mosquitoes are of the kinds capable of lodging the plasmodium, and unless there is or has recently been present in the neighborhood some person affected with malarial disease. Moreover, the most virulently malarious region is a safe place of residence for human beings, provided they protect themselves absolutely against the bite of the mosquito. This has been strikingly demonstrated in the case of the Roman Campagna.

From the disease-producing animal parasites we come now to those that are believed to be of vegetable nature. Under the general name of *bacteria*, there are multitudes of micro-organisms having pathogenic powers, each giving rise to some definite specific disease, and certain associations of different bacteria causing particular morbid conditions. Generations ago physicians had a glimmering of what we now term

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the germ theory of disease, as was shown by their use of such expressions as *materies morbi* and morbid poisons. Even the definite relationship of special microscopic organisms to individual diseases was foreshadowed by Salisbury nearly fifty years ago. But it was not until years after those conceptions, and in no wise descended from or led up to by them, that an intelligible and satisfactory germ theory of disease was formulated.

It is to Pasteur, the immortal chemist, that we owe this theory, as well as that of the attenuation of viruses—both of more than theoretical import, since they have given us aseptic surgery, the power of frequently preventing hydrophobia, the antitoxine treatment of diphtheria, and the ability to stay the hand of Death in the form of many a stalking pestilence. Every infectious disease is now held to be due to its own particular micro-organism, and many diseases that were not until recently thought to be infectious are now classed as such because they have been proved to be caused by living germs. Conspicuous among these diseases is pulmonary consumption. In the case of almost every one of these diseases we have discovered the specific germ and are able to demonstrate its presence, either by its microscopical appearance, by its behavior on contact with certain stains, or by the forms that cultures of it assume. The micro-organism of small-pox and that of cancer (the existence of which is assumed) have not yet been isolated. Some of these germs, like that of tetanus (lockjaw), gain entrance to the system only through a wound; others, like those of typhoid fever and cholera, are swallowed; others, like that of pneumonia, are inhaled; still others, like that of tuberculous disease, are either swallowed or inhaled. Some are believed to be transmissible to the unborn child; and a few are ordinarily harmless parasites, becoming pathogenic only when they accidentally gain access to other parts of the system than those which constitute their natural habitat.

These microscopic organisms do not by their mere presence set up disease, unless indeed they are in such overwhelming numbers as to block the capillary blood vessels mechanically. Some of them are carried broadcast in the blood current, while others remain at the point of entrance; in either case they elaborate certain products, termed toxines, which act, either locally or through the circulation, to cause the disease. These toxines eventually kill the micro-organisms that produced them, quite as an animal may be smothered in its own exhalations; or at least they would do so if the “host” survived long enough for the completion of the process. Meantime, they have either killed the “host” or been defeated by certain very interesting natural processes. But before either of these occurrences has had time to take place, fortunately, in the great majority of instances, save those of exposure to the most deadly of infections, the vital power of the

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invaded individual has coped successfully with the invaders at the very point of attack—has repulsed the attacking party without appreciable impairment of its own force—and no illness results. For example, practically all of us inhale the germ of consumption repeatedly, but most of us suffer no harm from it simply because the fluids which bathe the surface on which the germ effects a lodgment are endowed with properties which either kill the germ or rob it of its power for harm; but these properties suffice only when the general health is unimpaired.

In case the attack is not successfully repelled at the outset, what happens? There begins a struggle between the invaders and what may be called the reserves of the organism, consisting of the white blood corpuscles, which undergo a great augmentation in number. These corpuscles are endowed with the faculty of amoeboid movement; that is to say, they may shoot out projections from their substance, and even convert themselves for the time being into traps, seizing upon the pathogenic bacteria, incarcerating them within their own mass, and carrying them away to be thrust out of the system by organs whose function it is to eliminate extraneous matter. These corpuscles are, indeed, said figuratively to *eat* the malign micro-organisms, whence they have been termed phagocytes (from [Greek: phagein], to eat, and [Greek: kutos], a cell); also because they carry away refuse and noxious material, they have been called “the scavengers of the system.” By means of their amoeboid movement they are enabled to worm themselves through inconceivably minute apertures in the blood vessels, and attack and devour peccant matter wherever it may have effected a lodgment. These white corpuscles are also known as leucocytes, and their increase in number when they are called upon to resist bacterial invasion is spoken of as hyperleucocytosis. The discovery of their protective function is to be credited to Metchnikoff, a Russian physician now teaching in Paris. When they migrate from the blood vessels in great numbers they finally, after having fulfilled their office as phagocytes, degenerate into the corpuscular elements of pus, which is the creamy liquid contained in an abscess. Their migratory power was discovered by Cohnheim.

But as a general thing the phagocytes do not succeed in making away with all the pathogenic germs, or even with enough of them to prevent the illness which they tend to produce. The further combat is between the poisonous products, termed toxines, engendered by the bacteria and certain antidotal substances, called antitoxines, newly created in the watery portion of the blood by some wonderful provision of Nature that is not yet well understood. Each infective disease has its special toxine, and for the destruction of each the blood prepares its particular antitoxine; possibly, however, some of the antitoxines may be efficacious against more than one kind of toxine, for there are physicians who are convinced that vaccination is a temporary preventive of whooping-cough. But the elaboration of an antitoxine takes time, and the result in any given case, whether in recovery or in death, seems to be settled by the ability or inability of the vital powers of the individual to hold out until they are relieved by the evolution of the necessary amount of antitoxine.

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In the long run, provided the sick person survives, more antitoxine is generated than is required to save life. The excess remains in the system for a greater or lesser length of time, and this fact explains the individual's subsequent immunity to the disease from which he has recovered; any fresh invading force of the microbes of that disease finds that defensive preparations have been made in advance. In the case of some diseases this acquired immunity is usually lifelong, as in that of small-pox; in others, of which influenza is a notable example, it is as a rule very transitory; and there are all gradations between the two. It is thought that this acquired immunity to some diseases may be transmitted to the offspring, for it is quite certain that there are many people who are from birth insusceptible to scarlet fever, no matter what may be the extent of their exposure to that disease.

The recognition of Nature's elaboration of protective antitoxines has led to their artificial cultivation in the lower animals, and, thus produced, they have been used with brilliant results in the prevention and cure of at least one formidable disease, diphtheria. The immense reduction of the mortality from this disease that has followed the introduction of the treatment with the artificial antitoxine we owe to Behring, of Germany, and Roux, of France. Omitting unnecessary details, we may describe the process of obtaining diphtheria antitoxine as follows: A certain amount of diphtheritic poison (of the bacteriological sort, prepared by cultivating the diphtheria microbe) is injected into the circulation of a horse—sufficient to make the horse sick, but not enough to endanger his life. The horse's system straightway begins to elaborate the protective antitoxine, and there results from this one injection a sufficient amount of it to save the horse, although far too little to make the serum of his blood potent enough for medicinal use. Hence, after the lapse of a suitable interval, he is again injected with diphtheritic poison, and for the second time his blood begins to generate the antitoxine. And the process is repeated again and again, the virulence of the poison being increased each time, until the horse's blood is fairly reeking with antitoxine. Then blood is drawn freely from the horse, and it is allowed to separate into clot and serum, the latter alone being the part destined for use. This serum is tested on a small animal that has been inoculated with a deadly dose of the diphtheritic poison; if it saves the little creature from death, it is assumed to be potent enough for use on human beings, and, handled with all possible precautions against putrefaction or any contamination with pathogenic bacteria, it is furnished to physicians, its degree of potency being designated in "units."

If in this brief article, which does not purport to be more than a sketch of the tremendous strides made by medicine in the Nineteenth Century, so much space has been given to the germ theory of disease, it is because the demonstration of the truth of that theory has been absolute, and has constituted the very marrow of almost all the medical progress of the century that has been the outcome of continuous thought and study as opposed to chance discovery.

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Such results as the germ theory has now led to in the treatment of diphtheria it had already accomplished in the field of surgery as a consequence of that strict asepticism which, originating with Joseph Lister (now Lord Lister), and rapidly carried by him to a condition verging on technical completeness, was soon taken up by surgeons all over the world and brought wellnigh to perfection, so that the mortality of wounds of all sorts has been tremendously reduced, and many surgical operations are now practised frequently—indeed, whenever the occasion for them arises—that before the days of Listerism would have been looked upon as almost tantamount to the patient’s death-warrant. More particularly is this the case as to operations which involve opening into the abdomen, the chest, or the cranium. So little risk now attaches to such operations, properly performed, that the opening of the abdominal cavity for the mere purpose of ascertaining the condition of its contents—“exploratory laparotomy,” as it is called—is a matter of constant occurrence. Curiously enough, in some way not yet satisfactorily explained, that procedure in itself, without anything further being done, has in many instances resulted in decided amelioration of a morbid condition, if not in its cure. A striking example of this is seen in the benefit that often results in cases of one form of “consumption of the bowels,” namely, tuberculous disease of the membrane that lines the abdominal wall and invests the abdominal organs. This is not the only operation that does good mysteriously; that of cutting out a bit of the iris in a form of deep-seated eye disease, glaucoma, that tends toward complete blindness, is hardly more explicable; neither is an incision of the capsule of the kidney for certain forms of Bright’s disease, each of which stays the progress of the trouble in a goodly proportion of instances.

Another of the great divisions of the healing art, that of midwifery, has been enhanced quite as much as general surgery by the employment of Listerism. The process of childbirth, although a perfectly natural one, almost necessarily carries with it a certain amount of laceration, and, through the wound surfaces thus produced, absorption of poisonous material was formerly so frequent that puerperal fever figured prominently in mortality reports. It was Oliver Wendell Holmes—a graduate in medicine and a professor in the Harvard Medical School, though we are accustomed to think of him only as a delightful writer—who first declared that puerperal fever was the product of infection from without the body, and Semmelweis demonstrated the truth of the proposition. Holmes was a teacher of physiology, and his study of that branch of medical science was in itself enough to convince him of the doctrine which he inculcated.

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Listerism must be credited, not only with having added immensely to the safety of the major operations of surgery, but also with having led to great improvement of their technics by reason of the greatly increased frequency with which it has come to be thought justifiable to practise them; what we do again and again we are apt in the end to do well, whereas that which we turn to only in despair and as rarely as possible, we do clumsily and imperfectly. Listerism has been unjustly alleged by a few to be unworthy of the appreciation in which it is held by the great majority of medical men of all countries; simple cleanliness, it has been urged, is quite as efficient as the full Listerian precautions. This is begging the question, for simple cleanliness, “chemical cleanliness,” is all that Listerism purports to accomplish. The use of antiseptics has been decried in the interest of asepticism, as if the whole purpose of antisepticism were not to secure asepsis. Lord Lister is entitled to the full credit of establishing the aseptic surgery of the present day, in spite of the facts that his doctrine followed rather than preceded his early improvements, that aseptic procedures have been brought nearer perfection elsewhere than in his own country, and that the whole system rests on foundations laid by Pasteur.

While it is quite true that to the Listerian theory and practice are almost wholly to be ascribed the favorable results of the major surgery of the present day, we must not forget the immeasurable benefits to the diseased, the injured, and the crippled that have arisen from patient efforts and occasional brilliant intuition that have had no connection with the germ theory of infection. Take the case of a broken leg, for example, an injury that formerly condemned the victim to weeks and weeks of confinement to bed, together with the suffering and danger almost inseparable from the old methods of the long straight splint and tight bandaging. At the present time he who has met with such a misfortune is commonly able to be about on crutches within a few days, and his broken bone mends while he is cultivating his appetite and indulging in pleasant intercourse with his fellow-men. This great change has been made possible by one device after another, invented by different men. Josiah Crosby introduced the use of sticking-plaster for extension, instead of the chafing bands previously employed; Gurdon Buck substituted elastic extension by means of a weight and pulley for the rude and arbitrary traction in vogue before; James L. Little devised the plaster-of-Paris splint, whereby broken bones were immobilized with hardly appreciable discomfort; and Henry B. Sands established the safety and practicability of applying the plaster-of-Paris splint almost immediately after the reduction ("setting”) of the fracture. In the meantime Nathan R. Smith and John T. Hodgen had demonstrated the advantages of suspending a fractured limb from above. All

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these men were Americans; surely our country has contributed powerfully to the well-being of the subjects of fracture. Other Americans, notably Lewis A. Sayre, have enabled sufferers with joint disease, including the dreaded hip disease, to run about and gain health and strength, instead of languishing in bed. Sayre, too, by his suspension treatment and the plaster-of-Paris jacket, set the hunchback on his feet at a stage in his disease in which before he had been forced to prolonged and painful recumbency.

Although men professing special skill in certain operations, and doubtless possessing it, flourished in old times, and left more or less of their impress on the surgery of the present day, for that matter, it was not until the second half of the Nineteenth Century that regional surgery (which is what specialism virtually amounts to) was systematically cultivated. Now there is hardly a portion of the body to which practitioners who make its ailments a specialty do not direct their searching methods of examination or on which they do not practise their ingenious devices in the way of treatment. Specialism has always been decried by a large section of the medical profession. On the other hand, it has been and is still overrated by the laity. The true estimate lies between the two. The specialists have advanced surgery immensely, but, with many honorable exceptions, they have laid too much stress on their several specialties, making too wide a range of ailments fall within them. As for the community at large, their shortcoming lies in the fact that most of them would seek for a specialist in mumps in case that painful but transitory infliction were to come upon them, and in their underrating of the family physician.

To change for a moment to a topic akin to the germ theory of disease, the reader may be reminded that the antitoxine treatment of infectious disease involves in almost every instance the use of some product contained in the serum (that is to say, the watery part of the blood). This leads to the subject of the use of natural and artificial serum in the treatment of disease. To quote again from the article entitled, “The Nineteenth Century in Medicine” ("New York Medical Journal,” Dec. 29,1900): “It has been observed that the normal serum of certain animals that are insusceptible to particular infectious diseases, if injected into the human blood current or even into the subcutaneous tissue, confers more or less of immunity against those diseases.... Artificial serum seems to have been first employed by Edmund R. Peaslee as a benign application to the peritonaeum in the operation of ovariotomy. His conception of its mode of action is not very clear, but he was a very successful ovariotomist, and we can only conjecture that he builded better than he knew, like many another man. A few years ago much was expected from transfusion of blood, but gradually the conviction has forced itself upon us that it is

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wellnigh useless, and indeed that, on the whole, it is worse than useless. It has virtually been abandoned.... But experiments in transfusion have not been fruitless; they have culminated in demonstrating the inestimable value of infusions of ‘normal,’ or ‘physiological,’ solutions of sodium chloride, and not only of infusions, but also of peritoneal irrigation with such solutions. Many a life has been saved by resorting to this measure, even in apparently desperate cases.”

Within about a decade of the close of the century, Robert Koch, whose discoveries and ingenious studies in bacteriology had brought him world-wide renown, announced that he had produced a derivative of the tubercle bacillus, which he termed tuberculin, that he thought might prove curative of tuberculous disease. It was to be injected beneath the skin. If the subject was really tuberculous, he would “react” by manifesting a certain degree of fever, and repeated injections would bring about elimination of the tuberculous deposits and thus effect a cure. The world was carried away with such an announcement coming from such a man, and it was thoroughly believed that at last “the great white plague,” consumption, was to be conquered. Tuberculin did, indeed, cure certain minor forms of tuberculous disease, such as the skin affection known as lupus, but it soon became evident that it was almost impotent in the treatment of pulmonary consumption. It has, however, served to enable the veterinarian to make out the existence of tuberculous disease in cattle at an early stage of its course, and it is probable that by the slaughter of cattle thus found to be tuberculous much infection of human beings has been prevented.

Tuberculin failed of its prime purpose, but it does seem to have marked the initiative of a campaign against consumption which has already proved of incalculable benefit, and bids fair to put that omnipresent disease toward the foot of the list of causes of death. We have made substantial advances in our knowledge of the disease, and we no longer regard it as incurable. We have learned that it is communicable from one person to another, but also that its communication can easily be prevented, so that there is no reason to shrink from association with tuberculous persons. We have learned, too, that consumption in one’s progenitors, immediate or remote, hardly makes it even probable that he himself is doomed to suffer with it; the only tuberculous heredity that we now recognize is that of defective ability to withstand the infection, and even this we regard as in most instances readily surmountable. We have learned, furthermore, that pulmonary tuberculous disease is by no means so fatal as it was formerly esteemed, for men whose business it is to make great numbers of post-mortem examinations, such as coroners’ physicians and hospital pathologists, assure us that in a very large percentage of cases of death from other causes they find indubitable signs

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of past tuberculous disease of the lungs which had ceased its activity—been, in fact, cured, either spontaneously or by medical intervention. Such intervention, it has been abundantly proved, is altogether likely to be successful if it is of the right sort and employed early. There is, to be sure, no cure-all. Powerful as the climatic treatment is, it must be supplemented by measures accurately adapted to the individual case, and failure to comprehend this fact still leads many a phthisical person to his grave. But information is rapidly being diffused, sanatoria for such of the tuberculous as can take advantage of them are multiplying, and those who are shut off from their aid are growing more and more cognizant of how they should live in order to give themselves the best chance of recovery and save their associates from infection. The era of consumption-cures—meaning drugs—is past; but the disease is cured in an ever-increasing proportion of instances, and that, too, by medical though not medicinal measures.

At almost every turn medicine has been powerfully assisted by the sciences which should rather be termed correlative than subsidiary. Notable among them is chemistry. The isolation of the active principles of medicinal plants—such as morphine, quinine, strychnine, and cocaine—has been a remarkable service rendered by chemistry to medicine. How should we be handicapped if we still had to fight malarial disease with the crude Peruvian bark instead of its chief alkaloid, quinine! And how impracticable if not impossible would it be to render the eye insensitive to pain with any extract of coca leaves, no matter how concentrated—a purpose that we accomplish almost instantly with cocaine! Of minor importance, perhaps, but not to be despised, is the resulting liberation from the old slavery to bulky and nauseous drugs. The isolation of active principles long antedated the synthetical preparations, but the latter came at last—the marvellous array of hypnotics, anodynes, and fever-quellers that are now at our command, largely coal-tar products. But it is not to pure chemistry alone that we are indebted for the elegant dosing of the present day; progressive pharmacy, with its tablets, its coated pills, and its capsules, has put to shame the old-time purveyor of galenicals. Right jauntily do we now take our “soda mint” in case of slight derangement of the stomach, happily oblivious of its vile prototype, the old rhubarb and soda mixture. Even castor oil has been stripped of its repulsiveness by the combinations which the soda water fountain affords.

It was but a step, we can now realize, from the employment of isolated vegetable principles to that of preparations of certain glandular organs of the animal economy, but the doctrine of “internal secretions” had to intervene, and its evolution took time; not till toward the close of the century did the venerable Brown-Sequard lead up to it. We have not yet come to “eye of newt and toe of frog,”

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but what we have incorporated into modern therapeutics in the way of animal products lends at least some theoretical justification to the ancient use of the dried organs of various animals. It is but a few years since the “ductless glands”—such organs, as, for example, the thyreoid gland (an organ situated in the front of the neck, a small affair in its normal state, but prominent and even pendulous when by its permanent enlargement it comes to constitute a goitre)—were looked upon as puzzles, as structures destitute of any known function. Some observers even affirmed that they had no function, though the constancy of goitre in cretins ought to have shown the fallacy of this allegation in the case of the thyreoid. We do not now need to be told that the thyreoid gland plays a very important part in the economy, for we know that its surgical removal gives rise to a special disease known as myxoedema, which, in addition to its physical manifestations, is characterized by impairment of the mental powers. Consequently, this ductless gland—a gland, that is to say, which has no obvious canal by which it throws off any product of its activity—must elaborate some material that is necessary to the health of the organism and is imparted to the blood. That material, whatever it may be, is termed an “internal secretion.” Some of the internal secretions have turned out to be of singular value medicinally. It is apparently not the ductless glands alone that furnish internal secretions; the glands that are provided with ducts and yield a definite and observable product secrete also a substance (perhaps more than one) which they give up to the blood.

Prominent among the therapeutic advances of the century is the direct reduction of the high temperature of sunstroke and certain fevers by the use of cold. Although foreshadowed by Currie early in the century by his use of cold affusion in the treatment of scarlet fever, it did not come into general use until the closing decades. It is employed principally in typhoid fever, on the theory that a condition of high fever is in itself a source of danger quite distinct from the other injurious effects of a febrile disease. On the other hand, the employment of high degrees of heat has of late been shown to be a potent agency in the treatment of certain forms of disease, notably in various affections classed as rheumatic. Applications of very hot air, provided it is thoroughly dry, are borne without serious discomfort, and their employment promises to be of greater service in the conditions in which it is resorted to than that of any other agent.

A revelation in the treatment of heart disease has been effected by the Bad Nauheim system of effervescent baths and resisted exercises. It is not only functional disorders of the heart that are relieved, but grave organic diseases also. Somewhat elaborate explanations of the way in which the treatment proves beneficial have been given, but they are not altogether satisfactory.

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Thus far we have dealt chiefly with those developments of medicine that seem to have been the outgrowth of much thought and experiment, but there was one that can hardly be viewed as other than a happy discovery, yet it was one that was fraught with unspeakable mitigation of human suffering, and that wrought a boundless extension of the field of surgery. It was that of anaesthesia. The first to discover an efficient surgical anaesthetic was Crawford W. Long, of Georgia. It has been established that he performed several minor operations with the patient anaesthetized with sulphuric ether, but he did not proclaim his discovery, and so it was reserved for William T. G. Morton, of Boston (then a dentist, but subsequently a physician), to make the first public demonstration of the efficiency of ether as an anaesthetic, which he did in the operating theatre of the Massachusetts General Hospital, in Boston, in the year 1846. The news of Morton’s achievement spread broadcast, and it was at once realized that it was destined to revolutionize surgery. It certainly has done that, and in no less degree than was afterward accomplished by Listerism. Ether did not long remain the only anaesthetic known; Simpson, of Edinburgh, soon discovered that chloroform was possessed of even more decided anaesthetic properties. The inhalation of ether is disagreeable, and it is slow in producing the desired effect, whereas that of chloroform is not unpleasant, and it acts more rapidly. Consequently chloroform soon came to be generally preferred; but abundant experience has finally shown that ether is much the safer agent of the two, and improved methods of administration have almost entirely done away with the objections to its use, so that now it is looked upon as the preferable general anaesthetic. But general anaesthesia—meaning the suspension of sensibility in the whole organism, including unconsciousness—is not always necessary, and sometimes it is undesirable. We have now trustworthy local anaesthetics, the chief of which is cocaine, wherewith we are able to anaesthetize the part to be operated on without rendering the patient unconscious, and the co-operation that a conscious patient may be able to render is sometimes valuable. It was not alone in the direct saving of human suffering that anaesthetics proved a boon to the world; they have made possible an amount of experimental work on animals in the way of vivisection that humane investigators would otherwise have shrunk from, necessary as it has been and still is for the advancement of the healing art.

The operation of ovariotomy, first performed by Ephraim McDowell, of Kentucky, can hardly be classed with the happy accidents; but so little had been said about it or thought concerning it that when the news of it reached Europe “from the wilds of America” the editor of a ponderous English quarterly journal of medicine recorded his incredulity in the words “*Credat Judoeus, non ego*” An ovarian

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tumor inevitably proves fatal in the long run if it is not removed. In a certain percentage of cases it is malignant and will kill whether it is removed or not, but the general result of ovariotomy has been the saving of thousands of women from untimely death. Bell, of Edinburgh, had imagined the operation and had mentioned it in his lectures, but none the less to McDowell is due the credit of demonstrating its feasibility.

Medicine bore quite its full share in the mitigation of the horrors and hardships of war that marked the Nineteenth Century. Its work was shown in the great reduction of pestilential disease incident to camp life, in prompt aid to the wounded, in the establishment of salubrious field and general hospitals, and in improved methods of transportation of the sick and wounded. Certainly the soldier on the sick list never before had such a fair prospect of rejoining his comrades safe and sound as he has now.

In the care of the insane, too—care not only in the sense of humane treatment, but in the systematic employment of measures for their restoration to mental soundness—the century has been marked by notable progress. This has been chiefly in the direction of preventing insanity, and although mental disease is said to be on the increase, it may undoubtedly be said with entire truth that its growing prevalence is not in proportion to the heightened frequency of “the strenuous life.” We may confidently expect that a more pronounced mastery over diseases of the mind will come when physicians in general are taught psychiatry clinically, so that the beginnings of mental alienation may be intelligently met by the family practitioner.

The supreme achievement of the medicine of the Nineteenth Century undoubtedly has been the development of its preventive feature. When we recall the fact that but a few years ago an attack of infectious disease was interpreted as a visitation of Providence, by a perversity that even the triumphs of vaccination did not serve to do away with; when we contemplate the well-ordered and well-understood measures that are now resorted to in an ever-increasing number of communities (and resorted to not solely on the outbreak of an epidemic, but at all times), to purify the air we breathe, the food we eat, and the water we drink; and when we reflect upon the greatly reduced morbidity as well as mortality of most infectious diseases—we must realize the immense service that has been rendered by preventive medicine. No doubt we must all die some time, and the day is yet far remote when the only causes of death will be old age and injury; but a decided prolongation of the average lifetime, such as the life-insurance companies recognize, is an unquestionable gain to the human race.

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A great blessing that has been brought about in great measure by medical men has been the establishment of the profession of nursing. The work of caring for the sick between the physician’s visits is no longer, at least in large communities and in cases of severe illness, left to over-sympathetic and uninstructed relatives or to outsiders who traded on mystery. An intelligent and intelligible record is now kept of all important happenings in the sick room, remedies are administered as they were ordered, needless alarm at something deemed by the patient to be of ill omen is quelled, and in case of real emergency, overlooked as it might otherwise have been, the physician is summoned to meet it. The advent of the trained nurse marked an era in medicine.

The literature of medicine has fully kept pace in volume with the progress of the art itself, and its quality has steadily improved. To this the great tomes of that gigantic work, the “Index-Catalogue of the Library of the Surgeon-General’s Office, United States Army,” bear solid testimony. It is a consolidated catalogue, by subjects and by authors’ names, of practically every medical book published throughout the world and of every article in the periodical literature of medicine. For its existence the world is indebted to Dr. John S. Billings, formerly a surgeon of high rank in the army and now the director of the New York Public Library, and for its continued existence to the United States Government, and it is to be hoped that Congress will never cease to provide adequately for its continued publication. Its completeness and its accuracy long ago led to its being prized everywhere.

There are some problems of which medicine has hardly yet entered upon the solution. Prominent among them is that of cancer. Little as we now know of the real nature of that disease, we know quite as much of it as we knew but a few years ago concerning other diseases equally destructive and far more prevalent, which, however, we have now practically mastered. Who can say that we shall not triumph over cancer while the Twentieth Century is still young? Our final triumph is indubitable.

The strongest individuality in the medicine of the Nineteenth Century was without doubt that of Rudolf Ludwig Karl Virchow (commonly written by him simply Rudolf Virchow). Although he took no direct part in any of the striking advances in practice that appeal to the laity, yet he was recognized the world over, among all classes of educated and well-informed persons, as the one beacon light of Nineteenth-Century medicine whose glow had been the steadiest and the most enduring. This is because of the wide range of his learning in matters not pertaining closely to his profession. His professional brethren hold the same view, and this is because he so well controlled himself—checked himself at every turn by the severest application of system—that he continued for more than half a century an anchor to hold medical thought strictly

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down to fact. This was from no natural lack of volatility, for he was an *Acht-und-vierziger* (Forty-eighter). In 1846, as a prosector in the University of Berlin, Virchow entered with Reinhardt upon a series of pathological investigations which at once received wide attention. In conjunction with Reinhardt, he founded the *Archiv fuer pathologische Anatomie und Physiologie und fuer klinische Medicin*[6] (a periodical familiarly called "Virchow's *Archiv*"), the publication of which was begun in the year 1847. Reinhardt died in 1852, leaving the editorship in the hands of Virchow alone, and he was still its editor up to the time of his death, on September 5, 1902.

[Footnote 6: Archives of Pathological Anatomy and Physiology and of Clinical Medicine.]

In consequence of his having openly proclaimed himself a Democrat in 1848, Virchow was forced to retire from the University of Berlin in the following year. He was at once made a professor in the University of Wuerzburg, whence seven years later, in 1856, as the result of the strenuous interposition of various medical organizations, he was recalled to Berlin, where he was made a professor and director of the Pathological Institute. He was appointed medical privy councillor in 1874, having several years before that entered upon an active political career and been one of the founders of the Progressive party, which he ably represented in the Landtag and the Reichstag. In 1869 he took part in founding the German and the Berlin Anthropological Societies, of each of which he was several times president.

Virchow investigated the most diverse subjects, as his profound studies of Schliemann's discoveries, as well as his other archaeological researches, show, and he was a rather prolific writer. The most important of his early works was *Die Cellularpathologie*, the first edition of which was published in 1858. Chance's English translation appeared in 1860, and Picard's French version came out in 1861. It is safe to say that no book of the century exerted a profounder influence on medical thought than Virchow's exposition of the cellular pathology. His next notable publication was a collection of thirty lectures on Tumors (*Die krankhaften Geschwuelste*,[7] Berlin, 1863-67). That he was not too absorbed in these lectures to bring his great powers to bear upon topics of the day is shown by the fact that before their publication was completed he brought out his work on Trichinae (*Darstellung der Lehre von den Trichinen*, 1864). Old age found him with industry and versatility unabated, for it was in 1892 that his *Crania ethnica americana* appeared, and after that time he wrote a vigorous protest against the new-fangled spelling of the German language which he accused the schoolmasters of trying to foist on the people. This was published in his *Archiv*. It may well be that his arguments have not been unavailing, since it is observable that several German publications that had adopted the new spelling have now dropped it.

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[Footnote 7: Morbid Tumors.]

It must not be supposed that it was by his literary work alone, founded though it was manifestly on his profound study, that Virchow impressed his personality upon medicine; it was in his lectures and in his laboratory teaching, too, that he made himself felt. In all civilized countries there are many devoted workers in medical science who caught their first real inspiration from Virchow.

The writer once saw Virchow—only once, but it was a sight never to be forgotten. It was at a banquet given as one of the festivities incident to the annual meeting of the British Medical Association in London in 1873. The company was not a large one, but it included such celebrities as Professor J. Burdon Sanderson, Sir William Jenner, Professor Chauveau, and Professor Marey. Virchow was conspicuously the man toward whom the eyes of all others were oftenest directed. Virchow met with the love as well as the admiration of his contemporaries, and both sentiments will descend to their successors, for his impress on the records of medicine is indelible, both as an instructor and as a friend of all real truth-seekers.

AUTHORITIES.

There is no full and connected account of the progress of medicine during the Nineteenth Century, but the reader may consult with profit the various medical biographies, also the following works: Silliman's "A Century of Medicine and Chemistry;" Jenner's "The Practical Medicine of To-day;" Buck's "Reference Handbook of the Medical Sciences;" Eulenburg's "Real-Encyclopaedie der gesammten Heilkunde;" the "Annus Medicus," published in the *Lancet* at the close of each year; and Tinker's "America's Contributions to Surgery" (Bulletin of the Johns Hopkins Hospital, Aug.-Sept., 1902).